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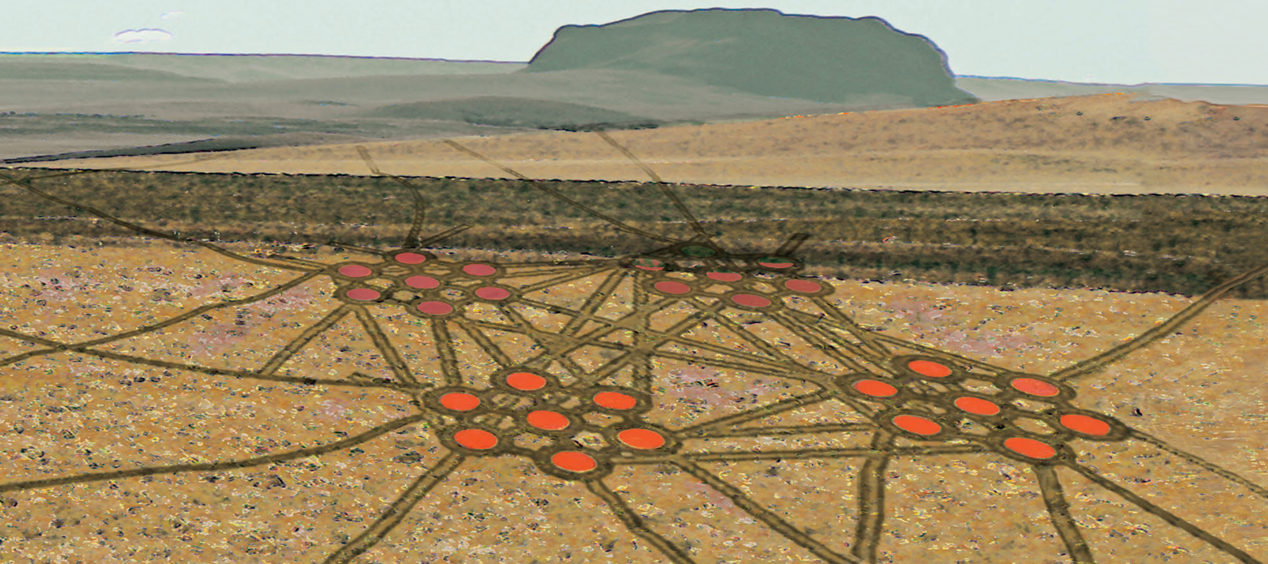

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INFORMATION AND ITS ROLE IN HUNTER-GATHERER BANDS

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AND ROBERT K. HITCHCOCK

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Preface

William A. Lovis, Robert K. Hitchcock and Robert Whallon

Information and Its Role in Hunter-Gatherer Bands explores the question of how information, broadly conceived, is acquired, stored, circulated, and utilized in small-scale hunter-gatherer societies, or bands. Given the nature of this question, the volume brings together a group of scholars from multiple disciplines, including archaeology, ethnography, linguistics, and evolutionary ecology. Each of these specialties deals with the question of information in different ways and with different sets of data given different primacy. The fundamental goal of the volume is to bridge disciplines and subdisciplines, open discussion, and see if some common ground—either theoretical perspectives, general principles, or methodologies—can be developed upon which to build future research on the role of information in hunter-gatherer bands.

The initial activation of our interest in and discussions about this topic came with the organization of an eponymous symposium at the 73rd annual meeting of the Society for American Archaeology held March 25–29, 2008, in Vancouver, BC, Canada. Our decision to develop this forum for the exchange of ideas on information in small-scale systems was underpinned by our belief that there was a need to reactivate and catalyze discussion across subdisciplines and disciplines on this topic of mutual interest, and to attempt to synthesize and generalize disparate approaches and knowledge in a systematic fashion. Ultimately, our goal was and continues to be movement in the direction of a general model. Given the lack of spatial and temporal boundaries attached to the topic, the participant net for the session, while selective, was broadly cast, ultimately resulting in presenters from both hemispheres of the Americas, Western Europe, Australia, and Asia, based on research conducted on all six continents by ethnographers, archaeologists, and linguistic anthropologists. The outcome of the session, which was both well attended and the subject of positive comments, more than met our expectations. This volume captures in an enhanced fashion the manifold ways in which the topic was addressed by various participants. While some of the original session presenters are not represented here, and others have been added, we believe the essence of our original goal and the session theme finds a common thread in the volume contributions.

Almost every aspect of band-level cultural systems is involved to some degree and in some way with the acquisition, storage, circulation, and use of information. It is not too much to say that information is as central and critical to the successful functioning and evolutionary adaptation of hunter-gatherer bands as are energy and reproduction. In fact, successful extraction of the requisite number of calories for adequate levels of reproduction and evolutionary success is largely dependent on the successful acquisition, storage, circulation, and use of information, as much as it is on technology or any other aspect of culture.

Surprisingly, given its crucial role in the functioning and evolution of human cultures, our understanding of the multifaceted role of information in these systems is, in most areas, only rudimentary. At the most fundamental level, there has never been an attempt to develop a systematic understanding of what kinds of information are relevant to the operation and evolution of even the least complex human cultural systems. Is information to be categorized on the basis of its content, how it is acquired, where it is stored, the extent of its circulation, its life span, other factors, or none of these? From time to time, all of these factors have been considered in discussing hunter-gatherer decision-making and adaptation, but all on an essentially ad hoc basis. Overall, we lack an effective working model for the role of information in these cultures.

There are very few, if any, societies left in the world today that forage for 100% of their subsistence. There are groups that might be defined as foragers because they obtain a substantial portion of their food from wild sources, but the vast majority of groups get at least some of their food from other sources, including through purchase; transfers from kin, friends, or other people; and/or from government, international, and nongovernment organizations' food relief and poverty alleviation programs.

Today, some groups are specialized foragers, people who obtain wild meat or wild plant products for the market. This is true, for example, of many of the Adivasis or Hill Tribe peoples in India, as well as some of the Batwa ("Pygmy") groups in the tropical forests of central Africa. Members of contemporary aboriginal groups in Australia will go back to their "country" and live on wild foods for varied periods of time but then return to towns, urban areas, or small-scale communities scattered throughout Australia. Other former forager groups who today are pastoralists or farmers may fall back on hunting and gathering in bad times; examples include the Okiek of Kenya, the Haddad of Chad, the Batek of Malaysia, and the Birhor of India.

A characteristic feature of hunter-gatherer societies was, and to a degree still is, sharing, across multiple dimensions, via complex and often spatially extensive social networks. Perhaps the area that has received the most attention in this regard is that related to food resources. Vegetable foods, which among some groups (e.g., those in deserts or savannas) tend to be more abundant than animals and far outweigh meat in the total diet, were not shared as rigorously or as extensively as meat. Wild foods were shared by the woman who gathered them, mostly within her nuclear family, and the sharing was done more casually than was the case with meat.

Though nuclear families are the units within which gathered or hunted foods are shared, one nuclear family alone generally was not enough to sustain food gathering full-time. But families organized into bands could effectively do that job. Bands, groups made up of families linked through kinship, marriage, friendship, and economic ties, usually provided sufficient numbers of adult men in cooperation and in rotation for hunting, and women enough to guarantee companionship and mutual help for both gathering trips and stay-at-home child care. Bands are small-scale communities consisting of several families who reside together for at least part of the year. Some bands, especially those consisting of families that have been together a long time, have names, often drawn from the geographic features in which they reside. These groupings vary in size but often number between 25 and 50 people, as was noted by Joseph Birdsell at the 1966 "Man the Hunter" conference.

Bands formed alliances, or formalized relationships, with neighboring bands whose resources could be used in time of need. Hunter-gatherers generally had flexible, overlapping, and interactive use of land and natural resources. There were times, however, when natural resource failures occurred, and groups had to move to other places where they could obtain food and other goods. This meant knowing where resources were available, and often this meant seeking permission from other groups to share those resources. In the Kalahari, the Australian outback, and the Great Basin of North America, as in other parts of the world, places containing resources were owned or managed by specific bands. This rigorous ownership facilitated the numerical adaptation of the band to the foods and goods available.

The natural resources on which groups depended include water; plants used for food, medicine, firewood, construction, and manufacturing of tools and other items; animals; trees, bushes, and rock formations used for shelter; and stones and minerals, some of which were used for tools as well as for decoration or painting on rocks (e.g., ocher). Information on the spatial distribution, number, type, and state of these items (e.g., degree of ripeness of fruits or nuts) was shared among individuals, families, and groups. Information was also shared about potential threats, such as the presence of predators or the direction that forest or bush fires were heading. In addition, groups and individuals shared information about the location, size, composition, and activities of other people on the landscape, some of whom could be either allies or competitors. This information was conveyed in a variety of ways, ranging from verbal and nonverbal communication to painting and engraving on rocks which some local peoples, archaeologists, and anthropologists see as devices for information storage and communication.

The study of band societies has been a long-standing feature of anthropology, with work by anthropologists in Australia, the Andaman Islands in the Bay of Bengal, the Arctic and Sub-Arctic, Africa, North and South America, and Asia. Debates about the variability in organization and adaptations of small-scale societies are found in the anthropological literature and have been the subject of major conferences, including the conference on Band Organization held in Ottawa August 30–September 2, 1965, published as Contributions to Anthropology: Band Societies; the "Man the Hunter" conference held in Chicago April 6–9, 1966, published as *Man the Hunter*; the first conference on hunter-gatherer studies (CHAGS) held in Paris June 27–30, 1978, and published as *Politics and History in Band Societies*; specialized conferences such as those held at the Center for Archaeological Investigations at Southern Illinois University (i.e., the 5th and 18th Annual Visiting Scholar conferences held April 15–16, 1988, and March 23–24, 2001, respectively) and published as the volumes *Between Bands and States* and

Hunters and Gatherers in Theory and Archaeology; and the present conference, held in Vancouver March 25–29, 2008.

The underlying aim of this book is to begin to build a general model of information in the context of small-scale, hunter-gatherer bands. This volume begins the task through a series of studies by international scholars in a variety of cultural contexts worldwide. The problem is framed in the introductory chapter by Robert Whallon. The substantive contributions focus on particular aspects of hunter-gatherer information from various disciplinary and subdisciplinary perspectives, with some concentrating their effort on reviewing the acquisition of information by such societies, and others taking up problems of circulation, storage, or utilization of information. However, each of these focused reviews is made with the larger aim of generalizing and contributing to an overall model. Particularistic case studies are used here only insofar as they contribute to a process of generalization and model building. These chapters are followed by a reflective statement by Martin Wobst (Chapter 13) and a concluding overview (Chapter 14) that evaluates the success of the volume in advancing toward the general model envisaged as our ultimate goal.

While it would be hyperbolic (and even self-aggrandizing) to suggest that almost everyone will find something of interest here, we are pleased that the breadth of contributions is actually rather substantial both in terms of regional scope and subdisciplinary representation. North American research is presented in the work by Funk on Yupik Eskimo/Inuit of Alaska (Chapter 2) and by Lovis and Donahue on Boreal Forest hunter-gatherers (Chapter 3). The northernmost islands on the Pacific Rim, the Kurils, are addressed by Fitzhugh and colleagues (Chapter 4). African foragers form the subject of two ethnographic studies, one on the Pygmies of Central Africa by Ichikawa, Hattori, and Yasuoka (Chapter 5) and the other on the Kua San of Botswana by Hitchcock and Ebert (Chapter 6). Hill's contribution considers the linguistic anthropology of Uto-Aztecan speakers in California and Arizona as a case of information transmission between different cultural groups (Chapter 7). Europe is treated by Zvelebil, who provides a broad perspective on postglacial, Mesolithic foragers (Chapter 8). Current and ongoing work on both precontact and contemporary native Australians is the topic of two papers, one by Veth and colleagues (Chapter 9), and another by McDonald and Veth (Chapter 10). The southernmost Americas are the focus of both ethnographic research on rock art and land use by Scheinsohn (Chapter 11) and ethnographic and precontact research by Borrero and his colleagues in different parts of Argentina, particularly around the Straits of Magellan (Chapter 12).

We believe that *Information and Its Role in Hunter-Gatherer Bands* is unique and will be of fundamental interest to those engaged in hunter-gatherer studies generally, to those interested in the development of theory and the modeling of human behavior in small-scale societies, and particularly those interested in the interactive nature and value of multidisciplinary perspectives. Hopefully, the presentations included here will catalyze further thought and discussion along all of these trajectories, in which case we will have been at least partially successful in meeting our original ambitious goal.

1 An Introduction to *Information and Its Role in Hunter-Gatherer Bands*

Robert Whallon

Abstract

An overview of the role of information in hunter-gatherer, band-level societies is presented. I attempt here to provide a comprehensive, overall framework within which to view this topic and with which to organize and pursue further research on it. This framework is a first sketch, subject to much future thought and revision, but it is offered as a beginning point for the development of a more complete and detailed understanding of what I believe to be a fundamental and crucially important aspect of the cultural systems of these societies.

Introduction

Although we have come some way from the early enthusiasm in archaeology for von Bertalanffy's (1968) General System Theory, it is nonetheless still true that open systems—of which human culture is an example—extract, circulate, store, and consume matter, energy, and information. Recent evolutionary and ecological approaches in archaeology to understanding the organization and operation of human cultural systems have largely emphasized their relations to matter and, especially, energy. The important roles now played by Optimal Foraging Theory and by Behavioral Ecology in this understanding are good examples. Perhaps still being guided in part by the ideas behind General System Theory, I think that the critical role played by information in cultural systems—how it is acquired, circulated, stored, and mobilized for use—has been too little recognized and too little investigated for too long.

By *information* in this chapter, we refer rather simply and straightforwardly to knowledge—including how to do things, how to react to various circumstances, how to behave in different social situations, what current resource conditions and availability are (quality, quantity, distribution, etc.), and so on. I do not use the term in its technical sense, as it is used in Information Theory (Shannon 1949), where it is related to signaling, entropy, and bandwidth. There certainly is a place in archaeology for using information in this technical sense, but it is primarily in the area of measuring and analyzing variation among artifacts, and that is not my focus of concern here.

In the more mundane, colloquial sense that we use here, information has long been recognized as an important element in the organization and operation of small-scale hunter-gatherer societies. Most discussions of such societies remark at one point or another on the great, even vast, amount of knowledge that these people have.

Most of this recognition has been given in the course of focusing primarily on other aspects of these groups, such as their foraging activities or ecology, for which it is obvious that information—such as knowing where and when resources will be available—is essential to the success and survival of the people involved. The necessity of knowing well certain skills, such as tool making and use, tracking, ambushing, identification of edible plants, and many others, is also often taken as a self-obvious given in understanding these societies. However, depending upon the particular interests of the ethnographer or archaeologist, the importance and quantity of social knowledge or of oral tradition, myth, ritual, and religion may be similarly stressed.

Information per se may occasionally be of more central attention, perhaps most frequently in the context of studying style and the information conveyed by stylistic variation (e.g., Wiessner 1983; Wobst 1977). Seldom, however, is the focus of attention specifically on the overall role of information in band societies, as a subject that merits detailed consideration in and of itself. The premise of this volume is that the overall role of information in band-level societies is worthy of such specific focus and consideration.

What I try to do in this chapter is to lay out a preliminary and provisional framework for looking at and comprehending the overall role of information in small-scale, band-level cultural systems. As will become apparent, only some of this framework is now clear to us, much of it is only vaguely discernible, and certain aspects of it are still unknown. I think it is worthwhile to attempt to sketch out a more or less comprehensive framework, incomplete as it is, to begin to lay the groundwork for more detailed study and investigations that can start to flesh out that framework and gradually to complete it.

There are at least three main kinds of information, or knowledge, that are essential in band societies: environmental, technical, and social. The necessity of knowing a large body of environmental information is more or less universally recognized by all students of bands and their adaptations. Technical knowledge—for the most part, how to make things and how to use them, but extending also to other physical skills such as how to move during a hunt, how to call an animal, how to prepare and cook food—is an equally essential realm of information that members of these groups must master. Finally, social information is indispensable, both to the everyday interactions among people within and beyond the local residential group and for eventual perpetuation of the group itself through the effective location of potential marriage partners and eventual creation of new families which produce offspring. The role of social information is clear when you consider that one cannot maximize one's inclusive fitness through reproduction if one does not know either where to find a potential partner or how to establish effective social contacts that lead eventually to marriage and the production of children.

Information of all three kinds must be acquired, circulated, stored, and ultimately mobilized appropriately and effectively for use. The acquisition, circulation, and storage of information, at least, occur both over space and through time, and somewhat different processes are often involved in each case. Mobilization, the activation of information by individuals and groups, could also be seen in both dimensions, but is taken here as a single process, which simultaneously and inseparably involves both spatial and temporal components. We consider each of these four processes in turn.

ACQUISITION

By acquisition, we mean the direct obtaining of facts from immediate contact and observation. Of course, information is also "acquired" indirectly, by transmission from someone else who possesses it and passes it on, but we place that manner of obtaining information in the category of circulation, rather than acquisition, which then refers to the primary, or first, obtaining of information.

Although it is not frequently so directly and specifically noted in all ethnographies of band societies, direct personal observation is an important aspect of information acquisition. One of the better descriptions of exactly how important it is can be found in Richard Gould's (1969) account of how an Australian Aborigine initiate consciously and intently observes everything about waterholes associated with sacred traditions. After receiving a large quantity of information on one of these places through instruction and memorization (part of the constant circulation of information within these groups), "the initiate looks around carefully to make sure that every detail of topography and vegetation also registers on his consciousness. Even while departing, from time to time he casts a glance back over his shoulder, 'back sighting' on the waterhole so that he will recognize it if he returns" (Gould 1969:121). This description captures beautifully not only the importance of exact environmental information to these people, but also the significant fact that such direct observational acquisition of this kind of information is an active, conscious process, not a passive absorption in passing.

A second significant characteristic of such acquisition is that it typically requires movement. The detailed observation of information is constantly expanded in the course of movement over space. Information is thus denser for areas over which movement is more frequent and thorough, and less dense spatially, although very probably equally detailed, for areas over which movements are less frequent and more sparse. Acquisition of information can therefore be embedded in other activities that generate movement. In this way, information is acquired coincidentally with movement undertaken primarily for other reasons, such as hunting or gathering forays, movement of residence to position the group for effective access to subsistence or material resources, or movement to other places for purposes of visiting neighboring groups.

In this respect, certain of these "other" reasons may, in fact, be seen as cultural mechanisms to create movement which might not be undertaken for strictly utilitarian reasons (such as foraging), but which have the ultimate effect of moving people regularly over a territory or of bringing people regularly together, in the course of which they either obtain new knowledge or systematically refresh and update their knowledge of that territory and of the people whom they encounter. The regular visits to places referenced in, and important to, sacred traditions to initiate younger group members or to carry out ceremonies in a prescribed ritual cycle—like the visits to waterholes and other locations important to the Australian reenactment of events in the "dreamtime," as in the case of the initiate discussed by Gould (1969)—might be considered a good example of such a cultural mechanism. Certainly, it is no coincidence that a large number of events from the dreamtime occurred at desert waterholes.

This kind of system, in which specific sites are regularly visited for the purpose of carrying out ceremonies, during which the sites are frequently renewed in various physical ways, such as repainting, suggests analogies with such well-known archaeological phenomena as the elaborately decorated Upper Paleolithic cave sites in southwestern France and northern Spain. These sites evidently were revisited and redecorated, almost certainly for ceremonial purposes, and at least in some cases we know that children were brought into these locations, almost certainly to participate in these ceremonies, perhaps also being initiated at these times. Whether these European Paleolithic examples are, indeed, analogous to the Australian sites at which rituals, ceremonies, and initiations related to the dreamtime were carried out is unknown. It is plausible, however, and these Paleolithic localities very likely served the similar function of creating regular movement over the landscape for ritual and ceremonial purposes, the informational effects of which would have certainly been similar to those in Australia—that is, regular, repetitive observation and monitoring of environmental conditions along the paths to these locations and in their vicinities.

It seems relatively obvious how the institution of cyclical visitation to carry out ceremonial activities at the sacred sites was related to the dreamtime functions in terms of acquisition and periodic updating of environmental (and in many instances social) information. What is interesting, however, is that other hunter-gatherer band societies who live in similarly marginal, risky environments do not appear to have any such obvious, religiously based institutions that serve a similar function. This raises the question of how and under what circumstances such institutions do, or do not, develop. We do not know, and, given that the embedded informational functions of such institutions have seldom been recognized by ethnologists or archaeologists, it is not surprising that no research has yet been undertaken to answer this question. Yet, it is an interesting and important one, which invites some serious attention.

Other movements may be consciously and specifically made for gathering new information or for monitoring areas in order to refresh and update information. Of course, excursions to inspect and evaluate environmental conditions would fall in this category. Others are made primarily for social reasons, allowing for the gathering and updating of social information (births, deaths, maturation, marriages, and the state of social relations among individuals), although environmental information is acquired during the course of such visits as well.

The visiting of relatives and friends is typically described in band ethnographies as an important activity. Often, when local resource abundance allows it, several groups may aggregate for a short time. Such visits and aggregations certainly embed the gathering of social information in them, while reaffirming old social ties and creating new ones. The social information acquired during these contacts is well known to be critical to small-scale bands for several reasons. It is drawn on when it becomes necessary for one or more people to split off from the group with which they are residing because of social friction, this being one of the few ways in which social conflict can be resolved in these groups. In addition, the network of social ties among a wide number of separate, small bands is widely understood to form a "safety net" which allows people to move out of their usual foraging territory in the event of local resource scarcity—as occurs during serious droughts, for example—and to redistribute themselves among surrounding groups in whose territories there happen to be adequate resources to allow survival. Current information on environmental conditions in surrounding territories, as well as up-to-date social ties with people in these territories, are both essential for successfully coping in this manner with local resource depressions.

Resource fluctuations, foraging, and survival are not the only reasons that these regional networks of social ties are important and so carefully maintained in these groups. Long ago, it was realized that human groups as small as typical hunter-gatherer bands were not viable as biological, breeding populations (Wobst 1974). For these small groups, the location of potential spouses and the contracting of marriages between individuals requires an extensive network of between-group social contacts, as well as, of course, current information about the existence of such potential partners and of the relevant social situation—who is free, who is promised, are social relations good, bad, or indifferent between the families involved, and so on.

The spatial extent of the areas that can be observed directly and/or the number of people and groups that can be interacted with face to face in these ways is limited. Direct observation and contact as mechanisms of information acquisition, therefore, often must be extended through the wider circulation of information within and among bands, which is discussed below.

Temporal aspects of information acquisition refer to two important and significant problems which differ fundamentally in the scales at which they operate. The first is the need to maintain accurate, correct information, keeping it refreshed and up to date on relatively short time scales, ranging from minutes or hours up to years. The second is the need to pass information to new generations from preceding ones, on time scales from dozens up to possibly a hundred years. This is done in a number of ways: with parents talking to children, with young learning from elders, and with initiates being trained by people with extensive cultural and environmental knowledge. Again, the maintenance of information accuracy or correctness over these much longer time scales is important, but the means by which this is accomplished are much different and are largely a question of mechanisms of information storage and circulation from generation to generation, both of which are discussed below.

Short-term temporal acquisition and maintenance of information is accomplished by constantly and consciously observing and absorbing information about immediate surroundings, including social surroundings. This conscious attention to local situations and conditions ensures the most frequent possible updating of information at the spatial scale of individual and band foraging territories and visiting radii. However, this immediate observational acquisition and updating of local information must be expanded and supplemented by the constant exchange of information among individuals within and between bands. While this can be seen as part of the total process of information acquisition by every individual, it is, in fact, simply the smallest scale, both spatially and temporally, of information circulation. Information circulation is thus of major, constant, and critical concern for small-scale band societies.

CIRCULATION

Given that information is differentially acquired by individuals or groups, no one of these entities usually has access to all available information necessary or useful for any action or response unless this information is circulated and shared in some way. Reliable mechanisms for the circulation of information must therefore exist that move the right information to the right people and do so frequently enough that, when it is necessary to draw upon and use that information, it is current and accurate.

The spatial scales over which information is circulated among hunting-gathering people and groups appear to vary, depending in part on the kinds of information involved and the immediacy with which that information is put to use. Locally relevant information that will be used actively in deciding upon actions and movements will tend to be largely about resource conditions, distributions, and densities, and personal life history information (e.g., births, deaths, maturation, social relations). This information will be circulated over the areal extent of local, minimal band foraging territories. Regionally, at the level of maximal band extents, similar information will likely flow in the same way. However, interregionally relevant information that may be used more sporadically, as less commonly occurring circumstances may require, will tend to be less detailed and may be more concerned with establishing a few firm social connections over long distances than with specific environmental and social conditions over such large distances and areas. We see some ethnographic examples of such long-distance contacts that are concerned primarily with social connections, such as walkabout among the Australian Aborigines, or the institution of *Hxaro* among the Bushmen (Wiessner 1982). Archaeologically, it also has been noted that contacts at the approximate scale of hunter-gatherer maximal band territories tend to involve the exchange of more utilitarian materials, while longer-distance, interregional contacts are marked by the exchange of more symbolic items, probably of greater social than practical significance (Whallon 2006).

As implied above, information about environmental and/or social matters at different spatial scales can be expected to be required with different degrees of frequency. The most frequently necessary information will undoubtedly be environmental and within the range of an individual's or group's (minimal band's) regular foraging territory. At the next level of frequency and spatial extent will be both social and environmental information on conditions in surrounding bands and their territories, either immediately adjacent or one territory removed—encompassing the larger, maximal band. Information from farther afield is likely to become important and drawn upon less frequently still, although the extremely large spatial scales of some major fluctuations in resource availability (Whallon 2006:266), or conditions of very low resource densities, do make even very large-scale knowledge occasionally of critical importance.

The various mechanisms for circulating information in hunter-gatherer band societies must therefore work to move information among individuals and groups over shorter to longer distances and with greater to lesser frequency. The majority of these mechanisms are simple and verbal: conversation, discussion, planning, and gossip, but sometimes also involving gift-giving and exchanges as part of the interaction involved and the often associated creation, renewing, or reaffirmation of social ties. However, some of them utilize other, nonverbal means of transmitting information.

Signs, Symbols, and Styles

It is well known that information can be encoded in and expressed by a variety of material, as well as by intangible (e.g., gestures, song, dance, dialect, etc.), signs, symbols, and stylistic features. These phenomena are relatively well studied in ethnology and archaeology (e.g., Conkey and Hastorf 1990; Sackett 1982; Wiessner 1983; Wobst 1977; among others). Such encoding and expression serve a myriad of purposes: signs as guides, statements of identity, indicators of status, markers of ownership, and so on. Some good examples of how material signs and symbols are used to communicate information are presented in this volume (e.g., chapters by Scheinsohn [Chapter 11] and Borrero et al. [Chapter 12]).

There is a temptation to see such encoding of information in signs, symbols, and style as a kind of information storage or form of preservation. It is important to remember, however, that the information encoded and expressed in these elements of culture can be extracted, interpreted, and understood only if the observers and receivers have the requisite knowledge to do this. Therefore, information can be stored in signs, symbols, or styles only as long as the knowledge necessary to interpret and understand them is remembered.

To anticipate our consideration of information storage a little, this knowledge, like virtually all other information in small-scale band societies, resides in people's minds. Even in highly developed, complex cultural systems, where there exist mechanisms for the actual storage of information in material form, both the encoding and the extraction of that information depends entirely on preservating and passing on through generations the knowledge necessary to use these mechanisms. For example, we often think of writing as essentially a means of storing and preserving information, which can be accessed by anyone at any later time. This system functions, however, only as long as the knowledge of how the system works remains in the active, mental storage of the members of some cultural group. At one time, writing in the Indus Valley script undoubtedly did store and subsequently communicate information to at least some of the members of the Indus Valley societies. Today, these writings contain zero information and communicate nothing to anyone. Similarly, if one were to ask an illiterate member of our society what information is contained in this chapter, the answer for that person would be "nothing."

The only mechanisms in hunter-gatherer band societies for the material storage of information are simple mnemonic devices, such as certain ritual signs and markings and, occasionally, representational devices such as maps. All the various other material, as well as intangible, cultural signs, symbols, and styles are simply means of expressing, and thus circulating or communicating, information.

A specific characteristic of the use of signs, symbols, and style to communicate information is that it may be, and for the most part is, passive. In addition, these are efficient ways of transmitting information. Once encoded, the information can be communicated many times and to multiple people, while the sender does not have to expend any further effort. The fact that a large number, perhaps the majority, of signs, symbols, and styles are material gives them one more distinctive characteristic: the person or persons communicating information by these means not only avoid the expenditure of extra effort every time the information is communicated, but they do not even have to be present for this to occur. In a sense, this allows the communicator effectively to be in two or more places at once as far as communicating information to others (and in certain cases back to oneself—as in the marking of trails, for example) is concerned.

Certainly, this is an area well worth a good deal of further study to enhance and refine our understanding of exactly what kinds of information are encoded and expressed in which of these ways. Although this is an area that already has seen rather extensive research, and remains an area of active interest, we are still some way from understanding it fully. One of the reasons it has been, and continues to be, a focus of particular interest and investigation is, of course, because many of these material signs, symbols, and styles are preserved over time in the archaeological record. These material items are thus almost our only direct link to the information that once circulated in earlier societies. This may be one of the reasons that we often mistakenly think of these items as storing information. The main problem in using the information encoded in them is that the knowledge necessary to access that information, once stored in the minds of the people who made them, is no longer available to us. We are therefore reduced to working out plausible general principles of interpretation of such items, an area where research is not only continually active but also much further needed.

The Problem of Degradation

The importance of information being accurate and up-to-date has been mentioned several times already. It is obvious that there is a close relationship between the frequency of acquisition (and reacquisition, or verification) and how up to date and accurate information is. However, it is not so obvious, but nonetheless critical, that there is a general, inverse relationship between the number of links through which information has passed in the course of circulation and its accuracy.

The phenomenon of degradation (that is, distortion or loss) of information as it is passed from one person to another is informally well known and is the basis for an old parlor game known as "telephone" or "gossip" (less commonly as "broken telephone" or "rumors") in the United States, "Chinese whispers" in Britain, and various other names in other countries and languages. In this game, a sentence or phrase is passed verbally from one person to another, typically in a circle or around a table, usually in a whisper so that it is not heard by anyone other than the two who are at that moment actually transferring the sentence or phrase between themselves. At the end, the sentence or phrase understood by the last person is compared to the one with which the process began, and the results are often quite humorous or amazing in the transformation and distortion of the original.

The serious point behind this lighthearted demonstration of the fragility of chains of verbal information transfer, or circulation, is that maintaining the accuracy or integrity of information will be a major concern whenever it must be circulated to any extent. The greater this extent, in terms of the number of steps, or links, required to circulate the information, either over space or through time, the greater the potential for significant distortion or loss. In situations where the information communicated is critical for survival, as it often is to hunter-gatherers, the concern for accuracy and the prevention of degradation must be extremely high, and there must be adequate effort and means to ensure the preservation and distortion-free circulation of information.

Spatially, the number of links in a chain of information circulation is probably at least partially related to the distance over which information is being moved, meaning that information will probably become less and less accurate as it refers to environmental and social conditions farther and farther away. Temporally, the number of links can be roughly counted as the number of generations over which information is handed down. We do not know exactly the pattern or rate of information loss/distortion as it passes through multiple connections in the course of transmission, but, in the absence of any mechanism of verification and correction, it is probably relatively rapid. Parlor games like "telephone" or "Chinese whispers" do not usually involve large numbers of people, yet significant, and sometimes extraordinary, distortions of information are said to occur in them. The psychological studies that have addressed this question directly (e.g., Mesoudi et al. 2006) have investigated rather short chains of transmission (four in the study just referenced), but the pattern of falloff in accuracy is clearly not linear, and more closely approximates a power law, or log-log, relationship, between information loss and the number of links in the chain. This would imply that the potential for significant loss even within the first stages of information transfer, or circulation, is high.

The concern with possible loss or degradation of information as it is circulated within small-scale band societies appears to be addressed by relatively informal means, and, although there are no specialized or specific social or cultural institutions for this purpose, the informal ones are engaged in intensively and incessantly.

One of the first things to note in this regard is that people in these societies seem to talk to each other all the time, in pairs, in small foraging or work groups, in camp groups, and in larger, less frequent aggregations. These frequent conversations or discussions serve two purposes simultaneously: they circulate information among the participants, and, equally importantly, they allow the constant cross-checking, refreshing, validating, and, if necessary, amending or correcting of the information being circulated. These functions of conversation are more or less obvious when the topics are the planning of foraging activities, debating possible group movement, or intentions and plans for technical projects—all openly and obviously related to passing environmental and technological information around. Gossip, too, however, has the same underlying functions with respect to social information (see, e.g., Wiessner 2009).

In addition to the essentially spatial circulation achieved by the transfer of information among individuals and groups in these manners, information is also passed on through time, from generation to generation. This is accomplished for some bodies of information by teaching, either informally or formally, as when information is handed down in initiation ceremonies. It also occurs in the course of ordinary daily conversation, discussion, and even argument. The transfer of information over multiple generations, however, is most relevant to the long-term maintenance or preservation of information by the cultural group and is thus best considered as a part of information storage in these groups.

STORAGE

Unless used immediately upon acquisition and forgotten immediately afterward, information must somehow be stored for later availability and use. In small-scale hunter-gatherer bands, the primary mechanism for information storage is simply human memory, and the locus of stored information is thus each individual's brain. The fact that virtually all information is kept in individual memories gives the organization of stored information in these societies certain characteristics that may be critically important for their adaptation and survival. It further poses some significant problems with respect both to the maintenance of accuracy and to the ultimate preservation of information against loss.

A pervasive and critically important characteristic of the information stored in these societies is that it is differentially distributed. Differential distribution of information does not, of course, mean that each individual or group has exclusively unique information that no other individual or group has. Obviously, the members of a cultural group must share a large body of common knowledge, and even when there are clear differences, there still must be large overlaps in the information held by different individuals or groups. Nevertheless, it is becoming quite clear that differences do exist and that these differences are often large and significant.

This differential distribution of information arises during its acquisition because of the diversity of activities and their organization in these groups. It is constantly reinforced by this diversity and organization of activities and persists unless actively countered by mechanisms of information circulation.

Differential distribution of information arises in the first instance because the different individuals in these societies are all engaged in slightly to substantially different activities that both focus their attention on different aspects of what is around them and may take them to different places. The varied technical, subsistence, and social activities of group members and the fluid nature of group organization ensure that each individual does some things alone, some things with one or more other individuals (with these partners or associations shifting and changing frequently), and only some things with the entire group together. The individual and small task group activities vary in nature and location, ranging from the residential camp to different foraging or task trajectories, which extend over shorter or longer distances. In short, the thoroughgoing division and differentiation of labor in these societies ensures that different individuals will regularly be doing different things in different places. Each band as a whole, of course, exploits, and thus gathers information on, its own distinct and different territory.

Finally, both individuals and groups travel beyond their own immediate foraging territory and thus have opportunities to observe and directly acquire information from more distant areas. However, individuals, especially, and smaller social groups such as families as well, may vary significantly in both their frequencies and distances of movement, leading, of course, to differences in the information acquired.

The primary and essentially universal axis of the hunter-gatherer division of labor is, of course, male–female. As a consequence, information on a wide variety of matters—including all the major areas outlined above—will always be differentially distributed between men versus women. To take one example, there are important differences between Yup'ik men's and women's experience and knowledge of space and places (Funk, Chapter 2, this volume). Another example is the major differences between the ways in which Warrabri Aboriginal women and men experience initiation and acquire and use ritual knowledge (Bell 1993). The extent and importance of the differential distribution of information within and among hunter-gatherer bands goes beyond this simple dichotomy, however. Just as I once earlier (Whallon 1989) tried to stress the existence of a "differentiation of labor" as well as the traditional male–female division of labor in band society, information is also differentially distributed among men and among women.

Age is a secondary axis of differential distribution of information, particularly in relation to skills that require a significant amount of knowledge. A number of studies of hunter-gatherer activities that require learning and skill development—for example, hunting, or foraging that involves difficult extractive tasks, such as *mongongo* nut processing—show long, slowly rising curves of ability and success, peaking at relatively late ages—in the 30s, 40s, or even the 50s—followed by slow, gradual declines over older ages (Walker et al. 2002). Another example, from a tribal rather than a band society, is the Una in Irian Jaya, where learning how to make "simple" polished stone adzes begins at adolescent initiation (around 16 years old) and takes at least until the age of 35 before a man can make at least symmetrical and appropriate blanks ready for polishing (Pétrequin and Pétrequin 1993:243–244). Age is clearly also a factor in the differential distribution of information (knowledge, skills) in small-scale societies.

The differential distribution of information is substantive and qualitative (what information is known) as well as quantitative (how much information is known). The differential distribution of information stored within the individual memories of the members of these small-scale societies has important effects noted above in terms of the short-term processes of information circulation (and of mobilization in the same way), and it may also have strong and significant effects on the cultural systems of these societies over long-term, evolutionary time.

Qualitatively Differential Distribution of Information

Substantively differential distribution of information occurs on different scales, ranging from differences among individuals to differences from group to group at all levels—from local residential groups to large, regional, maximal bands. In some instances, this is just a case of one individual knowing something that others do not know, and much of this is ephemeral, changing constantly as people communicate information among themselves. Still, at any given moment, such individual differences in the information kept in mind are likely to exist, and almost inevitably there will be differences in the information held by different social groups at all scales. Obviously, the various, more or less frequently aggregating, co-resident groups recognized ethnographically and archaeologically as "minimal bands" or "maximal bands" are typical social groups among which information is differentially distributed. Others may be small task groups, including foraging and working parties, or visiting parties. Some groups may be categorically defined—for instance, shamans or other religious practitioners as distinguished from "ordinary" people without any such special powers or abilities, or uninitiated persons as distinguished from the initiated members of society.

The most important of such categorical divisions, however, is clearly that between men and women. In some cases, the differential distribution of information between men and women is culturally recognized and determined in a strong form, with belief systems that define hearing, seeing, and learning certain things by one of the genders as wrong or even deadly dangerous—usually for women, as in some Australian Aboriginal cultures. In other cases, the differences between men's and women's knowledge is not formally recognized and is more simply accepted as a normal or natural part of life and the organization of activities in society, but the differences may still be many and significant (e.g., as among the Yup'ik Eskimo discussed by Funk, this volume).

The differential distribution of information in band societies has rarely been explicitly recognized and has been very little studied. When it has been noticed, the general assumption seems to have been that it is always effectively mitigated by the processes of information circulation discussed above. I would guess, however, that differential distribution of information is constantly arising through the processes of acquisition as fast as it is mitigated through circulation, and that some aspects of differential distribution, such as the differences between men's and women's knowledge, are culturally and organizationally maintained against any lessening through circulation. Basically, we do not really have a clear idea of the range of variation in patterns of differential distribution of information in band societies, nor of the rates at which such differentials are created and dissipated, nor, in cases of long-term, stable differential distributions, what kinds of information reside primarily in the minds of one category of people or another.

Funk's pioneering research in this regard (2005 and this volume) gives us a fascinating glimpse of some of the male–female differences in available knowledge/information that arise through the normal division of labor and the consequent differences in attention to different activities and events. With respect to sacred knowledge, some information can be found in ethnographic accounts of Australian Aboriginal restrictions against women's access to this information. However, we do not have the slightest idea of when and why such male–female differences arise without particular cultural definition, through the structuring of day-to-day activities, and when they are culturally defined and maintained with explicit and strong sanctions. Altogether, this entire area of understanding the role of information in hunter-gatherer bands is scarcely known and is an important, open field waiting to be investigated.

Although we lack a good picture of exactly how the probably common and significant differential distribution of information comes about and is structured, and of its effects in the short term on immediate activities or through a seasonal round of activities, we can nonetheless easily see some of its potential consequences over the long term. Given an uneven distribution of any highly important or critical information—knowledge of an essential technology, for example—any accidental, unexpected death of the person or persons in whom that information resides will pose a difficult challenge to the social group as a whole. With the total loss of some element of critical knowledge/information, the group must find someone else who has that knowledge and must convince that person to either join the group or to teach it to remaining members of the group. Alternatively, the knowledge/information must somehow be resurrected, reconstructed, or reinvented. If neither of these alternatives is successful, that knowledge/information will be lost to the group. Such loss may have significant adaptive consequences.

Historically, some hunter-gatherer band societies are known to have lost such major elements of their technologies—for example, how to make and use kayaks and how to use the bow and arrow (Polar Eskimo: VanStone 1972:48; Gilberg 1984:578, who mentions explicitly that the loss of knowledge of how to make and use kayaks for hunting was due to the sudden death by disease of all the old people), or bone tools, cold-weather clothing, hafted tools, nets, barbed spears, spearthrowers, and boomerangs (Tasmanians: Henrich 2004; although Read 2006 alternatively interprets these losses as adaptations). In areas other than material culture and technology, cultural elements such as knowledge of religious ceremonies and rituals, myths, and so on may also be lost in this manner. Even essential environmental knowledge, such as how to orient oneself on the landscape and navigate when traveling, may similarly be lost. An analogous process currently is in progress where the intricate knowledge necessary for successful navigation in the extremely difficult and dangerous terrain of the high Arctic is now being lost by the younger generation, which is not learning this knowledge from the elders (Aporta and Higgs 2005). As an Inuit elder explains, this traditional knowledge "is almost like a science. And maybe it is a science, as a matter of fact, but nothing written. It's just mental, it's just knowledge passed on from generation to generation" (Aporta and Higgs 2005:729). Here, the elders are not dying off from disease, but are being ignored by a younger generation which is adopting modern, GPS technology.

This process of random loss due to the deaths of individuals having information not kept by others can create cultural change of a significant sort that is not driven by adaptation and may, in fact, as in the examples just cited, be strongly maladaptive—a sort of "cultural drift."

Quantitatively Differential Distribution of Information

Quantity—that is, the differing amounts of information at each individual's disposition—is another aspect of the differential distribution of information in hunter-gatherer band societies, where human memory is the repository for the vast majority of stored information. Ethnographers have recognized the often striking differences among individuals in the amount and range of knowledge they are able to bring forth, to the extent that some fieldwork comes to rely primarily on a single individual or a very few individuals from an entire group (e.g., Funk [Chapter 2], Lovis and Donahue [Chapter 3], Ichikawa et al. [Chapter 5], this volume). These practical examples give an impression that such quantitative differentiation is almost discrete, consisting of one or a limited few very knowledgeable people who are distinctly set off from the rest of the population in this respect. However, this impression is essentially anecdotal, and the pattern of quantitative variation in the information possessed by different individuals in these societies appears never to have been studied or measured.

Psychologists, working with subjects from modern, literate societies, have recognized and studied the existence and effects of individual differences in memory capacity (Just and Carpenter 1992; Cantor and Engle 1993; Tuholski, Engle and Baylis 2001). Some of these studies have linked such variation in memory capacity to differences in observed skills, such as linguistic performance, and even to overall "intelligence" (Engle, Kane, and Tuholski 1999; Engle et al. 1999). These connections seem consonant with other, ethnographic observations about the distribution of skills and the frequencies of highly competent specialists in small-scale societies. Ethnographic accounts make it clear that some skills take many years to acquire, with only a very limited number of people ultimately becoming real masters and specialists.

The psychological literature appears to assume that individual differences in memory capacity and concomitant differences in task performance or general intelligence are normally distributed, which presents quite a different picture of quantitative differences among individuals in memory, knowledge, and skill. The difference between these pictures may be due to the very different kinds of societies studied by ethnographers, on the one hand, and psychologists, on the other—namely, those in which essentially all knowledge/information is held in memory and is transmitted by observation and word of mouth versus those in which knowledge/information is accessible from a myriad of diverse repositories that contain vastly more than can ever be held in living memories alone and is transmitted by a variety of formal institutions that probably provide most individuals with more information than they obtain from ordinary social interaction and contact.

Some ethnographic observations, by contrast, present a picture of approximately categorical differences, showing a small fraction of the population with extensive knowledge and consequent great skill as opposed to the bulk of people who have significantly less knowledge, and, thus, only average skill. Among the Una of Irian Jaya, for example (cited above; Pétrequin and Pétrequin 1993), after the long apprenticeship necessary for a man to polish stone axes acceptably, only a few adult men, around 1 out of 10, will ultimately become truly skilled, part-time specialists at this craft (Pétrequin and Pétrequin 1993:239, 244).

It would be useful to know how information is quantitatively distributed among individuals in hunter-gatherer band societies. The only extensive quantitative data on this is probably that on Ache hunting skill, the distribution of which has been intensively studied and which appears to show a highly skewed, log-normal distribution, with about a fivefold difference between the worst and the best hunters observed over at least 100 days of observation (Hill and Kintigh 2009:371). This is a large difference, and it would be quite useful to know if other differences in skills and other kinds of knowledge similarly follow a log-normal distribution, with such a wide separation between the best and the worst practitioners, or the most and the least knowledgeable, and so few really highly skilled individuals at the high end of the curve.

We might expect quantitative differences to play a role similar to what we have described above for qualitatively or substantively differential distribution of information within hunter-gatherer bands. That is, random removal of individuals with greater stores of information, which subsumes those with greater skills, could lead to random "drift" in the cultures of these societies. This process would not typically occur frequently, but over longer time spans it could have a highly significant impact. It potentially would have greater effect to the extent that the quantitative distribution of information were either relatively discrete or highly skewed, log-normal, as the little ethnographic evidence seems to suggest, than if such quantitative differences were simply normally distributed, as assumed in psychology and suggested by the normal distribution of IQ scores.

Finally, we do not know here if there is any relationship in hunter-gatherer bands between such quantitative differences in knowledge/skill and survival or life-span. In modern, complex societies, there is a correlation between intelligence—which, as we have noted, may be related to memory capacity (Engle, Kane, and Tuholski 1999; Engle et al. 1999)—and length of life (Deary 2008). If such a correlation exists also in small-scale band societies, it would perhaps diminish the potential effects of individual deaths on the pool of cultural information/knowledge/skill within them.

Need for Research on Differential Distribution of Information

The long and short of it is that we simply do not know many of the things we would like to know and need to know about either qualitatively or quantitatively differential distribution of information as it is stored in the minds of the members of small-scale, hunter-gatherer bands. Neither do we know anything about the degree to which there is variation among such societies in the extent or the patterns of differential distribution. Nor do we know whether there are any systematic differences in the ways in which different kinds of information are distributed among people in these cultural groups. Given that the differential distribution of information, in all its various forms, is potentially an important factor in long-term, evolutionary change and, as we will see below, may be significant in the organization of group activities, these large gaps in our knowledge represent an important area for future investigation and research.

Problems of Information Deterioration and Loss

A universal problem with the storage of information in individual memories is degradation and loss. Aside from the possible death of individuals uniquely possessing certain information/knowledge/skills, as discussed above, this happens in two ways. First, people may simply forget. Second, the same process of distortion, eventually to the point of total loss, through person-to-person transmittal, as discussed above for the circulation of information—referring to the parlor game of "telephone," gossip," or "Chinese whispers"—may occur as information is passed from generation to generation.

With respect to the problem of forgetting, little attention has been paid to the fact that people hold onto knowledge with very different degrees of tenacity. Some information is taken as essentially pragmatic in nature, readily subject to modification, and, if considered of only immediate, passing use, easily forgettable. No special personal, cultural, or "moral" value is attached to this information, and it is easily acquired, circulated, used, and eventually forgotten.

Other information is more deeply embedded in memory, some because it is associated with more than the rational memory centers of the brain and involves visual, auditory, taste, olfactory, or tactile images or memories. This extension of memory to multiple parts of the brain may reach to unconscious centers, as it does in the gradual acquisition over long training of ever more complex and difficult motor skills (for example, in the learning, over some 20 years, of the skills necessary for the fabrication of polished stone adzes in the New Guinea case mentioned above).

Some information is also deeply ingrained in people's memories because it is endowed with "moral" or sacred value. Such information is often taught at a young age or acquired under conditions of fear, pain, or sheer terror. There is a gradation of the stress under which this information is absorbed and the consequent strength with which it is held, ranging from knowledge of what is appropriate and proper, through notions of what is right and wrong, to ultimate sacred beliefs. The correlation between the strength and, thus, the longevity of memories and the degree of stress under which they were acquired is well known psychologically (e.g., Cahill and McGaugh 1998) and is clearly used culturally to instill different information in people with different degrees of strength. Such cultural means of embedding information in this way range from children's tales of bad to horrible consequences for improper behavior, sometimes at the hands of a terrible monster, to terrifying and painful initiation ceremonies and rites, in the course of which mastery of certain knowledge by the initiates is demanded.

It is immediately obvious that by these different means, different kinds of information are embedded in memory with significantly different degrees of strength and longevity (cf. Whallon 2000:84). It seems, further, equally obvious that holding different kinds of information with such different degrees of tenacity must be of real significance to the operation, adaptation, and evolution of band-level cultural systems. The problem in this respect is that these things are obvious only intuitively, on the basis of general experience, observation, and ethnographic description. This phenomenon, which undoubtedly is of real importance, has never been systematically recorded and studied.

Impressionistically, one might see a pattern where environmental information is acquired with the least stress and is the most easily modified; social information is more firmly held, with some of it, such as knowledge of the proper behavior with different categories of kin, acquired under the stress of moral persuasion and threat of consequences; and religious beliefs and sacred lore are the most tenaciously held and often acquired under implied or real threats or in conditions of fear and pain. However, there are myriad exceptions to such a simple pattern, and the truth is that presently we simply do not know precisely what kinds of information are regularly embedded in memory to these different degrees of strength and longevity, what the conditions are that lead to one or another kind of information being imparted under different degrees of stress to achieve these results, nor exactly what the cultural, adaptive, and evolutionary significance of such variability is. We can point to only one or two examples of how some of this works in certain circumstances. For the rest, most remains in the realm of speculation and questions that tug at our attention and beg for some serious future research.

The best example of how some of this works is given by Minc (1986), who shows how, among the Nunamiut Eskimo in northwest Alaska, environmental information that is periodically absolutely critical to adaptation (in the sense of sheer survival) is encoded in symbolic form, such that it is passed down in the form of religiously sanctioned, strongly inculcated belief systems. In this way, it remains culturally stored in a highly intact form over many generations.

In this example, roughly every 60 to 100 years the caribou herds upon which the Nunamiut depend cyclically decline to levels too low to support the people. The ethnographic record makes it clear that these periodic declines in this essential resource are unanticipated by the Nunamiut, and their normal technological and adaptive responses are inadequate to cope with the situation. In other words, "practical," rational knowledge of such environmental conditions and how to react to or cope with them is not maintained within the store of information consciously available to the group. Instead, effective response to these crises is stored in the form of a symbolic belief system that links interior animal species, such as the caribou, with coastal animal species. The coastal species are relatively abundantly available during the periodic environmental circumstances that bring about the decline and breakup of the caribou herds in the interior. This symbolic belief system is, then, the basis on which a shaman activates an adaptively appropriate group response of moving to the coast, ostensibly to placate the unhappy "spirit doubles" of the caribou—and, practically, to kill and eat coastal species in the absence of caribou in the interior hunting territories.

This case illustrates in a fascinating way how environmental information and effective adaptive responses may sometimes be encoded in a religious, symbolic system of belief that, in itself, contains or expresses no "practical" or "rational" knowledge. Crisis triggers a symbolic response—placating spirits—in which is embedded an adaptively appropriate action.

This case also gives us a first estimate of the temporal limits to "conscious" information storage in a system where human memory is the location of storage and word of mouth is the medium of information transfer. This kind of system apparently is incapable of maintaining information intact and available for as long as three to five generations, or up to around 60 to 100 years (cf. Smith 1988, who suggests a limit between 65 and 85 years). This is an important limit, because it means that, unless the information and appropriate responses can be encoded in a symbolic form, one that can be passed down over at least three to five generations without loss or distortion and that can be activated reliably in the event of crisis, these societies will be incapable of coping adequately with extreme resource fluctuations that occur as frequently as every 60 to 100 years. The consequence is that these groups are likely to suffer severe resource stress and experience strong selective pressure at least this often. Greater resource fluctuations are likely to occur less frequently; but on an evolutionary time scale, they nonetheless represent frequent buffeting of these groups within their environments. When we look at paleoclimatic records, we can see that the frequency and amplitude of environmental fluctuations must have often imposed severe resource stress on all prehistoric hunter-gatherer bands. The symbolic encoding of adaptive responses in a strongly held belief system, as seen in the Nunamiut, is one solution to this situation. Once again, however, we find ourselves facing a long series of unknowns.

In the first place, we do not know how common such solutions are in these societies. They are not obvious to the ethnographic observer, and, not being suspected, they have never been sought by ethnographers or ethnoarchaeologists. There is evidence from other hunter-gatherer cultures that some adaptively significant information and behavioral responses are incorporated into myths and other oral traditions (e.g., Sobel and Bettles 2000), and the important work of Smith (1988) specifically suggests that strong initiation ceremonies that transmit significant knowledge from generation to generation under conditions that ensure its long-term, accurate retention are associated with societies that face major resource crises at intervals that are greater than the three- to five-generation limit to the maintenance of accurate information. However, we do not know whether all or most of these "sacred" and ritually based means of long-term information storage actually function as adaptive mechanisms in ways similar to the Nunamiut example.

Secondly, the very stability of such religious, symbolic belief systems, while a positive feature for preventing loss and maintaining integrity of information, by the same token makes them resistant to further development or to modifications aimed at adapting to changing conditions. We have no idea how such systems come into being, nor how difficult this process might be. We also do not know, but can imagine, that they might change only slowly or with difficulty in response to new environmental conditions, and we would not be too surprised to see such systems persist for some time even in such new conditions, effectively becoming vestigial if not positively maladaptive.

MOBILIZATION

Information available within small-scale band societies seems to be mobilized in four main ways. First is the simple use by any individual of the information held in his or her memory. This may range from the observation of some desirable resource, which is then immediately procured, to the use of skills or motor habits learned through long training. It is here that we see the effects of greater or lesser memory capacity and related overall intelligence, and different aptitudes and abilities, in the greater or lesser success of different individuals in various activities or aspects of life.

Second, one can say that information is mobilized for use when one or more people see and are able to extract and correctly interpret the information that is encoded in a sign, symbol, or style. Strictly speaking, the simple acquisition of information from a sign, symbol, or style is an instance of communication, or circulation of information. However, since the result of extracting such information is most often an immediate reaction, one could see this also as an instance of mobilization of that information—the recipient directly incorporating that information into his or her store of active knowledge and immediately using it to generate a reaction or guide consequent behavior. Further, in addition to the passive communication of information by the majority of these (typically material) signs, symbols, and styles, some are used actively to directly and instantly communicate and mobilize information, as in the use of hand signals among members of a hunting party (e.g., Gould 1969:69) or creating smoke signals to convey a previously agreed-upon message (e.g., Gould 1969:13)

The third kind of information mobilization can be found within rituals or ceremonies that embed information in symbolic belief systems, as illustrated in detail in Minc's (1986) study of the response of the Nunamiut to the periodic decline in the caribou population. This is an intriguing phenomenon, because it appears to represent about the only way in which small-scale band societies can store and then mobilize information relevant to coping with critical conditions that occur only every three to five generations or less frequently. As discussed above, however, this may be a rare mechanism for information storage and mobilization. It is not at all clear how information gets encoded in such symbolic belief systems, and, while its longevity in such systems is of positive adaptive value as long as long-term environmental cycles are stable, this very characteristic may lead to the mobilization of information that no longer generates appropriate adaptive responses in situations of changing patterns of environmental variability. Therefore, while this phenomenon merits further study, it does not appear to be a common way in which information is mobilized in these societies.

Fourth, and finally, the typical and most common way in which information is mobilized in hunter-gatherer bands is through conversation, discussion, and open planning. Not only is this the main mechanism of information circulation in these societies, it is also the main mechanism for mobilizing information to guide action.

On the face of it, this appears to be a simple process. However, the differential distribution of information within these societies must determine to a greater or lesser extent who needs to be present and participate in such open mobilization of information in order to organize and perform certain tasks effectively. This, then, naturally influences certain aspects of social interaction and organization. To take an obvious example, a Nunamiut Eskimo group without a shaman would quite possibly be incapable of reaching the decision that it was essential to go to the coast to propitiate the unhappy spirit doubles of the caribou. In this particular cultural system, in which the knowledge required to mobilize the information embedded in the symbolic belief system is so strongly differentially distributed that only a shaman is able to go into trance, communicate with the spirit world, and announce that the solution to the crisis faced by the group is to leave for the coast, it becomes more or less obligatory that each major band contain such an individual alongside all the other, ordinary members of the group.

On a less dramatic note, hunting parties surely are more successful when they include one or more highly experienced, skilled hunters than they are when made up of only less experienced, less competent hunters (see the data on differences in hunting success in Hill and Kintigh 2009). These differences among hunters clearly shape the formation and composition of hunting parties and patterns of cooperation among individuals. Such differences are part of the multitude of differences in how information, in the form of knowledge and skill, is distributed within band societies, many of which will have similar effects on group organization and patterns of social interaction and relationships.

In terms of how the differential distribution of information affects group action when the main means of mobilizing information is through open discussion and planning to reach consensus, one may also point to the well-established fact that in such conditions of decision-making there is an optimum number of participants, or information sources. This number is around six, with the effectiveness of decision-making falling off sharply as this number becomes either larger or smaller (Johnson 1978; Reynolds 1984). If we assume that decisions are made primarily by the active adult members of a band, this means that the optimum group for deciding anything that relates to women's activities (and that therefore demands the mobilization of information held specifically or largely by the women of the group) would be six active, adult women. The same would hold true for men deciding anything relating to their particular activities. Ideally, then, this translates organizationally into an optimal group size of some six families, with the six husbands discussing until consensus is reached on their actions, and the six wives doing likewise. A smaller group would not be able to pool information and reach decisions as effectively, while a larger group would have to decompose into smaller units to make as effective decisions. Taking average family size to be somewhere in the range of 4 to 4.5 persons, this works out to an optimum band size of 24 to 27 members—basically spot on the "magical number" of 25 discussed in hunter-gatherer studies ever since the Man the Hunter conference and publication (Lee and DeVore 1968: 245–248). One can probably say that the ways in which information is structured and used in band societies play a significant part in forming and maintaining certain major characteristics of group organization.

SUMMARY

This has been a brief, and in parts quite sketchy, outline of one way to look at the role of information in hunter-gatherer band societies. It is not meant as a definitive statement on the subject but, rather, as a thought piece, a work in progress. The subject is not only important for understanding the organization and operation of these societies, their processes of adaptation, and their evolution, but is also large and complex. Ultimately, a complete model of how information is acquired, circulated, stored, and mobilized in band societies will involve considerations that include not only ethnography/ethnology and archaeology, but will extend as well to such fields as psychology and ecology. A very little of that has been touched on above—just enough, hopefully, to give an idea of the extent of the subject and the various directions in which its investigation leads us.

Some effort has been made to point out significant areas or questions that stand as large unknowns in this subject. It seems important to stress the fact that we simply do not yet know certain things, although attempting to outline an overall model for how information functions in band societies leads us in some places directly to these things. For example, how long can substantive information about rarely occurring but extreme resource crises, and about how to respond to them successfully, be maintained accurately and actively available in group memory? We do not know exactly. We have some empirical evidence that it is almost surely less than some three to five generations, or 60 to 100 years, and that the "telephone," or "Chinese whispers" phenomenon results in degradation and eventual loss of such information within that time span. Therefore, it is clear that this is an area and a process that has strong long-term adaptive consequences, and it would be very useful to know more, and more precisely, about it. This, along with a number of other areas and aspects of the role of information in band societies, is fertile ground for future research.

The contributors to this volume all share an interest in advancing our understanding of the role of information in hunter-gatherer band societies. In their papers, they all explore various aspects of how information is obtained, transmitted, kept, and used in these societies. Their varied areas of investigation and their different approaches to the topic testify to the breadth and diversity of these processes and to the variety of ways in which they might be approached and explained. Together, they all contribute to our understanding of the subject. We would probably all agree, however, that we still have a way to go to reach anything close to a full understanding of this aspect of the organization and operation of these societies. Some intriguing, interesting, and exciting research still awaits us.

2 Yup'ik Eskimo Gendered Information Storage Patterns

Caroline Funk

Abstract

Yup'ik men and women store information about people, places, and events to differing degrees of completeness and confidence. The gendered patterns present in Yup'ik information storage tend to conform to expectations based on models of evolved spatial predispositions and the gendered division of labor. Yup'ik men store information about landscapes at high levels of detail more often than women, and women maintain information about relationships in greater detail than men. Yup'ik men and women curate information about subsistence and domestic organization, creating a conservative, risk-minimizing duplication of information storage that defies evolutionary and economic models for human behavior.

Introduction

Yup'ik Eskimos, in at least one small nation of Alaska's Yukon-Kuskokwim Delta, store information about landscapes, subsistence, domestic organization, cemeteries, travel, and historical events by linking personal knowledge to established locations on their landscape. The process is performed differently by women and men, and with variability in the extent of knowledge among men. The storage of information is essential to Yupiit[1] survival. In their physically and socially dangerous landscape, stored information directly secures access to subsistence resources, helps to assure personal safety, and maintains family and social networks that provide another layer of security (Funk 2004, 2005, 2010; Whallon 2006). Not all types of cultural information are stored in relation to particular areas of the landscape, because many Yup'ik oral histories describe right and proper behavior or deep mythic history without reference- to specific locations. Such information also may be essential in risk mitigation and social security over long time periods (as in Minc 1986). However, this chapter is concerned with the system of information stored in association with the locations of camps, villages, and larger general regions. I examine patterns of information storage and transmission in evolutionary terms, and suggest that they result from adaptive risk-mitigation processes structured on innate human psychological tendencies and the gendered division of labor (Hiss 1990; Kelly 1995; Silverman and Eals 1992; Smith 1991; Whallon 2006; Wilson 1995).

The Yupiit and Their Region

Yup'ik cultures are part of the broad western subarctic Eskimo cultural tradition. In the past and in modified form today, Yupiit follow a seasonal subsistence round that focuses on aquatic and avian species as well as plant resources. The Yup'ik homeland on the Yukon-Kuskokwim Delta of western Alaska is a vast watery landscape about the size of Wisconsin (Figure 2.1). Yupiit and their ancestor cultures have inhabited this dynamic landscape for at least 4,000 years (Dumond 1984, 1987; Shaw 1998). The land surface has minimal topographic relief and is mainly comprised of very little higher topographic relief and is mainly low tundra, about 50 percent of which is covered by water in the form of lakes, streams, and rivers that are influenced by storms and tides. The research in this chapter centers on the oral histories from elder Yupiit living in a small triangular area on the delta between the mouths of the Yukon and Kuskokwim rivers (Figure 2.2). Today, Yupiit and Cupiit live in the Triangle area in three modern villages and combine their grandparent's techniques for living with twenty-first-century adjustments.

Yup'ik grandparents and all prior antecedents lived in a number of large, seasonal villages and small camps throughout the area (Fienup-Riordan

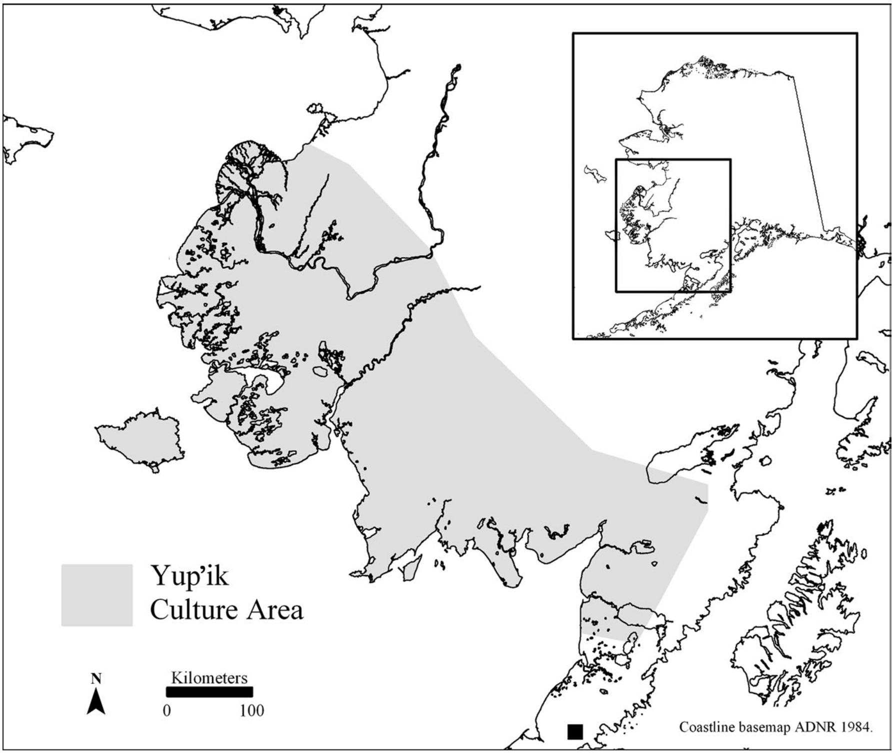


Figure 2.1. Yup'ik Alaska. Yup'ik territory includes a significant portion of western Alaska. Yup'ik cultures within the region are not uniform in language dialects, histories, religions, or memories except in the most general sense. The base data layer for this figure is taken from Alaska Department of Natural Resources (ADNR) 1984.

1984; Funk 2005; Pratt 1984a, 1984b; Figure 2.2). Movements among the camps and villages were motivated largely by seasonal shifts in resource availability (see Funk 2005 for a complete description of resource patterns). The subarctic delta landscape is generally homogeneous over thousands of square miles, but resources are seasonally present in discrete patches (Funk 2005). Some of the residential mobility may have been motivated by social processes (as in Whallon 2006). The Triangle area's Yupiit of history and prehistory engaged in intermarriage, cooperative subsistence, and shared ceremonial and social events, and they allied together to defend against and perpetrate raids on common enemies from the next nation to the north.

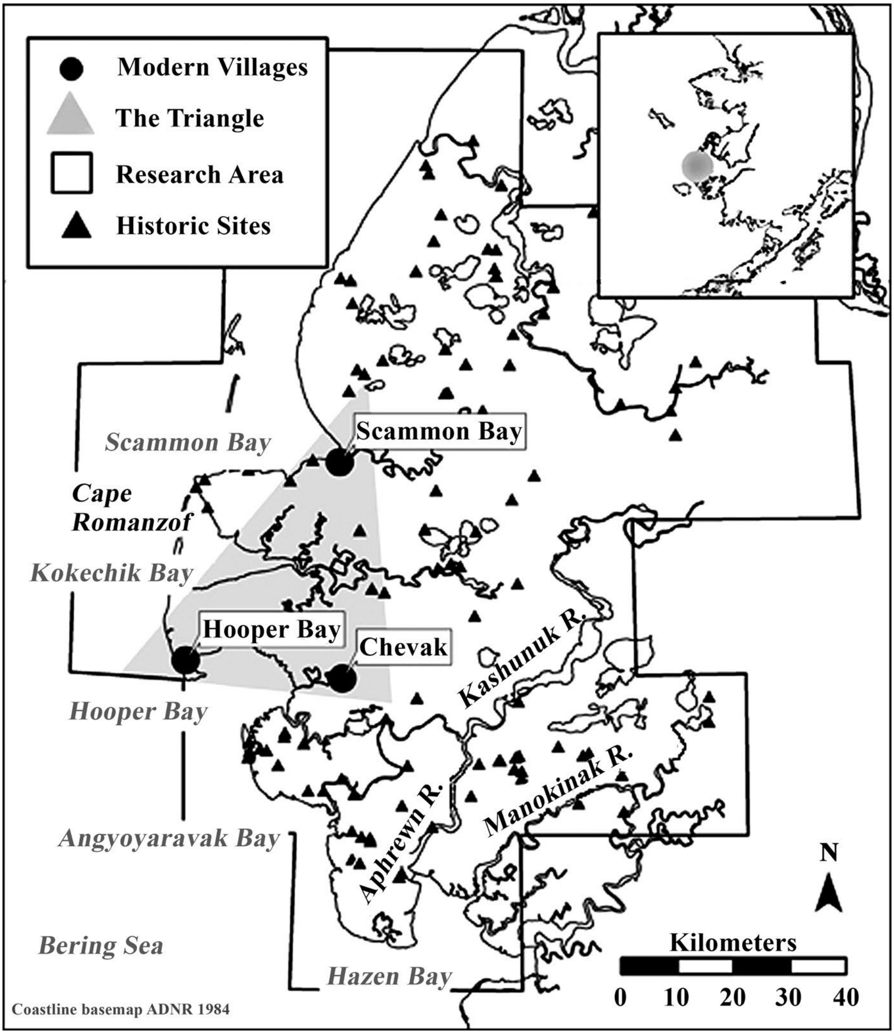


Figure 2.2. The Triangle Research Area. The Triangle area is in the center of Yup'ik territory and includes hundreds of camps and villages used and remembered by elders from the three modern villages in the region. The base data layer for this figure is taken from Alaska Department of Natural Resources (ADNR) 1984.

Any and all of these processes may have stimulated movement with motivation fundamentally different from subsistence requirements. Historic and prehistoric subsistence-oriented movement and social relationships required significant investments in information storage and transmission.

BIA ANCSA 14(h)(1) Investigation Results as a Data Source

Information is stored in Yup'ik men's and women's memories of places and events as well as in formalized oral traditions. It is transmitted within cultural contexts that include casual conversation, elder-to-younger-person speaking events, and deliberate information exchanges in the everyday process of life. In the late 1970s to early 1990s, Yupiit memory was elicited on specific topics and transmitted in a culturally alien context during the Bureau of Indian Affairs (BIA) Alaska Native Claims Settlement Act (ANCSA) 14(h)(1) investigations. The ANCSA investigations resulted in the recording of over 1,100 oral history tapes in the Yup'ik region, about 250 of which relate directly to sites and events in the Triangle area (Pratt 1992:76–77). A sample of 39 of these tapes from the 1983 season form the data set used in this study (Table 2.1). ANCSA investigation goals and processes deeply influenced the context of the oral histories because they targeted specific aspects of sites and required a non-Yup'ik communication process.

In 1971, the federal Alaska Native Claims Settlement Act granted 40 million acres of land in Alaska to newly formed Alaskan Native corporations (Pratt 1992:74; Pratt and Slaughter 1989:5). Section 14(h)(1) of this act allowed the for-profit Native corporations formed by the act to receive historical and cemetery sites as a portion of their land entitlement (Drozda 1995:100; Pratt 1992:74; Pratt and Slaughter 1989:5). The Native corporations had to apply for specific sites of historic significance or those that contained burials within their regions. In 1978, the BIA ANCSA Project Office was established to investigate the applied-for sites. ANCSA site application investigations included three components of research: archival, oral historical, and field. The oral historical portion of the investigations occurred while ANCSA employees lived in rural Native villages. Oral histories were recorded about events and activities that occurred at the applied-for sites, as well as about previous occupants of sites, seasons of site use, and the identities of any burials. The interviews were in Yup'ik and English, with local younger-generation men and women serving as translators. The oral history tapes offer challenges when they are included in empirical studies.

Oral histories are not simple data sets to be mined without regard for information context. Yup'ik oral histories are not static records of the past or of life procedures. They change content and focus according to context and the purpose to which listeners will put the information (Cruikshank

Table 2.1. ANCSA Oral History References

Interview Tape Nos.	Interviewees
83 VAK 002	George Paniyak
83 VAK 004, 005, 006	Joe Friday and George Paniyak
83 VAK 007, 008, 009	Joe Friday and Tom Jones
83 VAK 010	George Paniyak
83 VAK 011	George Paniyak
83 VAK 012	Robert Chayalkum
83 VAK 013, 014	Ulrich Nayamin
83 VAK 014	Leo Moses
83 VAK 014	Albert Atchak
83 VAK 019, 020	Lucy Tuluk and Angelina Ulroan
83 VAK 021	Aggie Ayagarak
83 VAK 022	Joe Friday
83 VAK 023	Joe Friday
83 VAK 024	Joe Ayagarak
83 VAK 025, 026	Joe Friday
83 VAK 027	Joe Friday
83 VAK 031B	George Paniyak
83 VAK 032A	Rosalie Paniyak
83 VAK 032B	Albert Ulroan
83 VAK 033A	Gregory Teve
83 VAK 033B	Dick Bunyon
83 VAK 036	Mary Chim
83 VAK 037, 038	Angelo Hoelscher and Magdaline Hoelscher
83 VAK 039	Dan Akerelrea
83 VAK 040	Francis Aguchak and John Amukon
83 VAK 041	Mike Joe
83 VAK 049	Edward Aguchak
83 VAK 053	Mike Simon
83 VAK 054, 055	Agnes George
83 VAK 056	Angelina Ulroan
83 VAK 057	Teddy Sundown and John Amukon
83 VAK 058	Jimmy Walker
83 VAK 059	Mike Simon
83 VAK 062	Buster Smith
83 VAK 063	George Moses
83 VAK 065	Thomas Moses
83 VAK 067A	Mathias James
83 VAK 067B	Nicholas Tommy and Jimmy Charlie
83 VAK 070	Thomas Moses

SOURCE: This set of ANCSA 14(h)(1) oral history tapes was recorded in 1983 from the Chevak base of operations (83 VAK). The tapes are on file at the BIA ANCSA Office, Anchorage, Alaska, and the Rasmussen Library Oral History Program, Fairbanks, Alaska.

1995, 1998; Fienup-Riordan 2007; Funk 2005; Morrow and Schneider 1995; Vansina 1985; among others). This means that data, which are small pieces of interpreted information taken from the oral histories, should not automatically become facts on their own, as they may lose significant meaning or even change meaning on extraction from context (but see Funk 2005:54–82 for a more extensive discussion of the Yup'ik ANCSA oral histories). However, by coding variables that attempt to categorize the context of information transmission, the tone of transmission, and details about the information transmitted on any given topic, oral history may be made more systematically interpretable. In such a process, the subtle and nuanced elements that usually prevent "fact" extraction are recognized and coded. Yet still there are concerns. The most significant limitation for the purposes of this study is that the topics discussed and the contexts of their discussion were not typical of Yup'ik communication processes. Thus, the *type* of information may not reflect Yup'ik conversational processes, and the context probably changed the emphasis of information presented, but patterns in information knowledge should represent Yup'ik information storage practices: men and women either know information or they do not.

The BIA ANCSA investigators performed interviews in the Triangle region from 1981 to 1985 during four field seasons. However, only the 1983 interviews were used in this study. The 1981 interviews reflect the inexperience of the BIA interviewees and the uncertainty of the local elders. The questions posed to the elders were either too direct and limiting or too vague and impossible to answer. The elders' uncertainty came through as responses designed to answer what they thought the BIA wanted to know or as questions to clarify what they were meant to talk about. The lack of consistency in the 1981 interviews made it difficult to define discrete communication events that could be coded. The 1984 and 1985 interviews, on the other hand, show signs of polished experience in the process. The BIA interviewers had clearly gained skill in communicating with Yupiit, and the elders recognized the legal ramifications of their answers sufficient to focus on transferring information directly relevant to the ANCSA 14(h)(1) requirements. Discrete communication events are clear in the later interviews, but the information transmission process was no longer effectively Yup'ik in nature. This change likely would render the information storage patterns invalid in terms of understanding hunter-gatherer information handling. The 1983 interviews were performed by experienced BIA ANCSA employees with Yup'ik elders who understood the process but were still communicating in their own style. Even so, the 1983 interview process was not entirely without problems.

The orientation and information-gathering interviews recorded early in the 1983 season provide a good example of the communication issues between ANCSA interviewers and Yup'ik elders. Several of the interviews focused on determining if graves were present at specific sites. The apparent goal of the BIA ANCSA crew was to work through a series of site names and locations and have local men and women simply state if graves were present, how many there were, and who was buried in them. Such a pointed discussion of cemeteries was not a conversation topic of interest to Yup'ik elders, and the interviews often failed to remain focused on the goal. In one notable interview with Mr. Joe Friday and Mr. George Paniyak (83 VAK 004-006), the interviewer made it successfully through three sites before the men abandoned the focus to discuss topics more interesting to them, such as subsistence use of the sites. Thus, ANCSA goals did influence the topics discussed in the interviews, but the influence was minimized by a natural tendency for Yup'ik elders to discuss their own interests first. During this particular example interview, the BIA interviewers grew obviously frustrated and began to ask pointed, abruptly toned questions about burials. Still, Mr. Friday and Mr. Paniyak persisted in mentioning domestic and subsistence use first. Their mention of graves occurred at the end of the segments as a somewhat offhand mention: "Sure, there are graves there." It is interesting now to see persistence in the transmission of information of cultural interest overwhelming the purpose of the ANCSA interviews, but it must have been exceedingly frustrating for the Yup'ik elders and the ANCSA interviewers.

EVOLUTION-BASED THEORIES AND HYPOTHESIS DEVELOPMENT

Several theoretical models guide this study of information storage and transmission: evolutionary psychology, the gendered division of labor, and social networks as a risk management technique. Evolutionary psychology models suggest that males and females develop markedly different foci in the gathering and curating of information about landscapes (Silverman and Eals 1992; Silverman et al. 2007). This perspective guides my hypotheses about the level of detail about landscapes stored by Yup'ik men and women. Economic and social models about the gendered division of labor also explain male/female differentiated behaviors that developed during evolutionary processes (Kelly 1995; Sanday 1981). These guide my hypotheses about the level of information detail curated by men and women with regard to domestic and subsistence tasks. Whallon's (2006) suggestion that the maintenance of social ties is an evolved response to risk guides my hypotheses about Yup'ik information storage with regard to how women store information about potential collaborative work partners.

Male/Female Psychological Spatial Predispositions

Evolutionary psychology models are based in the notion that sex differences in spatial cognition are related to mating processes and the sex-based division of labor (Silverman and Eals 1992; Silverman et al. 2007). Silverman and Eals suggest that polygynous male mammals must have the ability to navigate large areas so that they may seek mates (1992:533). They hypothesize that this need is related to the development of larger mammal (e.g., human) brains because of the increased complexity of controlling spatial data (Silverman and Eals 1992:533–534). There are two implications here: human men are inherently polygynous, and humans in general should have large brains with enhanced spatial information–handling abilities. The link to sexed (or, in cultural terms, gendered) differences in spatial information–handling abilities lies in the relationships among resource distributions, female aggregation habits, and the need to defend mates from male incursion (Silverman and Eals 1992:533–535). In their survey of mammal studies, Silverman and Eals found that if males concentrate on resource defense, females tend to be dispersed along with the resources, and if males concentrate on defense of mates, the females tend to live in clustered aggregations (1992:534). In the first scenario, it is possible that females would develop enhanced spatial information–handling abilities equal to those of males. Since their hypothesis assumes that humans are polygynous, and that females are defended mates who move to resources, and thus males and females logically should have equal spatial abilities, Silverman and Eals had to add the division of labor to their hypothetical model of evolved differences in spatial abilities (1992:534).

The modified human evolutionary psychology model relies on the assumption that human men tend to hunt while human women tend to forage (Silverman and Eals 1992:534). Even if women move about the landscape, they should orient to resource patches, while men have information about expansive landscapes for hunting purposes and to defend against outsider incursion. The development of the ability to acquire and store information about prey and the landscape is linked to male use of broad landscapes. The development of detailed knowledge and stored information about smaller spaces is linked to female use of patches that are limited in size even if far from one another. Females are aggregated in the resources, and both are defended simultaneously. Silverman and Eals's tests suggest that American male and female college students' cognitive abilities support this model. Men have a stronger ability to orient themselves to visible or abstract locations in memory or while in motion (Silverman and Eals 1992:534–535; Silverman et al. 2007). Women have an enhanced ability to remember details of an "array" of objects and can recollect "incidental" objects not directly related to their main focus (Silverman and Eals 1992:535).

These human psychological predispositions, if real, should be evident in gender-specific hunter-gatherer information about landscapes and smaller spaces such as subsistence camps or specific resource patches. Of course, patterned similarities to the model should only be expected if the hunter-gatherers in question are polygynous and have a gendered division of labor similar to that described in the model. In fact, Yup'ik families were sometimes comprised of polygynous spouses, and men did perform most of the broad-scale activities in the era of traditional subsistence practices (Fienup-Riordan 1983, 1986; Funk 2005). Thus, Yup'ik men should have more information in higher levels of detail about broad landscapes than Yup'ik women. Men should have greater abilities to read maps, to describe locations in the abstract and with real-world referents, and to actually physically navigate the landscape (as in Silverman and Eals 1992). According to the model, Yup'ik women are expected to store and transmit highly detailed information about specific patches at particular camps and villages. They should curate seemingly unrelated information about other details of camps and villages as well. They should have information in low levels of detail about landscapes in general, and about movement about the landscape.

Gendered Division of Labor

If the gendered division of labor relates to spatial perceptions and associated landscape knowledge and information, it may affect information on other topics as well. I suggest that information on *all* topics is stored according to the gendered division of labor. The organization of labor within any hunter-gatherer culture should deeply influence which gender stores any given type of information and at what level. Thus, the categories of information remembered by men and women are directly related to the tasks performed by each in the context of the unit of production, which for traditional hunter-gatherers, including the Yupiit, was the nuclear family or occasional polygynous family (Frink 2003; Kelly 1995:265; Sanday 1981). Among the Yupiit, a dual sex configuration was (in the past) and is (now) typical: men and women perform complementary and equally essential tasks (Sanday 1981). If information storage is framed according to gendered economy, men and women in hunter-gatherer cultures should not be ignorant of the other's information, but it should not be their main focus. Additionally, men and women are expected to use different physical cues as mnemonics (as in Wilson 1995:176–177). Yup'ik men should have more detailed information about hunting, fishing, trapping, and processes related to male subsistence responsibilities that tend to be performed individually or with partners. Yup'ik women should have more highly detailed information about on-site subsistence processes such as berrying, fishing, fish processing, and other cooperative food-production activities. Their information about on-site domestic activities should be in much higher detail than the men's knowledge.

The mode of production may be more than an economic model in that it functions also to maintain social relations (Ingold 2000; Kelly 1995:31). If this is true, it is possible to link gendered storage of information to risk mitigation, because social relations seem to be an essential aspect of hunter-gatherer risk management (Whallon 2006). Yup'ik women might be expected to remember details about marriages and genealogical relationships, since they often function in cooperative work groups comprised of related females (Fienup-Riordan 1983, 1986; Frink 2003, 2007). Knowledge of genealogical relationships can be measured by information about burials. If the labor model does explain patterns in gendered information storage, Yup'ik women should remember significantly greater details about burials than Yup'ik men.

In the Yup'ik world, burials are distinctly marked and recollected through many generations. In terms of the model, this acts as remembrance of relative obligations that transcend the living and incorporate the long-dead. The process is echoed in Yup'ik naming conventions, where names are derived from recently deceased community members and relatives (Fienup-Riordan 1983); in fact, the two processes, grave memory and naming, probably serve the same function with regard to social networks. Male and female memories of historic events such as festivals, shamanic activities, games, and war operate as a long-term record of past obligations, cooperation, and alliances. This is social network maintenance, and if linked to the mode of production and evolutionary processes, gendered patterns in information storage on these topics should be evident.

TESTING HYPOTHESES

Hypotheses derived from evolutionary psychology and economic models are tested below with data drawn from the BIA ANCSA oral history interviews. I expected to find that Yup'ik men and women controlled remarkably different information categories, and that overlap in knowledge categories was distinctly different in the level of detail or confidence in the information. Men and women should store information closely related to their gendered psychological predispositions and economic responsibilities. But none of these expectations were universally upheld, and the counterintuitive results demonstrate a far more conservative and shared approach to information storage and transmission than I anticipated. However, before any patterns could be discovered, the oral history information had to be transformed into comparable, quantifiable data.

I defined a series of eleven variables that derived from the hypotheses and seemed likely to be related to the topics typically addressed in the oral histories (Table 2.2). In addition, I recorded the order in which topics were mentioned in the interviews, the gender of the interviewee, and the level of doubt

Table 2.2. Variables

Categorical Variables*	Other Data Collected
Landscape	Level of doubt
Travel	Order of mention
Subsistence	Interviewee gender
Cemetery	
Chronology	
Domestic organization	
Historic event	
Reference	
Knowledge	
General information	
Life history	

* Eleven variables were coded according to level of detail provided in the interviews. Reference, life history, and general information variables did not occur sufficiently often to provide a statistically valid sample, but they do demonstrate the process of information communication among the community members and across generations.

expressed by the interviewee. I compared the variables using summary statistics and the chi-squared test (χ^2). Finally, I drew qualitative anecdotal statements from the oral history interviews to support observed patterns or to demonstrate conscious Yup'ik awareness of the patterns revealed.

The coded categorical variables synopsized the information in the oral history interviews so that it could be directly compared in an empirically meaningful manner. But since there are relatively few interviews, statistically speaking, and interview lengths range inconsistently from a few minutes to several hours, I divided the interviews into segments. Each interview consists of a series of conversations that are divided by natural breaks in Euro-American and Yup'ik communication styles or by shifts to new site locations. I used these breaks to define discrete segments within the larger interviews. Each segment was coded as a single communication event. Within a single communication event, each topic mentioned was recorded and coded as an independent moment of information transmission. For example, in interview 83 VAK 002, Mr. Paniyak communicated in 25 separate topical segments: segment A included four different items of information (subsistence, chronology, chronology, cemetery), segment B included three (subsistence, subsistence, cemetery), and so on. Thus, each of the longer interviews includes many information transmission segments, which can be compared. The study data population was derived from 39 interviews, with 361 interview segments and 1,483 moments of information transmission.

The variables were coded according to strict definitions. Any mention of graves or death was coded as *cemetery*—and there are many cemetery codes, because ANCSA 14(h)(1) specifically includes the preservation of cemetery places, which drove interviewers to target this topic. Seasonal use of any place, or mention of resources or subsistence-related activities, were coded as *subsistence*. The *domestic organization* category includes organization of sites, use of sites, and names of people who lived at specific places. Any indication of timing of events was coded as *chronology*. Site names and locations, names of waterways, physical characteristics of the landforms, and changes in landforms were all coded as *landscape*. A *knowledge* code indicates that the interviewee was stating the source of his or her information or the level of knowledge. "I don't know about that" was also coded as *knowledge*. If the name of another, more expert person is indicated in the interview, this was coded as *reference*. *General information* and *life history* codes were used to categorize personal life events or more universal cultural events and processes not clearly related to the other categories. The articulation of site-associated or time-period-associated concrete events was coded as *historic event*.

The occurrence of different information categories is important to the analysis, but the level of detail given on any topic more clearly illustrates who, as in what gender and what individual, stores information of different types. For example, I can describe the process of changing a tire in excruciating detail (unfortunately), while my colleague knows that tires can be changed and is almost certain there are instructions in his car manual. The topic is the same; the level of detail reflects a significant difference in information storage because of our differing exposure to the subject. To capture this difference in Yup'ik information storage, each of the topical variable codes was assigned a level of detail: *high*, *medium*, *low*, *neutral*, and *reference*. A reference code indicates that an interviewee specifically indicated who else might have information on the topic. Neutral information indicates a negation: no graves present or no site present, but not "I don't know." Low-level information consists of a basic mention of the topic; graves are present, that place has houses, it is old, and the like. A lack of knowledge is considered a low level of detail. High detail levels include names of individuals who occupied a site or were buried there, locations of individual dwellings and burials, exactly when in years or cultural-age terms a place was used, locations of intrasite domestic activities, and exact targets of subsistence activities at a site or in an area. Medium-level details are numbers of houses or graves, seasons of use, generation-level time frames, or general subsistence activities.

Each interview segment was also coded for security of knowledge. Yup'ik communication style requires that one speaks only about that which one knows (Fienup-Riordan 1982:256–260). Additionally, it is important to state the source of the information being transmitted. This is not a culture of speculative knowledge, and so it was possible to determine the security of the information in the interview segments. Interviewees were coded as having *no doubt* or being *maybe sure*, *doubtful*, or *without any knowledge* for each segment. Individual topics within the segments were not coded, because while information surety is a common nuance of the interviews, it did not appear with sufficient detail or consistency to permit such fine-grained coding.

In the study sample interviews, 31 elders spoke, of whom 7 (about 22%) were women (Table 2.1). This male-to-female ratio roughly matches the entire oral history sample for the region over the four years of investigation: 79% of the interviews were held with men overall. Many of the 1983 interviews were held with one particular elder, Mr. Joe Friday, alone or with another elder man or two. As discussed later in the chapter, Mr. Friday seemed to be unique in the robustness and richness of his information storage. He, and a few men like him throughout the Yukon-Kuskokwim Delta, retained such a complete history of his people and landscape that he forms his own category in this study. Only six (19% of the sample interviews) of his 1983 interviews are included in the study.

The first level of analysis included listening to interviews and reading transcripts. During this first phase, I coded the variables and noted general patterns and Yup'ik perceptions of information storage. The second phase of analysis entailed simple summary statistics. For each variable, the percentage of high, medium, and low level of knowledge codes were calculated (Table 2.3). To check for significance, each variable's knowledge-level codes for men and women were compared using the χ^2 statistical test for significant difference (Table 2.4). This test functions particularly well for categorical variables, although a few of the chi-squared tables do include cell values less than 5, which is not ideal. Chi-squared strength tests indicated that none of the relationships were particularly strong; all values were under .05, when values indicating a strong relationship should be closer a value of 1. The analysis reveals general trends rather than strong causal patterns.

Genders Store Different Information and Information Differently

Yup'ik men and women believe that they store different information from each other, and summary statistics and the chi-squared test sometimes support this notion. However, do Yup'ik men and women store information according to the roles defined in evolutionary psychology and the gendered division of labor, including those tasks linked to maintaining social networks? Do men and women store information differently with regard to geographic locations, and at different levels of detail? The answer to both is yes: most of the time they do, but not always as expected.

Landscapes

Yup'ik men and women both link information to geography most of the time; information is associated with specific camp or village locations and geographical regions. This practice is demonstrated in the changing style of the BIA ANCSA interviews. When reviewed in chronological order, it is clear that during the earliest interviews (the 1981 interviews), BIA investigators failed to make strong geographic links between *what* they wanted to know and *the place* they wanted to know about. They did not acquire consistent camp or village site information. In later seasons, the interviewers

Table 2.3. Summary Statistics

Variable	Gender	Level of Detail	Times Mentioned	%
landscape	women	high	9	28.13
	n = 32	medium	10	31.25
		low	11	34.38
		reference	2	6.25
	men	high	73	53.68
	n = 136	medium	40	29.41
		low	16	11.76
		neutral	2	1.47
		reference	5	3.68
travel	women	high	9	90.00
	n = 10	medium	1	10.00
	men	high	20	39.22
	n = 51	medium	24	47.06
		low	7	13.73
subsistence	women	high	20	42.55
	n = 47	medium	26	55.33
		low	1	2.13
	men	high	118	62.11
	n = 190	medium	71	37.37
		low	1	0.53
cemetery	women	high	21	46.67
	n = 45	medium	7	15.56
		low	17	37.78
	men	high	47	24.10
	n = 195	medium	44	22.56
		low	90	46.15
		neutral	13	6.67
		reference	1	0.51
chronology	women	high	15	62.50
	n = 24	medium	3	12.50
		low	6	25.00
	men	high	76	47.80
	n = 159	medium	24	15.09
		low	56	35.22
		neutral	3	1.89
domestic organization	women	high	18	60.00
	n = 30	medium	10	33.33
		low	2	6.67
	men	high	134	68.02
	n = 197	medium	48	24.37
		low	13	6.60
		neutral	2	1.02
historic events	women	high	4	36.36
	n = 11	medium	3	27.27
		low	4	36.36
	men	high	40	54.05
	n = 74	medium	17	22.97
		low	17	22.97

NOTE: Men and women store and transmit information about different topics at different levels of detail most of the time.

Table 2.4. Chi-squared Test Results

Variable / Level of Detail	Men Actual (Expected)	Women Actual (Expected)	χ^2 Probability (p)
Landscape (n = 159)			
high	73 (66.53)	9 (15.47)	0.00272
medium	40 (40.57)	10 (9.43)	
low	16 (21.91)	11 (5.09)	
Travel (n = 61)			
high	20 (24.25)	9 (4.75)	0.01284
medium	24 (20.90)	1 (4.10)	
low	7 (5.85)	0 (1.15)	
Subsistence (n = 237)			
high	118 (110.63)	20 (27.37)	0.03716
medium	71 (77.76)	26 (19.24)	
low	1 (1.60)	1 (.40)	
Cemetery (n = 226)			
high	47 (54.46)	21 (13.54)	0.0242
medium	44 (40.85)	7 (10.15)	
low	90 (85.69)	17 (21.31)	
Chronology (n = 180)			
high	76 (78.87)	15 (12.13)	0.0669
medium	56 (51.13)	3 (7.87)	
low	24 (26)	6 (4)	
Domestic organization (n = 224)			
high	134 (131.45)	17 (1.55)	0.51347
medium	48 (50.49)	10 (7.51)	
low	13 (13.06)	2 (1.94)	
Historic event (n = 85)			
high	40 (38.31)	4 (5.69)	0.50935
medium	17 (17.41)	3 (2.59)	
low	17 (18.28)	4 (2.72)	
Doubt (n = 301)			
doubtful	11 (15.09)	8 (3.91)	0.00582
maybe	48 (53.2)	19 (13.80)	
no doubt	180 (170.71)	35 (44.29)	

d.f. = 2

NOTE: With the < .05 significance rule, five of the eight tests run show a relationship between gender and level for detail on any given variable.

were prepared with maps, site names, and site visits; the interviews were longer and included far more detail, or the interviewee referred the interviewers to someone considered expert in knowledge of that site's area. This means that Yup'ik men and some women use site locations as mnemonic devices to retrieve stored information about specific places. This is called *landscape queued memory* (Hiss 1990; Wilson 1995), and it is no surprise that

Yupiit as hunter-gatherers perform this process. Not all Yupiit do it the same way, though, which leads to the current set of hypotheses.

According to the evolutionary psychology models, if Yupiit are polygynous mammals, with men who are mobile and protect resources (including women), and if Yup'ik women gather more than they hunt while Yup'ik men hunt more than they gather, then:

1. Yup'ik men should store information about broad landscapes and movement about those landscapes;

2. Yup'ik women should store information about more restricted if spatially separate landscapes; and

3. both should have knowledge of subsistence resources and activities.

Thus, men should store and transmit highly detailed information about landscapes, travel, and subsistence. Women should store and transmit highly detailed information about domestic organization and subsistence, and low-level details about broader landscapes and travel. These expectations are upheld, but not always exactly as predicted.

Yup'ik men transmit highly detailed landscape information more often than women (54% to 28% of the time, respectively; Table 2.3). Men present low-level detail information about landscapes far less often than women (12% to 34%, respectively; Table 2.3). This pattern holds as significant under the chi-squared test ($p = .0027$; Table 2.4), suggesting that the information storage and transmission process is gendered with regard to landscape information. Information about traveling throughout the landscape is stored somewhat differently than expected. Women provide highly detailed instructions about how to get from place to place almost every time the topic arises (90% of their travel information is highly detailed, although it is infrequent, occurring only 10 times in all 1,483 information transmission incidents; Table 2.3). Men provide mostly high and medium levels of detail in travel information and more rarely low-level details (Table 2.3). Again, the relationship is significant under the chi-squared test ($p = .0128$; Table 2.4), but it defies model expectations. Men provide highly detailed information about subsistence more often than women (62% to 43%, respectively; Table 2.3), although both provide very little low-level information about subsistence activities (Table 2.3). The difference also is significant with the chi-squared test ($p = .0371$; Table 2.4). So, men have more information about landscapes, women have less but express greater detail in travel about the landscape, and both genders store detailed information about subsistence, although men have more highly detailed information.

Anecdotal evidence drawn directly from the interviews suggests further nuances in landscape-oriented information storage among men and women. Women have a particularly interesting approach to landscapes and travel. When faced with a map, most Yupik women interviewed made thinking noises over the maps, murmuring to themselves and to each other. Some women just did not understand the idea of the maps. Mrs. Agnes George, when asked in her interview to describe sites by name or by their place on the map, said, "Look, I just don't know this," or "it is so confusing," and "I can't recognize . . ." (83 VAK 054–055). When Yup'ik women did link information to camps and villages, they tended to present information about sites in terms of that camp's or that village's place in the seasonal round. They also tended to give specific directions on how to get there not by river name or cardinal direction, but by descriptors, as in "go through where they dip net fish" (Agnes George in 83 VAK 054–055). The infrequency of their travel knowledge makes sense, as Yup'ik women never traveled about the landscape without men, unless they were the only survivors of a raid, and even then they were inclined to wait for a passerby. If they did have to travel alone, it was a careful process of picking their way across a vaguely known greater landscape to familiar smaller spaces. This pattern is in accord with the evolutionary psychology spatial model which predicts that women have poor general landscape information, have excellent subsistence information, and can effectively travel from patch to patch by using other patches as landmarks en route. It is an interesting manifestation of the expected patterns.

The notion of information storage predispositions and gendered information is familiar to local Yup'ik elders. In a far simpler analysis than the one laboriously created here, Mr. Albert Ulroan states that for men and site information, "reading a map helps but if he knows Eskimo names a man remembers. Woman remembers only one spot and no where around" (83 VAK 032B). Gendered mnemonic devices and psychological predispositions are expected elements in Yup'ik information handling, both in theory and in popular perception.

In contrast to women, men generally were deeply knowledgeable about the landscapes of their family and of their personal experience: they recognized places on maps and described travel in terms of named landmarks such as rivers, hills, or portages. At local regional scales, Yup'ik men remembered site-specific information about seasonal subsistence resources, variations in resource abundance or quality, travel routes to camps and how they have changed in the past generation or two, other men who have nearby camps, the presence of ancient camps and villages, and how acts of war were perpetrated in each area. However, their knowledge of subsistence and camps and villages stopped outside of their immediate use area most of the time. In defining the limitations of their information, men made statements about how often or how long ago they traveled to or through a particular area—as, for example, Mr. Mike Simon traveling "a certain river, so has some knowledge of the area" (83 VAK 053). (Women tended to say how many years they used a particular subsistence camp to indicate depth of knowledge.)

When men in the interviews reached the geographic limit of their knowledge, they referred the interviewers to men who used the surrounding areas. In evolutionary terms, this means Yup'ik men had *complete* information for their immediate area and the social networks to get information about other areas (Kelly 1995:97–98; Smith 1991; Whallon 2006). A good example of the reference process and completeness of knowledge can be found in interview 83 VAK 014, when Mr. Ulrich Nayamin states that he "is not too sure of this area. . . . Joe Friday would know more about this," and "Joe Friday stayed around this area all through when he was a boy." In 83 VAK 033A, Mr. Gregory Teve suggests that John Nash will know a site or an area because "he has been everywhere." Mrs. Aggie Ayagarak, in interview 83 VAK 021, makes what might be a significant distinction between men's and women's information. She is suggesting possible sources for information about different areas, and she clearly states that Joe Friday and her husband *will* know about two areas, and that her mother *might* know about another area. The difference between the genders referenced might be coincidental, but the remarks come in fast succession in the interview, suggesting that there is a cognitive, accepted difference in the landscape- and site-based information stored by men and women.

Labor and Social Networks

Surprisingly, men and women share the responsibility of storing information about domestic organization and history, but information about burials and the timing of events is stored and communicated differently for men and women. According to the models of gendered division of labor and social network maintenance, if Yup'ik men and women have separate economic tasks that focus on acquisition (men's hunting, fishing) or processing and household maintenance (e.g., women's butchery, storage, child care, clothing and goods production), and if these tasks are individualized or in partnerships for men and cooperative groups for women, then:

1. Yup'ik men should store information about subsistence resources and social relationships; and

2. Yup'ik women should store information about domestic organization, subsistence resources, and social relationships.

Thus, men should store and transmit highly detailed information about subsistence resources. They may store information about social networks in the form of knowledge about burials, the timing of use of areas, and the history of places. These information categories may be less expansive for men than for women, since Yup'ik men cooperate with fewer individuals than Yup'ik women and are exposed to fewer contacts and fewer opportunities for communication (Whallon, Chapter 1, this volume; Fitzhugh et al., Chapter 4, this volume). Further, their labor tasks may not require a fine-grained knowledge of heritage. Similarly, men are not expected to store much information about on-site domestic organization. Women should store and transmit highly detailed information about domestic organization, subsistence, and any categories associated with maintaining cooperative relationships, such as burials, histories, and timing of use of places by individuals. It is expected that women will store and transmit a greater variety of information at higher levels of details at this scale. According to both the evolutionary psychology and gendered division of labor models, women should control a vast amount of information at the site, rather than the landscape, scale. These expectations are not supported uniformly, and in fact men store much of the site-level information, resulting in a duplicate record of subsistence at the site level and social relationships over time and space.

Subsistence information is stored at high and medium levels of detail by men and women, as discussed above. At the site level, men remembered what subsistence resources were harvested in what season, particularly concentrating on fish, trapping, or berries. They also spoke about trends in the availability of these resources. Women, unsurprisingly, also had information about what resources were available, but women tended to concentrate on fish, sea mammals, and berries. Both men and women transmitted information about on-site processing areas and storage areas. The curation of subsistence information by both genders at such high levels, regardless of theoretical model predictions, conforms to conclusions of earlier research focusing on Yup'ik subsistence and site location (Funk 2005). During that work, a conservative approach to subsistence was demonstrated in defiance of evolutionary models that called for slightly more risk for higher gain (Funk 2005). If men and women share and duplicate the burden of storing information about subsistence at landscape and site scales, it is another manifestation of the conservative approach to risk minimization. However, their shared information about domestic organization is less easily explained.

Yup'ik men store highly detailed information about the organization of camps and villages more of the time than women (68% and 60% of the time, respectively; Table 2.3), but there is no significant difference in the level of detail for this topic ($p = .51347$; Table 2.4). Both men and women mostly transmit highly detailed information about domestic organization; and of their information about who used sites, families who lived in specific houses, and events and processes that occurred in specific site areas, only 6% was at a low level of detail (Table 2.3). This is contrary to expectations: men were expected to curate far less information on these topics than women.

The highly detailed domestic information storage by Yup'ik men is contrary to intuitive and anecdotal explanations as well. Yup'ik men do not profess to be experts on domestic organization and activities. For example, Mr. George Paniyak bluntly states that he "knows rivers but not sites" (83 VAK 031B). Similarly, Mr. Dan Akerelrea "doesn't look for graves when he travels" (83 VAK 039), nor does Mr. Gregory Joe (83 VAK 041). However, men and women don't store exactly the same kinds of information about places and heritage. Yup'ik women tended to produce information about individual use of houses, graves, and storage or processing areas. Women knew who lived in what house, where everyone was buried (and what they died of and when), how people were related, and what areas of the site they generally used. Men weren't ignorant of these details but tended not to focus on family histories or processing areas; instead they knew more reliably where particular men used to tie their dogs or store their kayaks. However, men did provide details on what might be expected to be women's topics, and did so regularly. There seems to be little gendered difference in the storage of domestic information at this scale, despite model and anecdotal predictions.

The storage of information required to maintain social networks is another burden shared by men and women, when the task is measured by the storage of information about burials, historic events, and the timing of past events and site use. However, women curate more information than men in this category. Women transmitted highly detailed information about cemeteries far more often than men (47% and 24% of the time, respectively; Table 2.3). Men remembered low-level details about graves most of the time (46%; Table 2.3). The gendered difference in level of detailed information on this topic is significant ($p = .0242$; Table 2.4), suggesting that women do control more information about heritage than men. This conforms to expectations built on the labor and social network model, which assumes that women work in cooperative groups and thus store more information about potential labor collaborations.

Similarly, women tend to give more precise timing for past events than men; they transmit highly detailed information 62% of the time, while men do so only 48% of the time (Table 2.3). This difference is just beyond acceptable significant limits ($p = .0669$; Table 2.4), but it is close enough to be suggestive of a gendered difference in information storage on this topic. The style of expression used to indicate timing of events is different for Yup'ik men and women in the oral histories as well. Women related events precisely to childhood, marriage, childbirth, or deaths. This creates a fairly clear sense of timing. Men were precise in chronological expression, but relied less often on life events. Instead, they tended to calculate absolute years with reference to global events such as wars or epidemics. Men were also far less precise in their use of generation timing and were prone to using the simple reference of "old." Again, the highly detailed information on chronology stored by women relates to heritage information and the maintenance of social networks to promote cooperative relationships.

Information about historical events is transmitted at similar levels of detail for men and women (Table 2.3). Both genders transmit and store information at high levels of detail more than medium and low levels of detail, and men tend to have highly detailed information more of the time than women (54% and 36%, respectively; Table 2.3). There is no significant difference in the storage of this information ($p = .50935$; Table 2.4), furthering the notion that it is a shared burden. However, like information about domestic organization, historical events that occurred at sites are remembered differently by men and women. Women remembered the food served, the families present, the games, songs, and dances, and more of the mystical tales of non-human beings. Men talked about competitions at the festivals, especially remembering physically strong or fast individuals. They focused on the dance masks and spectacles performed by shamans as well as shamanic battles, and maybe this is related to the fact that shamans were mainly active in the men's house, a place that Yup'ik women occupied episodically rather than typically. Men also spoke about site-specific events pertaining to the Bow and Arrow War days—how particular places were raided, which were safe, or which were vulnerable—while women mentioned these topics with less detail (see Funk 2010 for a thorough discussion of the war era).

The models based on division of labor and maintenance of social networks do roughly predict the patterns we see in gendered information storage, in that women do store more information about heritage than men. But, both men and women store and transmit information about subsistence, domestic organization, and historic events. This suggests that Yupiit information storage creates a replicable, redundant, and conservative knowledge-base that probably reduces risk. Another marker of conservative information storage may be the surety of the information. How doubtful of their information are men and women?

Doubt

Yup'ik men and women do not discuss what they do not know according to cultural communication rules. Measures of doubt should indicate a strong emphasis on surety, and in fact, men and women have no doubt about their information most of the time (72% and 56%, respectively; Table 2.5). If they combined their information, as in interviews that included both men and women, the level of surety increased (to 74% no doubt; Table 2.5). However, women were more willing to transmit doubtful information than men (13% and 4% of the time, respectively; Table 2.5), a difference that is significant in the chi-squared test (p = .00583; Table 2.4).

Table 2.5. Doubt

	Women (n = 63)		Men (n = 249)		Both (n = 39)	
	Count	%	Count	%	Count	%
No doubt	35	55.56%	180	72.29%	29	74.35%
Maybe	19	30.16%	48	19.28%	7	17.95%
Doubtful	8	12.70%	11	4.42%	1	2.56%
Don't know	1	1.59%	10	4.02%	2	5.13%

NOTE: Men and women expressed doubt in blunt statements and in tone of voice.

The level of doubt is an imprecise measure at best, particularly since it was coded for entire segments and not individual information transmissions. Even so, if we take the first topic mentioned in any given segment as the main subject, it is possible to glimpse what men and women were sure of and on what information topics they were willing to transmit doubtful information. Of the variables discussed above, only information about cemeteries was doubtful for men and women to any interesting percentage. Men were willing to express doubtful information about graves five times, or 8% of the time, and women were willing to do so once, or 6% of the time. Otherwise, most of the information transmitted was coded as maybe or no doubt for the key variables. The exceptions are that men expressed doubt four times (13% of the time) for landscape information and once (4% of the time) for historic events. This means that for subsistence, chronology, domestic organization, and travel explanations, Yup'ik men and women were pretty sure of their information, or they did not transmit it.

Not Merely Psychology, Labor, or Social Networks, but Comprehensive Knowledge?

One man, Mr. Joe Friday, was interviewed far more than any other individual in the 1983 and other BIA ANCSA 14(h)(1) field investigation seasons. Mr. Friday was targeted so often because he and one of the BIA interviewers developed a deep friendship, but also because he had seemingly complete knowledge of the entire region. He had information about most camps and all large villages, and he knew who typically used each area for what purpose and in what season. Mr. Friday was a traveler; he moved about the landscape from a young age, alone or with a hunting partner, to visit and just see. He also employed specific memory devices to maintain the information he acquired. He said that he keeps his memories ordered by location: "[H]is memory of this history is like pages. Get him to an area and he'll turn to that page [translated by Leo Moses]," and "the memory of life is never to be forgotten" (83 VAK 022). Mr. Friday often stated the origin of his information during the interviews, a typical Yup'ik technique, but he is certainly the most prolific referencer. In a general statement of how he knows about old sites and activities, he said: "[I]n those days, when people talk about old places, they would talk about where their locations were and what was in the village and the incidents that occurred in that place" (83 VAK 022). Mr. Friday obviously listened and remembered.

Other Yup'ik men used landscape cues as well. Mr. Dan Akerelrea stated that he "needs to see spots to describe or remember them" (83 VAK 039). This theme was echoed by other interviewees (83 VAK 040). Their mnemonic devices were the sites or landscapes themselves. Other men were less inclined to commit some information to memory: Mr. Angelo Hoelscher said that when he was young, he was too busy "running errands," and he didn't hear most of the old stories (83 VAK 037–038). Mathias James simply stated that "he was not particularly interested in old places and graves when he was growing up, so he is not sure about some things" (83 VAK 067A).

Mr. Friday's information breadth and depth is unique among Yup'ik men, but his role of gathering broader-scale information may be typical and necessary in all hunter-gatherer cultures (see Fitzhugh et al., Chapter 4, this volume). His information seems so deeply detailed on all of the topics measured in this study that his interviews may have skewed the results of the analysis. It appears that he defies any age or gender divisions in information retention and transmission. However, it is possible this perception is incorrect, as other elder Yup'ik men were not as certain that Mr. Friday knew it all. Many men and women suggested that Mr. Friday would know about a place, an area, or an event, but others were less confident in his knowledge. At least once he was openly derided for saying a place was mounded by foxes and not by people building houses (Mr. Paniyak in 83 VAK 031B). And again in interview 83 VAK 065, Mr. Thomas Moses was amused that Joe Friday claimed to know a particular area.

Several of Mr. Friday's 1983 interviews were not coded as part of the study. As described above, it seemed likely that this one man's prolific knowledge would alter the results of the study, and even if his knowledge was not remarkably detailed on all topics, there is no reason one man's information should have formed the bulk of the sample. When Mr. Friday's information was removed from the general data set, some interesting patterns were evident, although the gendered differences noted above still stand, as the statistics demonstrate.

Mr. Friday's interviews yielded 342 coded moments of information transmission (Table 2.6). At 23% of the total number of incidents coded, this is a formidable portion of the sample. If his information was uniquely gender-neutral in its comprehensiveness, there should be noticeably high frequencies of high-level information for male- and female-dominated variables such as landscape and cemeteries. Rather interestingly, this is not the case.

Table 2.6. Mr. Friday's Information Transmissions

n = 1,483	No. of Transmissions	% of Sample
Mr. Friday	342	23.06%
Men	777	52.40%
Women	237	15.98%
Both	127	8.56%

NOTE: While coding the variables, it seemed as though Mr. Friday's interviews were more thorough and contained a higher number of information transmissions than other interviews. This is true: Mr. Friday's six interviews make up 23% of the coded information transmissions.

Earlier in the study, the landscape variable was shown to be male dominated in that men transmitted the highest level of detail about landscapes more often than women (Tables 2.3, 2.4). Mr. Friday transmitted highly detailed information more often than the rest of the men combined, and far more often than women (67%, 52%, and 30% of the time, respectively; Table 2.7). He transmitted low-level information even less often than the rest of the men (5% and 16% of the time; Table 2.7). Comparing Mr. Friday's information level about landscapes with that of other men and with that of women, we find significant differences (p = .0041; Table 2.7). Yet, there is no significant difference between Mr. Friday's landscape information when compared only with that of the rest of the male sample (p = .1244; Table 2.7), and there is a significant difference between Mr. Friday's information and women's information (p = .0007; Table 2.7). This suggests that Mr. Friday's landscape information is more like hyper-male, high-detailed knowledge, rather than a combined male and female knowledge about landscapes. He is different from other men in the high level of detail for many landscape areas.

Tested against a female-dominated variable, Mr. Friday's information does not appear so comprehensive. In the earlier tests, women's highly detailed information dominated the cemetery variable, and the difference was significant (Tables 2.3, 2.4). In this comparison, Mr. Friday is outperformed by the other men in the sample: he has fewer incidences of highly detailed information (23% to their 29%; Table 2.8) and more incidents of low-level detail than the other men (57% to their 43%; Table 2.8). Both male categories have fewer incidences of high-level detail than women (47% for women; Table 2.8). The differences among the men and women are significant in the chi-squared test (p = .02657; Table 2.8). Once again, there is no

Table 2.7. Mr. Friday's Scores on a Male-Dominated Variable

	Friday Actual (Expected)	Men Actual (Expected)	Women Actual (Expected)	χ^2 Probability
n = 159				
high	28 (21.66)	45 (44.87)		0.004114
medium	12 (13.21)	28 (27.36)		
low	2 (5.21)	14 (14.77)		
n = 129				
high	28 (23.77)	45 (49.23)		0.1244
medium	12 (13.02)	28 (26.98)		
low	2 (5.21)	14 (10.79)		
n = 72				
high	28 (21.58)		9 (15.42)	0.0007
medium	12 (12.83)		10 (9.17)	
low	2 (7.58)		11 (4.42)	
	Friday (n = 42) Count (%)	Men (n = 87) Count (%)	Women (n = 30) Count (%)	
high	28 (66.67%)	45 (51.72%)	9 (30.00%)	
medium	12 (28.57%)	28 (32.18%)	10 (33.33%)	
low	2 (4.76%)	14 (16.09%)	11 (36.37%)	

NOTE: In earlier statistics, the landscape variable showed that men transmit the highest level of detailed information to a significant degree. Mr. Friday's scores are comparable.

Table 2.8. Mr. Friday's Scores on a Female-Dominated Variable

	Friday Actual (Expected)	Men Actual (Expected)	Women Actual (Expected)	χ^2 Probability
n = 226				
high	19 (25.27)	28 (29.19)	21 (13.95)	0.02657
medium	17 (18.96)	27 (21.89)	7 (10.15)	
low	48 (39.77)	42 (45.92)	17 (21.21)	
n = 181				
high	19 (21.81)	28 (25.19)		0.175
medium	17 (20.42)	27 (23.58)		
low	48 (41.77)	42 (48.23)		
n = 129				
high	19 (26.05)		21 (13.95)	0.0184
medium	17 (15.63)		7 (8.37)	
low	48 (42.33)		17 (22.67)	
	Friday (n = 84) Count (%)	Men (n = 97) Count (%)	Women (n = 45) Count (%)	
high	19 (22.62%)	28 (28.87%)	21 (46.67%)	
medium	17 (20.24%)	27 (27.84%)	7 (15.56%)	
low	48 (57.14%)	42 (43.30%)	17 (37.78%)	

NOTE: In earlier statistical tests, the cemetery variable had the highest levels of detailed information coded for women most of the time, to a significant degree. Mr. Friday's scores are like the men's, not the women's.

significant difference between Mr. Friday's information and that of the other men (p = .175; Table 2.8), whereas there is a significant difference between Mr. Friday's information and the women's information (p = .0184; Table 2.8). Here, Mr. Friday does not have a hyper-male level of detail, and he does not have information at a level of detail similar to women. It appears Mr. Friday does not defy the proposed models for hunter-gatherer information storage, but instead conforms to expectations for male information storage in general. His information may be more expansive across space, and he does control a higher level of detail than men on some topics, but he does not have a greater breadth of information topics than anyone else.

Patterns in Male and Female Information Storage among Yup'ik Hunter-Gatherers

The acquisition of information never stops for Yup'ik men and women. Mr. Ulroan states that when he is being flown around by the BIA to look at sites, he is always "looking at river mouths" to assess the subsistence landscape (83 VAK 032B). The men and women of the Triangle area acquired new information and restructured the information they did have in mental storage even within the duration of the ANCSA 14(h)(1) project. The information stored and transmitted by men and women is not static; and a similar analysis to this one, performed in another generation with slightly different economic balances, may reveal entirely different patterns of information handling. Different types of information aid in different survival scenarios, a notion expressed by the elders themselves: "[T]he stories of long ago are like legends to the young people now. The children of today are very different compared to how [he] and his peers grew up" (translated for Angelo Hoelscher in 83 VAK 037–038). In a similar theme, but worded somewhat differently, Jimmy Charlie and Nicholas Tommy seem to lament that there are "only few left who know the area from traveling by kayak" (83 VAK 067B). The evolutionary psychology, gendered division of labor, and social network maintenance models should be able to account for such changes, particularly with regard to new economic divisions and changing social network requirements.

The Yup'ik men and women who were elders in the 1980s stored information in patterns that are in accord with general models of evolutionary psychology and the gendered division of labor, including the social network maintenance elements of labor. Men stored information about landscapes, traveling, subsistence, domestic organization, and historical events at high levels of detail. Women stored information about traveling, subsistence, domestic organization, cemeteries, timing of events, and historical events at high levels of detail. There is a marked overlap in the storage of information about subsistence, which conforms to earlier notions of an extremely conservative approach to risk in this region. The patterns are significant, but not statistically strong.

Yup'ik information storage patterns provide compelling data for a general model of hunter-gatherer information handling. Furthermore, information stored in the patterns described above budgets the expense of information acquisition and curation (Whallon 2006). When the information load is shared according to domestic economic structures and psychological predispositions, it is not an onerous burden to be carried by each individual (Kelly 1995:150) *and* it has built-in checks and repetitions to satisfy conservative preferences. I expect that all successful hunter-gatherer cultures used analogous techniques to store information: linking it to places on their landscape according to gender and task, ultimately developing a cultural landscape that unifies place and memory *and* mitigates risk.

ACKNOWLEDGMENTS

I learned about the rich record of the Yup'ik oral histories housed at the BIA ANCSA office during my thesis research in the late 1990s. This current work emerged from interests developed during those years of research. I thank the symposium organizers for inviting me to be a part of their theory building. Thanks also to Debbie Corbett, Ken Pratt, Matt O'Leary, and other scholars in Anchorage who aided me. I appreciate the care taken to produce high-quality information by Calista Region elders and the BIA ANCSA investigators during ANCSA field research. And I thank the Calista Corporation for formally granting permission for me to work with the regional ANCSA files. Any errors are my own.

NOTE

1 Yupiit (people) is the plural form of Yupik (a person). Yup'ik is the adjectival form.

3 Space, Information, and Knowledge: Ethnocartography and North American Boreal Forest Hunter-Gatherers

William A. Lovis and Randolph E. Donahue

Abstract

The acquisition, organization, and scope of spatial knowledge among hunter-gatherers of the eastern boreal forests of North America is explored using, among several linked analytic dimensions, published ethnocartography, landscape marking, and toponymy, primarily from the Naskapi, Montagnais, and Cree. Several outcome generalizations reveal that older males acquire, harbor, and are reservoirs for enormous scales of spatial information on both resources and mobility, made possible by fluid and shifting long-term social group memberships over substantial distances. Such spatial information and its organization appear to be encoded as nested scalar hierarchical units based on drainages and watercourses, while local group naming and identity, as well as cosmology, are often keyed to significant drainages or prominent landscape features. Drainages act as transportation or mobility corridors between productive patches. Connectivity between drainage systems and segments in the form of portages and their locations are of significance and are sometimes physically marked. Naming practices for drainage and lake features exhibit an internally structured and commonly held logic that facilitates information transmission. These generalizations carry significant implications as analogues for archaeological analyses of hunter-gatherer space, as is briefly demonstrated in a northern England Mesolithic case study.

In a recent synthesis, Istomin and Dwyer (2009) explore the ethnolinguistic, psychological and geographical literature on the relationship between what they view as the two primary theories of so-called wayfinding, or human spatial orientation: the "mental map" and "practical mastery" approaches. The former is presumably rooted in the construction of "abstract cognitive representations of the spatial relations between objects" (2009:29), or specific recognizable landscape points, whereas the latter involves moving between or making transitions between known visual perspectives or "vistas" which can be framed as larger, more complex relational spatial sets (here they cite Ingold 2000 as a primary practitioner). They make the strong case that the two approaches are, in fact, not mutually exclusive, but complementary, since one concentrates on route knowledge whereas the other emphasizes survey or landscape knowledge.

> [H]umans rely on mental maps but also memorize vistas while navigating, and an individual's navigation method, ability, and the form of the mental map is likely to depend on a situation as well as on factors such as age, sex, familiarity with the environment, and life history. (Istomin and Dwyer 2009:29)

Structurally, spatial knowledge is often encoded hierarchically, as groups or clusters of individual places (Istomin and Dwyer 2009:36; McNamara et al. 1989). Ultimately, such encoding can be approached as an issue of scale, since the number of nested nodes in the hierarchy conditions the range of relative coarseness or fineness with which spatial information, whether route or survey or both, is encoded. Likewise, the size of an area encompassing a cluster, and the number of individual locations within any given such area, are also linked to the relative resolution with which spatial information is stored and the amount of information that can be stored and then recalled and distributed. Individual locations or places within clusters of any given size and hierarchical position are known, and mobility or route information is keyed to movements between clusters (rather than to individual locations) in an attempt to position oneself for a given reason—the "situation" mentioned in the above quote. Here, we attempt to apply some of these principles to the hunter-gatherer organization of spatial or landscape information, employing indigenous maps, or ethnocartographic information, from several sources.

Hunter-Gatherers, Landscape Spaces, and Information

Geographic or landscape information is fundamental to the superimposition of other kinds of environmental observations. Hunters can only locate animals in space if they know the details of that space, and only if they can transmit the salient information effectively. A good hunter—or, for that matter, a good leader—knows more than simply good hunting or trapping techniques. He knows how to use information at different scales to make decisions that lead to a successful outcome a preponderance of the time.

Our perspectives on band-level hunter-gatherer use of space and what we now recognize as the interaction between landscape and mobility were formed from readings of boreal forest and subarctic ethnographies of Athapaskan, Algonquian, and Inuit peoples, initially by pioneering observers such as Franz Boas, Frank Speck, and Loren Eiseley. Further insights were gained from the writings of luminaries such as Eleanor Leacock, Edward S. Rogers, James G. E. Smith, Georg Henrikson, Richard Nelson, and Lewis Binford, among many others. Collectively, the work of these authors was a catalyst to think of hunter-gatherer notions of space as vast information sets constantly undergoing rearrangement across multiple dimensions as contexts and consequent decision-making needs shift. Some of the information in this pool has utility over *la longue durée*, in that content is altered over long-term cycles, whereas other information is of very short or even of almost instantaneous or transient utility. Depending on the temporal scale of a pending decision, different individual pieces of information, or combined sets, may have more or less relevance.

Likewise, in the transmission of information in the spatial dimension, the scales of interaction and their catalysts are also variable. As Whallon (2006) has indicated, there is a contextual partition in the way that utilitarian versus non-utilitarian mobility is systematically necessary, invoked, and employed. He coins the phrase "informational mobility" to refer to those aspects of mobility where the primary goal is either the acquisition of new information or the updating—what he calls "refreshing"—of older information. Here the distinction is the primacy of information gathering to any given mobility episode, recognizing that information is *always* being gathered by hunters-gatherers, and it is also always being filtered. The social components of ritual and ceremony, duty, and the like are ways of " 'making' people travel, visit special locations or other groups, aggregate, etc., in directions or at times that would not be normal in routine foraging and material procurement" (2006: 263).

The social reservoirs for these different temporal scales of utility and their means of, or mechanisms for, transmission also vary. Long-term, slowly changing, persistent information sets are often deeply embedded in oral tradition and are commonly transmitted between or across generations as oral tradition, stories, or myths (Minc 1986) and at times can even become entwined in cosmology. The social repositories for such information are often found in societal elders, who variably harbor information based on crosscutting categories of gender, role, age, and status (see Funk 2004, 2005, and Chapter 2, this volume, for a Yup'ik example). Cross-generation transmission may take place both within and between various social partitions, including both the categories previously mentioned, as well as kin- and non-kin-based social units. As necessary, information is invoked and managed by separate or aggregated segments of the social group. The cumulative information available to a hunter-gatherer band at any given time is, therefore, potentially quite extensive, spans several temporal spectra or scales, may be new and/or socially stored, and also of variable resolution or grain ranging from fine to coarse. It is precisely this comprehensiveness that provides the oft-touted adaptive decision-making flexibility of northern hunter-gatherers in particular, and of small-scale or band-level hunter-gatherers generally.

Given the vagaries of different landscapes with respect to relief, watercourses, standing water, vegetation, and other aspects of the natural and cultural environments, the acquisition, retention, organization, and transmission of such information requires variable, judicious distillation and/or enhancement, and appropriate partitioning. For example, the fact that flowing water is directional results in a dichotomy—one goes upstream or downstream. In some respects, it doesn't matter how many convolutions downstream or upstream might have, since one goes to lower elevations downstream and higher elevations upstream, each with predictable consequences across a variety of other linked dimensions. As an example, Lake Mistassini may be "160 miles from the coast as the crow flies, but the river is 400 miles long" (Richardson 1991:68). To simplify retention of the useful information, precise orientations and positions of landscape features become distilled or enhanced, and it presently appears that this may occur differentially at different scales, each emphasizing different aspects of the information pools.

LANDSCAPE KNOWLEDGE

> The key to successful exploitation of the subarctic forest is an intimate knowledge of local geography. (Nelson 1973:183)

Nelson's matter-of-fact assertion bears remarkable truth. In the attempt to better understand this relationship, the goals framed in this paper are several.

First, we attempt to understand the fashion in which band-level subarctic hunter-gatherers accumulate and organize spatial or geographic information, with the linked goal of understanding how such information is distributed across the social group and its various partitions. These attempts are rooted both in North American subarctic ethnographies as well as in analysis of maps derived from what has most commonly become known as *ethnocartography*, a subdivision of ethnogeography, but which has a substantial time depth in explorer, traveler, ethnographic, and geographic literature. Certain aspects of toponymy are also applied to this discussion, as noted elsewhere. Second, we ask the question: How does what is learned about the organization of spatial geographic information by northern band-level hunter-gatherers apply to the archaeological interpretation of past hunter-gatherer landscapes? We are particularly interested in employing the derived information as analogue bases for better understanding Mesolithic landscape use in northern England specifically, and western Europe broadly (Donahue and Lovis 2006; Lovis et al. 2005; but see early work by McManamon 1975).

In these endeavors, there is no intention to homogenize the large number of subarctic societies, both Athapaskan and Algonquian, that are drawn upon and discussed, but rather to extract points of similarity that might have broader applicability. Nor is there any intention to diminish by omission the deep emotional, ideological, and cosmological interactions with their environment that are common to the societies we use as exemplars. Additionally, while information per se leads to decisions, at present there is no attempt to insert either the nature of or the structure of decision-making into this analysis. The published cartographic information we utilize is the product of male hunters and primarily, but not exclusively, male ethnographers, which introduces a clear but unavoidable gender bias. Finally, we employ facets of indigenous toponymy to better understand the cartographic shorthand derived from other aspects of the analysis, with full recognition of the potential pitfalls of such approaches.

The significance of accurate information and its transmission cannot be underestimated in the defined context. Despite its sense of hyperbole, at its core the following statement by Hugh Brody encapsulates the consummate importance of reliable information at any scale.

> Anthropologists and others have often pointed out the remarkable preoccupation among hunting peoples with literal truth. Precision and accuracy in all aspects of land use have obviously been integral to survival. It is not surprising, therefore, that among the Inuit, Beaver, and

> many other hunting peoples, there is great hostility towards any unreliability about resource harvesting activities. It is striking that in some hunting peoples' languages there is no very clear distinction between making an error in judgement and telling a lie. In a society where information about the land and its animals can make the difference between life and death, there cannot be much tolerance for errors of judgement. (Brody 1981:175)

Given all of the above, however, it becomes starkly evident that the potential information pool that might need to be retained and transmitted by subarctic hunter-gatherers, particularly those exploiting large and heterogeneous areas, is indeed quite extensive, regardless of its staged acquisition (see Binford 1983 for a discussion of accumulated geographic knowledge). By the same token, we also know there are approximate upper limits on the amount of named categorical information that can be stored, retained, and recalled by any given individual (Hunn 1994). This disparity requires reconciliation. For boreal forest hunter-gatherers to make efficient use of the information they acquire over a lifetime requires some shared systematic approach to, or grammar for, spatial landscape information storage and retrieval; this is the primary focus of the following discussion.

DISTILLING SCALAR INFORMATION

The Region and the Drainage

The spatial-information distillation process for large geographic areas is perhaps most graphically evident in the omnibus map of southeastern Labrador by Montagnais-Naskapi hunter Mathieu Medikabo (Figure 3.1), which Eleanor Leacock (1969:6–7, maps 1, 2) contrasted with a proper cardinally oriented drainage map of the same region (Figure 3.2). Medikabo's map is noticeably distorted spatially, achieving an almost, but not quite, rectangular shape. Shorelines are presented as almost straight or linear and oriented in the same fashion as almost all major drainages; up and down or right to left—that is, as axes rather than as accurate and specific directional orientation. This same style or kind of simplification is paralleled in a map published by Speck, drawn by the hunter (T)Cibic,[1] of an entire river drainage showing how he gets to his hunting area (Figures 3.3, 3. 4). This is a graphic representation of "route knowledge" per Istomin and Dwyer (2009).

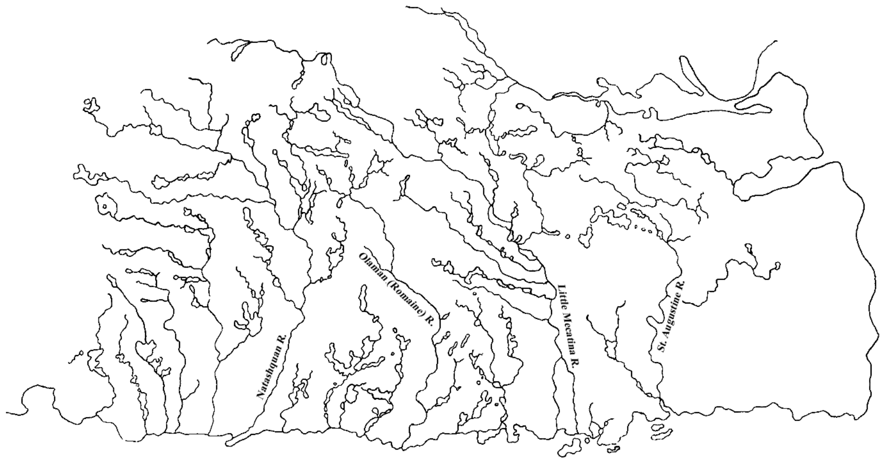


Figure 3.1. Southeastern Labrador as sketched by Mr. Mathieu Medikabo. (Reproduced courtesy of the © Canadian Museum of Civilization, NMC *Bulletin* 228, page 6. *Sketch by Mathieu Medikabo [Leacock 1969:6, map 1].*)

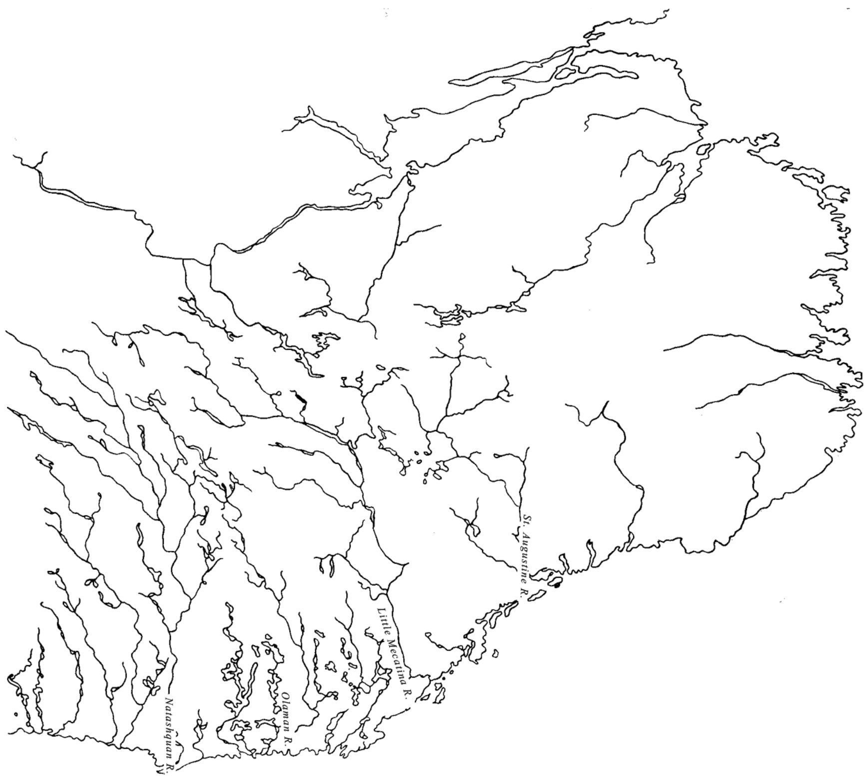


Figure 3.2. Map of southeastern Labrador by Mathieu Medikabo as corrected. (Reproduced courtesy of the © Canadian Museum of Civilization, NMC *Bulletin* 228, page 7. *Sketch by Mathieu Medikabo [Leacock 1969:7, map 2].*)

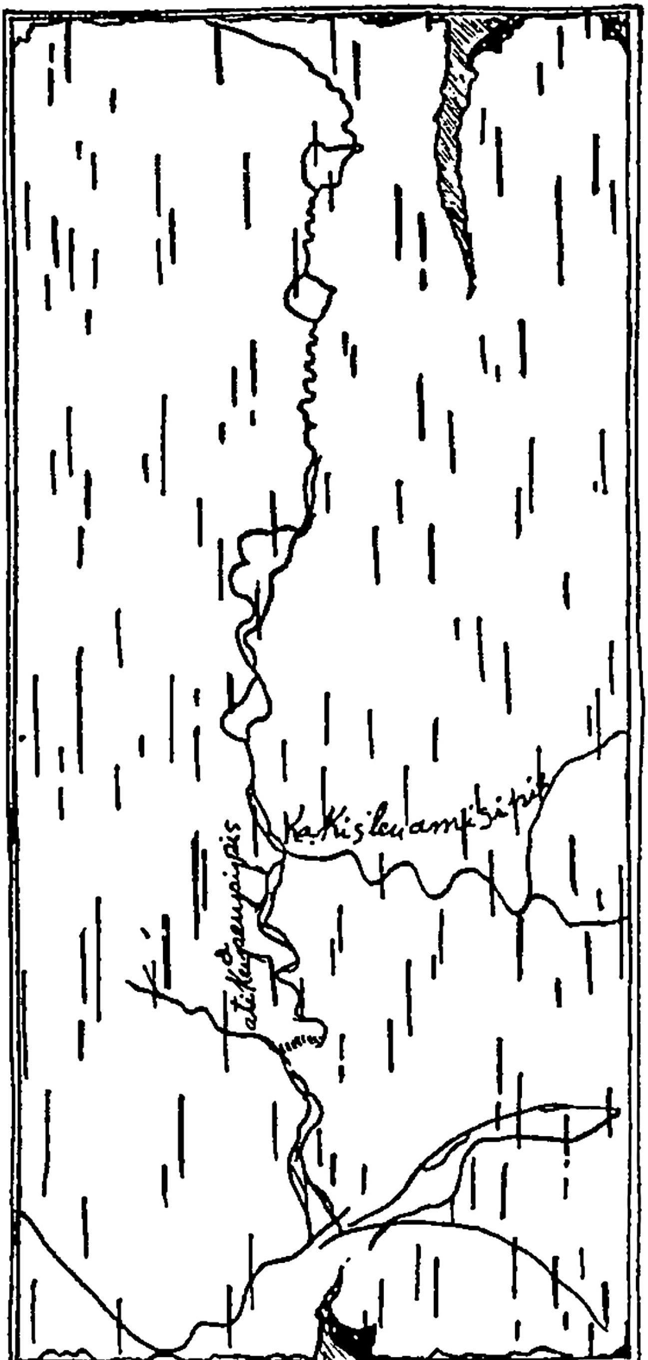


Figure 3.3. Map by Cibic of the river Atikwabe'o. (Copyright © 1934 University of Oklahoma Press. *Reprinted by permission of the publisher from Speck 1935:148, fig. 14D.*)

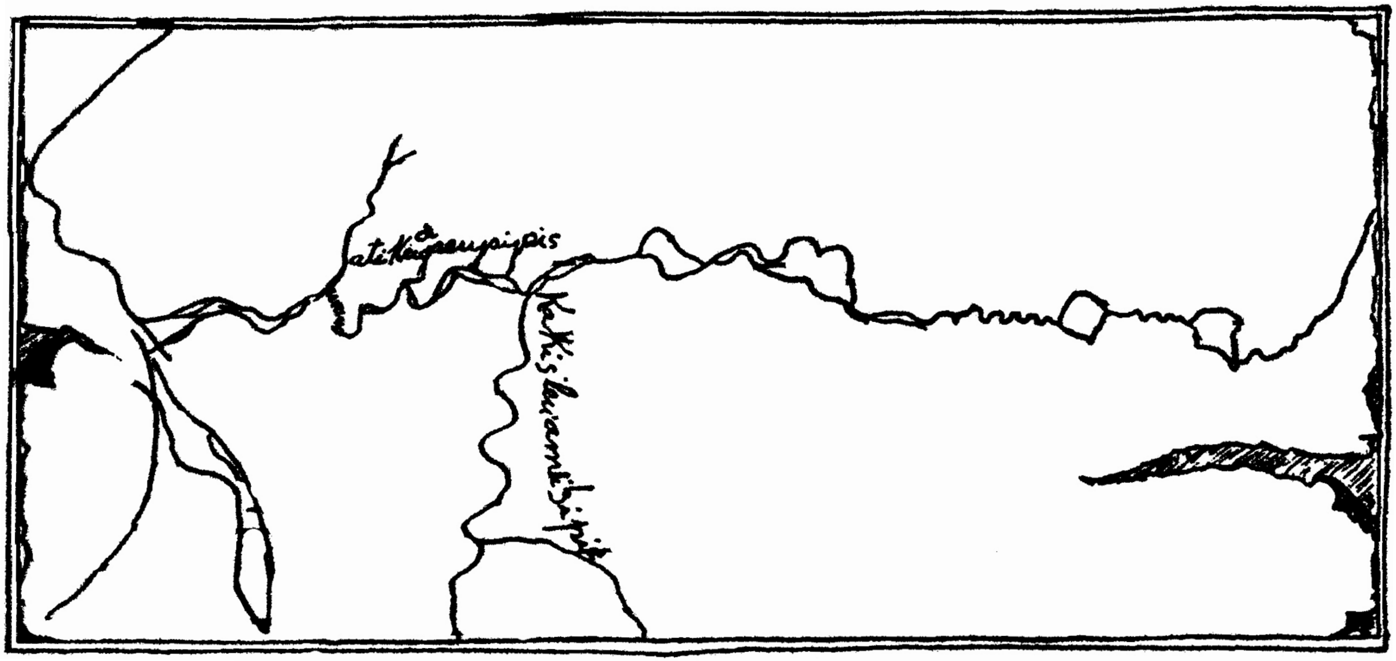


Figure 3.4. Map by Cibic of the river Atikwabe'o, Speck's faux birchbark removed for clarity. (*Map modified from and reprinted by permission of the publisher from Speck 1935:148, fig. 14D.*)

The regional-scale map attributed by Speck to Cibic is in his discussion of scapulimancy, and is embedded in a substantially larger discussion of divination practices among the Naskapi, designed to illustrate the similarities between the cracks in a scapula and the hunting territory of the person engaged in the divination. Speck's annotation of the map provides information on the position of Lake St. John, the Naskapi names for two rivers, along with a translation of one as Black Beaver River (in the figure caption: Speck 1935:145, fig. 14D). In the accompanying text, he relates: "The same hunter, Cibic, burned a shoulder-blade which showed a river with two forks (fig. 12A). This represented his hunting territory, which he had outlined on a birch-bark chart (fig. 14D). Scapulimancy is often cartographic . . ." (Speck 1935:146).

The Cibic map illustrates a main stream identified as the Atikwabe'o River (labeled *ati'Kei[d]peupipis* on the map), and a branch labeled Kakwste'*namickciic* (the one translated as the Black Beaver River). The main stream is oriented left to right, and the branch juts "downward" at a right angle and eventually forks. The area on the left of the scroll is identified as the Lake St. John shoreline "into which the river empties." There is either a lake or small inlet just below the embouchure of the main stream with Lake St. John. Several small lakes are arrayed along the main stream, and the latter eventually arcs upward in a curve intersecting the top edge of the bark (perhaps due to lack of space, or perhaps the stream actually makes the arc).

The mapmaking on this scroll is more in keeping with the style displayed by Leacock's informant Medikabo (discussed earlier as well as below) than it is with its cartographic brethren presented by Speck. It is linear, oriented right to left and up and down. Some of the bends in the depicted streams appear *pro forma*, while others appear to be done with care. Lake sizes and shapes are different, suggesting an attempt at accurate portrayal. This map appears to portray the largest spatial area of the group of materials published by Speck and, like the large Medikabo map, has no other symbols, such as dots or dashes, indicating portages or other kinds of land routes.

Locating this river on the landscape surrounding Lake St. John has proven difficult. The only inlets or lakes that approximate that shown on the map are on the north side of Lake St. John, suggesting that the orientation of the map may not necessarily be in cardinal directions. At the various scales of contemporary maps inspected for drainage system characteristics, none of the streams on the north side have long, sweeping, left-oriented curves. One draining to Lake St. John from the south, however, does. It is possible that contemporary shoreline alterations have obliterated the landmarks portrayed in this sketch or that, as noted above, the curve is a product of the size of the birchbark, and that a straight stream is actually being represented. If this is the case, then multiple interpretive options are present.

On both the Medikabo and Cibic maps, drainages of varying size run through lakes sequentially, entering at one end and departing at the other. Notably, there is no indication of relative drainage size other than its position within the larger drainage system. Key lakes may be present at the start or upstream headwaters of drainages. Lakes are also drawn with one specific shore along the river drainage: right, left, top, or bottom, and not always the same shore. Lakes are of different shapes and sizes. While impossible to validate, this variable representation is most likely intentional, and suggests an information shorthand facilitating both the retention and transmission of key mobility information by indicating that one travels directly through or across certain lakes, along a right or left or top or bottom lakeshore on other lakes, or that the end point is a large destination lake. That this is not simple speculation is bolstered by ethnographic observations, particularly related to geographic naming practices among the Cree and the Naskapi, among others; this topic is addressed in greater detail further along in this discussion, supplemented by parallel information about the marking of portages and land routes on local-level maps.

Tributary and Lake Systems

Most certainly, the categories of information provided on the Natashquan Band hunting territory map as portrayed by Mathieu Medikabo (Figure 3.5; Leacock 1954:29, map IV) were elicited by and relate to the queries posed by Eleanor Leacock regarding so-called trapping arrangements—the central topic of her research. The characteristics of the Natashquan River allow the hunting territory to be located at about 51° north latitude, just downstream of a prominent bend and northward-branching segment of the river. Among the natural features, all major and minor streams and lakes are shown. Cultural information is abundant. Three hierarchically arranged categories of occupation are displayed and their spatial locations specified: family tents, overnight camps, and temporary camps. Overnight camps are attributed to two different group compositions, distinguished by gender and age: two young men and a boy, and two older men and a boy (trapping parties are almost always, but not exclusively, composed of males, so gender is not particularly difficult to ascertain). The temporary camp is attributed to an older, partly blind man and his wife. Trap lines are graphically defined in space as dendritic or branching networks, with the trunks of the networks revealed to be jointly trapped lines, and the branches as so-called single or individually trapped lines. Whether Medikabo provided the information, or whether Leacock inserted it independently, the associated map key indicates how many traps are associated with each trunk and branch of the trap line system. This level of detail, however, is not unusual and is also present in other regional cartography (Speck 1927).

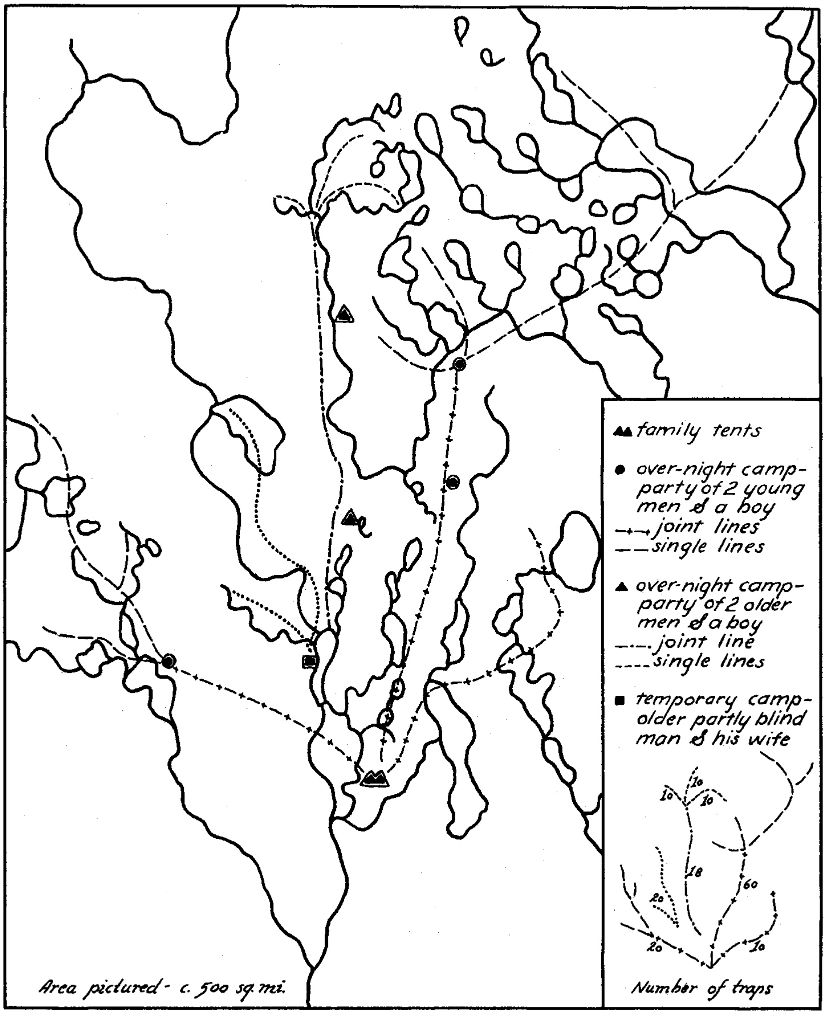


Figure 3.5. Leacock's reproduction of a map by Mr. Mathieu Medikabo of the Natashquan drainage trapping area and arrangements. (*Reproduced from Leacock 1954:29, map IV.*)

While limited, Speck's published inventory of either indigenously drawn maps or maps transcribed from the originals nonetheless affords a significant entrée into and departure point from this topic. In a fashion similar to Leacock, Frank Speck's 1927 article in *Anthropos* presents two transcribed maps of hunting territories, drawn on birch bark, by Lake St. John Montagnais hunters (Figures 3.6, 3.7). No doubt the maps were drawn at Speck's request to enhance his information about family hunting territories. The cartographers are identified by name, and the sketch map locations are keyed to a master map of numbered hunting territories. Therefore, the locations of the sketch maps relative to current topographic maps can be approximately reckoned. That said, over the 80 years since Speck's work was prepared, a number of watercourses have changed course, and some of the smaller drainages that were labeled with indigenous names now lack comparable identification on modern maps, which rely on English and French language names; both of these are topics discussed further below.

One of two maps in Speck's 1927 "Family Hunting Territories of the Lake Saint John Montagnais and Neighboring Bands" is attributed to "Mani," is keyed to parcel number 42 on Speck's master map, and is reputed to display the Quiatchouan River system and Long Lake. The second is attributed to "Matsina'bec" (Bad man), is keyed to parcel number 54, and displays the Ofopikouba River system (Speck 1927:388, unnumbered map; 394, fig. 1; 395, fig. 2).

Speck's commentary on these maps includes several significant observations: while the positions of lakes, rivers, and portages may all be "accurately" [this author's use of quotations] displayed, other topographic features are ignored because they are useless for travel; portages (what are termed "carrying places") are marked with different types of lines (usually dots or dashes) than are watercourses (Speck 1927:393). Thus, at this scale, land and water routes are differentially represented. This same cartographic nomenclature is also present on the two maps drawn by different informants and later published in Speck and Eiseley (1942:217, figs. 1, 2). The former is of a small area encompassing a hunting camp, while the latter is of a larger hunting territory; and in these two cases (unlike in others), small north arrows have been included, allowing for cardinal orientation (Figures 3.8, 3.9).

Each of these published maps allows varying degrees of association with current landscapes and, consequently, different inferences that can be drawn from them. In the following two instances, for example, the maps are from locations that have been impacted by the Smallwood Reservoir as well as by other, smaller stream impoundments. The sketch map drawn by

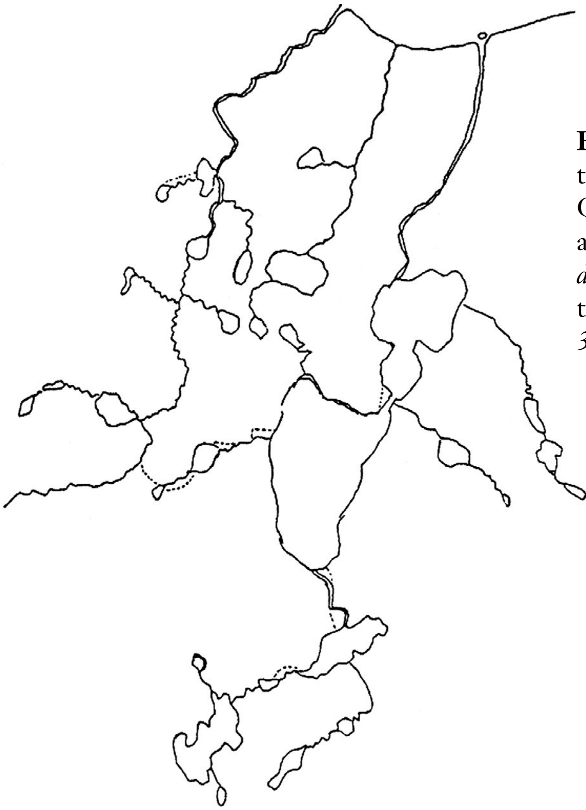
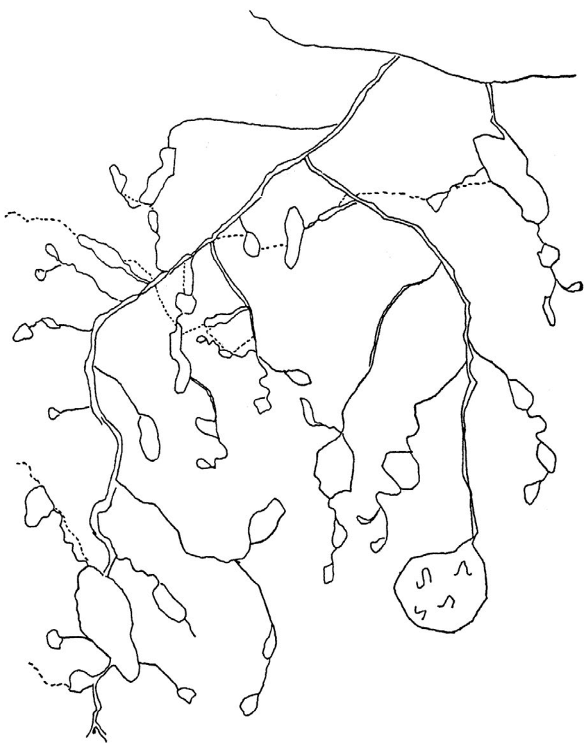


Figure 3.6. Hunting territory map by "Mani," Quiatchouan River system and Long Lake. (*Reproduced with permission of* Anthropos *from Speck 1927: 394, fig. 1.*)

Figure 3.7. Hunting territory map by "Matsina'bec," Ofopikouba River system. (*Reproduced with permission of* Anthropos *from Speck 1927: 395, fig. 2.*)



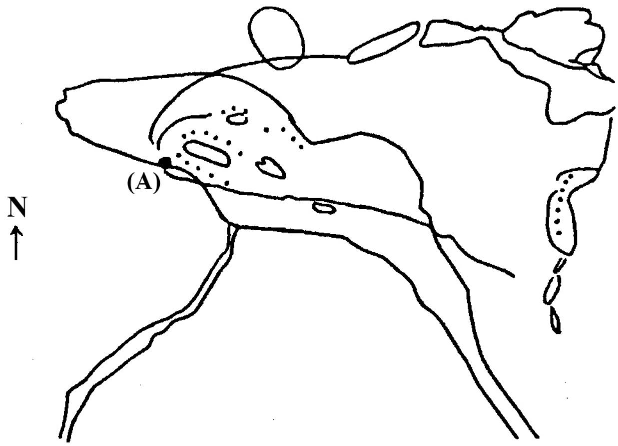


Figure 3.8. Map of Pien Andre's winter camp at the head of the Ashwanipi River/Petisikapau Lake. (*Reproduced from Speck and Eiseley 1942:217, fig. 1.*)

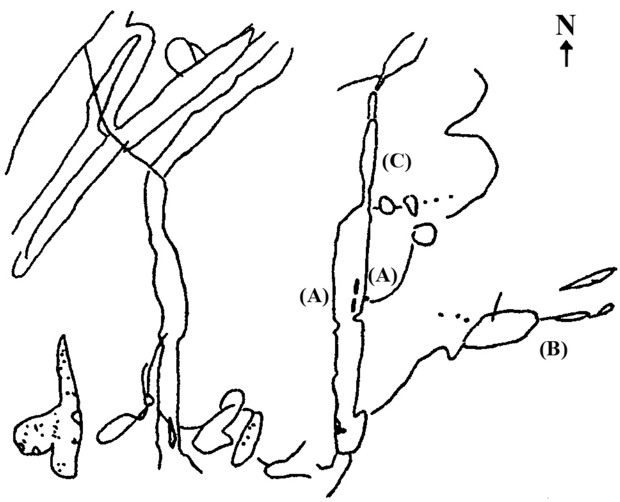


Figure 3.9. Map of Andrew Mackenzie's winter camp between Menihek and Petisikapau Lakes. (*Reproduced from Speck and Eiseley 1942:217, fig. 2.*)

Pien Andre of his winter camp on ice-covered Kamacko'gan cakhi'gan (lake), near the head of the Ashwanipi River in the vicinity of Petisikapau Lake (Speck and Eiseley 1942:217, fig. 1), is notable for several reasons. First, it demonstrates that during winter, the specific numbers and locations of ice-fishing holes, with their hooks, are carefully monitored—much as the positions of trap lines were known to Mathieu Medikabo. Second, it clearly notes both overland and ice travel routes by individuals, suggesting routinized movement or circuits for hunting and fishing. Third, it demonstrates that winter travel involves combinations of overland travel and movement across frozen lakes (an interesting observation from the standpoint of archaeological modeling). In similar fashion, the areas drawn by the hunter Alexander Mackenzie of the area between Menihek Lake and the Petisikapau Lake and river system (Speck and Eiseley 1942:217, fig. 2) display comparable sets of information, including overland routes between lakes, routes that transect lakes, and islands in lakes. In both cases, relative orientations appear to approximate reality, as the inclusion of north arrows would indicate.

A rather different perspective on the organization of spatial information and knowledge derives from the maps by Mani and Matsina'bec of their Lake St. John area hunting territories, both of which can be rather accurately placed on the landscape (Speck 1927:394, fig. 1; 395, fig. 2). As previously noted, Mani's map (Figure 3.6) is located at parcel number 42 in Speck's unnumbered master map on page 388. This positions the map area west of the Rivière Metabetchouan, south of Lake St. John and east of the LaCroche River. Speck's captional reference to Long Lake probably refers to what is now labeled Lac des Commissaires. Matsina'bec's hunting territory is located by Speck at parcel number 54. This places it to the east of the Rivière aux Écorces, which drains south from Kenogam Lake. The Quiatchouan River appears to be an eastward tributary of the Écorces. The Ofopikouba River system referred to in the caption is now the Pikouba River and lake system, which has a tributary variably labeled Lac Jacque Cartier and Chicoutoumi River.

There is little in the way of direct spatial accord between the sketch maps and current topographic and drainage maps, either in terms of scale or orientations, although relative placements seem to be reasonably accurate. Both maps display their respective lakeshores at the top of the map, to the "north," which is correct. Both also emphasize or enhance the sizes and shapes of lakes, and transportation connectedness, often by diminishing the actual length of river distances and at the expense of accurate orientation and scale. Each clearly displays what are either winter trails or portages. Here, however, the cartographic emphasis is on presenting a coherently bounded and internally connected space, including the relationships between lakes and the routes one uses for passage between them—that is, how one moves across the landscape from location to location. In fact, these maps are reminiscent of the way in which archaeologists analytically perceive and organize "catchments" around sites and resource extraction zones.

Toponymic Considerations

The practice of naming points or areas on a larger landscape, referred to as a *toponymy* by ethnogeographers, allows partial understanding of emic perceptions of spatial organization and cultural cartography. To a degree, it is being employed to inform analysis of contemporary land use practices (e.g., Ebert 2008); at the same time, understanding of the functions of toponymy also provides insights into perceptions of land use and world view (Cruikshank 1990; Dargin 2004). One significant component of the naming process is the "encoding of information" (Ebert 2008:4).

For example, Rogers (1969:44–45) documents almost two dozen separate words or phrases used by the Mistassini Cree that describe different shapes and sizes of lakes, with different shoreline or bottom characteristics. He describes the systematic naming of streams relative to the lakes they drain into, or from:

> Streams were named after the lake from which they discharged. They retained this name until they joined another large stream or entered a lake. Below this point a stream was known by the name of the stream or the lake it joined, retaining the name until the river joined another stream or lake. The naming process was then repeated. (1969:45)

Rogers also elaborates on the subdivision of larger geographic spaces, given separate names, such as "where a number of streams joined or entered a lake" or "the area between two neighbouring lakes connected by a short discharge." Confluences of streams are particularly important locations (Richardson 1991:94–95, quoting Rogers). Rogers's description speaks to a formal grammar of toponymy shared by the larger group, simplifying information transmission.

In like fashion, Speck (1923), when listing the names of areas hunted and trapped by specific Mistassini, reveals that they are named after their key descriptive characteristics—topographic as well as animals and plants, and even events or people. A partial listing would include (Speck 1923:466–467): "poplar river," "main river," "foam river," "marten river," "outlet," "canoe lake," "tamarack lake," "rush lake," "deep lake," "sturgeon spawning place," "loon pursuing," place "where the current has swept away the alders," or simply "grandmother." These names mimic several of the multiple categories of naming that have been identified in such systems (Ebert 2008). In fact, the Mistassini themselves unsurprisingly derive their name from a prominent rock providing a lake with its identifying eponymous description: "Big Rock People" (Speck 1923:454). All of these natural landmarks are known to both the people who live on or near them as well as the members of adjacent groups. Speck's comments are particularly revealing in this regard: knowledge of the landscape "exists in great explicitness in the minds of the northern Indians, a state which we are totally unable to describe for the want of adequate means at our disposal in respect . . . to cartography . . ." (Speck 1923:461).

At a more generic level, the importance of these observations to orientation and path finding in the boreal and subarctic regions reveals that one "must know the location of many trails, and of portages between lakes or across river bends . . . every hill, ravine, creek, or meadow—every detail of the local landscape"; and "a man must know the location of every favorable microhabitat of the plants or animals he seeks" (Nelson 1973:182–185). This speaks to knowledge sets that relate to more refined scales of information.

The scale of the "standard knowledge" held by the older generation in these regions is a consequence of two factors operating in tandem: highly fluid social relations and high levels of mobility. Testimony to this observation is provided by the recording that, in 1950, three Montagnais-Naskapi (Moise, Mingan, Natashquan) bands hunted and trapped an area of 450 by 300 miles, or 135,000 square miles (Leacock 1954:19, map III). Apparently an even larger area was considered to be "the same hunt" (quotes in Leacock 1954:20); Leacock goes on to say, "Hunters from the bands summering on the St. Lawrence used to cross over the Height of Land [250 miles from the St. Lawrence to the high plateau which forms the headwaters of the Atlantic drainages] regularly at Christmas . . ." to trade and "hunt caribou above the Hamilton River." This description is certainly suggestive of Whallon's "informational mobility," although perhaps not *sensu strictu*.

Further, as Nelson points out, "Travel in the open upland forest and tundra country differs from travel in the dense lowland forest because it is not so dependent upon detailed knowledge of the landscape" (1973:182–185). Terrain and vegetation have important impacts on the degree to which artificial means of orientation must be incorporated into the local landscape. In open, relatively flat tundra zones with little vegetation, landscape and geography are less often employed as information sets for orientation. Greater relief—that is, frequent hills and mountains—provide more readily visible and accessible points of orientation. When relief is minimal, other aspects of the geographic and cultural landscapes are employed for these purposes, such as rivers, current directions, lakes, dry and wet grasslands, as well as trails and other such features.

This becomes evident in representations of hunting/trapping areas presented by Speck and Eiseley in several cases (Figures 3.6–3.9) and by Leacock in another (Figure 3.5), while Binford observes that when band territories' annual ranges are spatially readjusted, it is in terms of movement or relocation to a different drainage or river system (1983:38–39). In fact, Leacock (1969:16, n. 1) observes, "For those interested in space orientation, it is noteworthy that Mathieu oriented his maps around interior water sheds" and "at different times he would select different smaller stream and pond systems to draw in detail, according to the topic of our discussion" (Leacock 1969:8; see also Rogers 1969:44). It is the individual drainage or drainage system that appears to be the fundamental unit of information organization at different scales. Details of drainages, lakes, wetlands, and overland trails or portages are all incorporated at a more accurate level of orientation; but, at the same time, specific characteristics are exaggerated—the relationships, proximity, and routes between drainage features; that is, the internal connectivity of the system becomes paramount.

ARTIFICIAL MARKING: SUPPLEMENTING LANDSCAPE INFORMATION

When geography is redundant, or when vegetation or snow cover inhibits the visibility of orienting landscape features (either of which can result in spatial ambiguity), artificial marking becomes more important. Again, Nelson writes, regarding both summer and winter examples among the Kutchin, "markers are very important at places where a trail opens onto a river, lake, slough or meadow, where travelers may have difficulty finding the trail's opening when they reach the other side" (1973:183). Leacock reveals the use, among the Montagnais, of various kinds of modified sticks as markers to indicate whether a winter family tent group would either welcome further additions to the aggregate or not (1954): "Even after the group has formed, it may not make the final decision upon where it is going to trap until reaching the upper branches of the Natashquan River, whereupon it leaves a signal for the parties coming after, telling which fork of the river it has taken" (Leacock 1955:38).

The Mistassini Cree engage in tree marking in several contexts, some intended as temporary or short term, and others as more long-standing means of direction finding. Shorter-term use includes tree marking as a means to direct others to a kill site—for example, "The hunter then returned to camp blazing a trail along the route"; "When the return trip was made, the men and boys constituting the party partly cleared the route to the kill of obstacles and brush and made additional blazes"; and "There were large blazes on a few trees indicating route in" (Rogers 1973:17, 18, 20, respectively). Richardson (1991:13), in a section of his book titled "How the Hunter Finds His Way," relates the experiences of a hunter who remarks on the fact that on at least one trip they found direction because "[a]long the way to Mistassini there were blazes on the trees" and "you could still see the old blaze on it"—that is, a dead tree. This speaks to long-term use of blazes as trail- and portage-marking devices, perhaps when oral or even cartographic transmission of such information may be inadequate to the task. Figure 3.10 graphically illustrates why marking portages is important; six men don't simply portage a 10-meter-long canoe, even one of birchbark, and its contents, several hundred meters without knowing the exact position of the portage route.

In fact, the need at times to provision portage locations results in their unintentional marking, witnessed by the fact that logs used as rollers for canoes are often strategically placed at portage locations (Richardson

Figure 3.10. Six men portaging a 10-m-long birchbark canoe, Long Point, Quebec, Canada, ca. 1900. (*Reproduced with permission of Mr. Jack Deo, Superior Views, Inc., Marquette, MI.*)

1991:139). On the other hand, Speck observed that "[a]mong the Mistassini there seems to be no method of marking the boundaries of their territories by blazes or other landmarks" because they all know the terrain so well that boundary marking is unnecessary (1923:460). So, if taken on their face, these observations suggest that at least among the Mistassini, as well as other groups, territorial boundaries were not physically marked, but various physical means of revealing directions or routes appear to be relatively common. In the context discussed here, the latter are used for shorter-term, more immediate information transmission (but see Scheinsohn, Chapter 11, this volume, for a discussion of more permanent landscape marking).

Enormous stores of information relative to any given activity are thus available through the informational confluence of having traveled incredibly long distances and across vast land areas on multiple occasions, having named or learned the names of different features of the land traveled over, having marked or learned the marks associated with directions, portages, and paths, and having assimilated the nuances of the river systems and smaller drainages, including their lake inlets and outlets, and the nature and position of rapids. It is no surprise, therefore, that certain well-traveled male elders possess remarkable stores of spatial landscape information at a very large scale, as witnessed by Leacock's Montagnais informant Mr. Mathieu Medikabo, Funk's use of the interviews from the Yup'ik elder Mr. Joe Friday, or Speck's reliance on his Cree informant Mr. Cibik. The sum of a lifetime of such learning, across an area that Binford (1983) refers to as the "life range" of an individual, results in remarkable historical connections to the landscape. Speaking about Job, an old Cree hunter, Richardson writes, "So this was the place he had known all his life: he knew every Indian who had ever used it in the last half century, he knew all the pathways around it, he knew the people who had died and been buried here and the children who had been born here" (1991:165).

ARCHAEOLOGICAL IMPLICATIONS OF THE ANALYSIS

It appears that among northern hunter-gatherers, very often emic conceptions of territories, or subdivisions of territories, and the uses of space both socially and in terms of exploitation areas are organized around or focused on drainages or drainage segments, including lakes and marshes (see Zvelebil, Chapter 8, this volume, for similar observations relative to cosmology). This is true whether one is focusing on water or cold-season ice. Precise orientations of drainages do not appear to be particularly significant at an emic perceptual level at any scale, although such orientations are apparently known with relative accuracy (Istomin and Dwyer 2009:37–41 for a mobile reindeer herder example).

This observation suggests that archaeologists, at least in more northern regions (if not elsewhere), would be well served by employing or continuing to employ similar physical units of the drainage or drainage segment as their research areas or primary units of regional analysis. Notably, this generalization can be applied across exploitation territories of variable size and with variable resource densities or carrying capacities. In fact, even in more resource-dense regions to the south, such as the early nineteenth-century upper Great Lakes, the drainage was often the organizing geographic unit for band territories among the Ojibwa and Ottawa (Cleland 1991:99, fig. 1), suggesting that this principle may have broader heuristic applicability regardless of the size of the exploitation area. With this in mind, however, one cannot assume that the drainage or drainage segment was continually part of the annual territory of a single hunting-gathering band. As exploitation territories shift periodically, so does the use of such drainage units by different groups (Binford 1983; McManamon 1975).

Different stream segments or tributaries of a larger system may well play very different roles in the larger economic, resource procurement, and mobility system and may not represent a full range of activities, either economic or seasonal. Drainage segments may be highly specialized in their resources and patterns of use. To a degree, it can be argued that we already know this, although the implications of this analysis can take our understanding a bit further. If one views distant components of a subarctic drainage or path system as a means of connecting spatially discontinuous resource patches, then arguments regarding the differences between concentric and reticular spaces (e.g., Albert and LeTourneau 2007) warrant further exploration by archaeologists, particularly when residential mobility prevails.

Ethnocartographic information reveals, much as non-site or distributional approaches have argued (Ebert 1992), that spatial behaviors potentially leaving archaeological residues are redundant and cumulative across a shared conceptual landscape. However, specific locations that we might classify as a discrete spatial unit, such as the "site," are not necessarily the rule. Rather, more general locations for settlement, and the short-term local movement of a house(hold), settlement, or campsite, prevail. Regional generalizations of land use are best undertaken at a non-site scale of investigation, reference, and inference.

In the subarctic, landscape marking appears to be most often employed as a path- or way-finding device rather than as a territorial marker or an overt mark of ritual locations. Moreover, it appears that when marking takes place as an information transmission device, it can apparently be for both the near term and the long term. At least among the groups surveyed for this research, there is no indication of permanent (i.e., long duration) landscape marking, although some temporary marking may last extended periods of time and be associated with specific events. There is remarkable consistency in the emic knowledge of spatial land use by both individuals and groups, making such long-term landscape marking as an information transmission device *almost* unnecessary (but see Scheinsohn, Chapter 11, this volume).

Even vast exploitation areas are interlaced with substantial networks of paths, portages, and other routes for movement between local and distant resource zones. Consistent with territorial organization around drainages and their segments, water routes—including major rivers, as well as streams, marshes, and lakes—are most often an integral component of such networks during both warm and cold seasons and are connected with one another by land routes. Water routes are named according to systematic rules. Key locations along such paths may be marked by blazes (the cutting of visible marks in the bark of trees), by provisioning behaviors such as stockpiling of raw materials, or by other devices. Significant environmental features are employed eponymously, as well as for the identification of such locations in the local toponymy, and act as spatial referents for the larger pooled information set.

The use of toponymy—that is, place-names, organized in systematic fashion—can be viewed as a mnemonic with scalar or hierarchical variation. Different kinds of information are portrayed at different hierarchical levels in the cartographic representations of space, suggesting either differential import or differential information recall. If, as has been suggested (Funk 2004, 2005, this volume, Chapter 2), this relates to notions of *landscape queued memory*, then the use of a systematic toponymy acts as the referent to specific points on a landscape, which in turn triggers recall of increasingly refined or detailed information in the information pool. Thus, information appears to be hierarchically nested, with different levels of the hierarchy keyed to different levels of landscape feature, from local habitation to multiple drainage systems.

EPILOGUE

In separate ongoing analyses, the application of these organizing principles as analogues for the Mesolithic of the Yorkshire Dales Hunter Gatherer

Research Project (YDHGRP) research area on the Malham Plateau of northern England suggests that multiple nested scales of spatial organization are evident: one at a macro regional level (Figure 3.11) as defined by Jacobi (1979); and, at the level of the YDHGRP research area, at least two, and perhaps three, separate exploitation areas present in the northern part of the Pennine uplands (Figure 3.12). The River Ribble is west of the Pen-

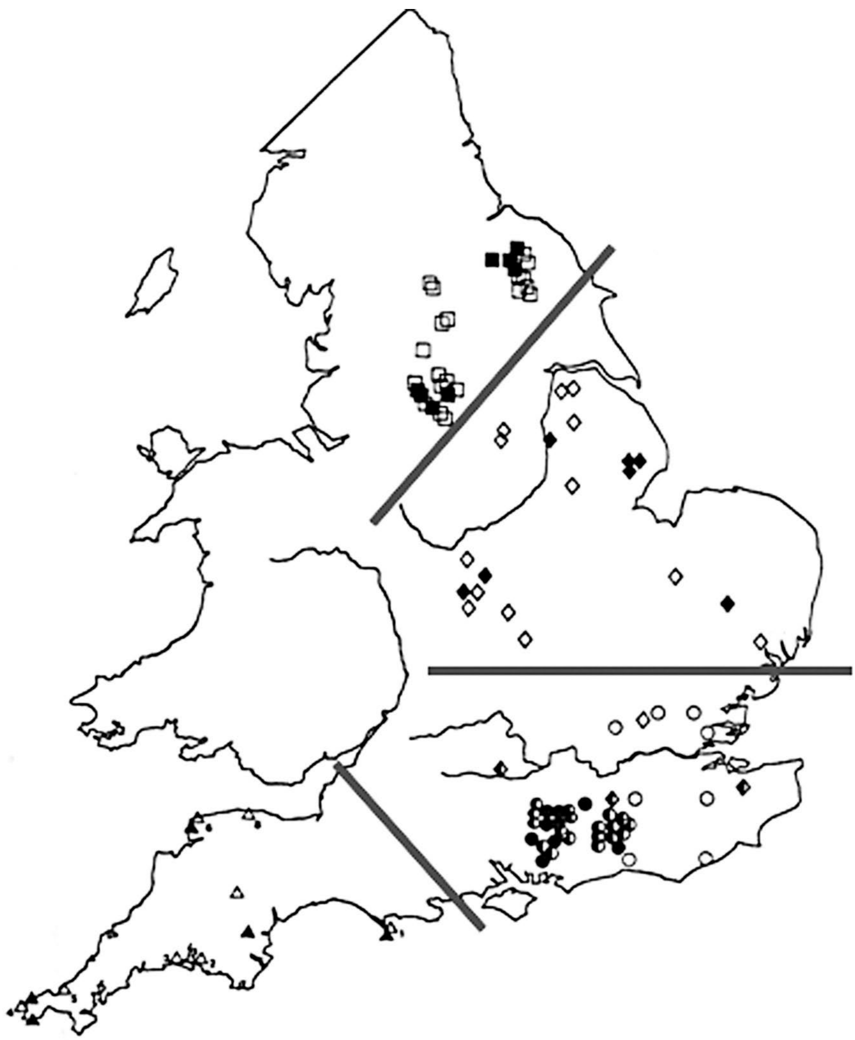


Figure 3.11. Mesolithic partitioning of space in England based on microlith styles and displaying partitioning by drainage and landscape. (*Modified after Jacobi 1979:68, fig. 12.*)

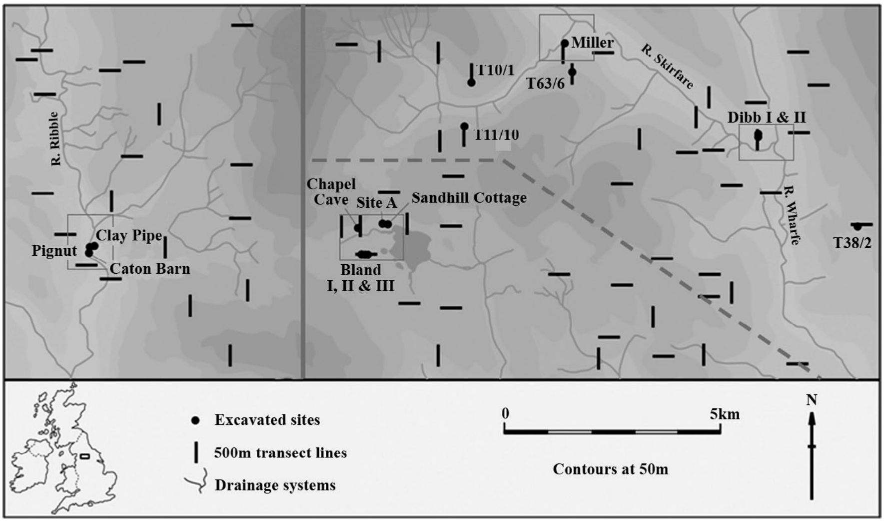


Figure 3.12. Hypothetical partitioning of space in the Yorkshire Dales research area based on drainage features and displaying site clustering around key landscape features, as well as random survey transects.

nine ridgeline and forms the western segment of the study area, and one or more segments of the River Wharfe form the eastern partitions.

Recently, chemical characterizations of Pennine upland black cherts (Evans et al. 2007, 2010; Langer 2007; Langer et al. 2008) have revealed that regional spatial variation may be observable archaeologically, and that its organizational structure is certainly testable. Presently, it appears that chert and flint distributions are organized along an east-to-west, or coastal-to-interior transect, rather than a north-to-south transect. Notably, regional Mesolithic locales in the Yorkshire Dales study area also tend to cluster in areas of highly visible or even regionally unique physical features, or at stream confluences, as might be predicted by the analogue model developed from northern hemisphere hunter-gatherers. Application of the principles outlined here will be pursued in future regional research.

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NOTE

1 As indicated, the cartographer is most likely the hunter with the variably spelled name Tci.bi.c, (T)Cibic, or Cibic (either Jimmy or Simon Rafael; there is a lack of accord between the prose text and the related table; Speck 1927:393, 400).

4 Modeling Hunter-Gatherer Information Networks: An Archaeological Case Study from the Kuril Islands

Ben Fitzhugh, S. Colby Phillips, and
Erik Gjesfjeld

Abstract

This chapter develops a model to frame differences in the degree and intensity of hunter-gatherer information networking as strategic responses to differing degrees of environmental variability and interaction costs. With this model, we argue that hunter-gatherer bands (i.e., more or less egalitarian, small-scale, and mostly wild-food-producing groups) should be more connected at local, intergroup, regional, and supraregional scales when the costs of networking are low and environmental productivity and predictability are also low (probability of local failure is high). At the other extreme, high-cost landscapes with high predictability and reasonable productivity should lead to greater insularity, but with punctuated failures due to rare and unpredictable environmental perturbations. High-cost, low-predictability/low-productivity landscapes should necessitate higher levels of investment in networking, through the generation of specialized traders, subsidized to serve the essential function of connecting groups. And low-cost, high-predictability/high-productivity landscapes should generate networks that are less focused on linking groups for mutual benefit and are instead more political and competitive due to the reduction in interdependence between communities despite the inevitability of social contacts. This model is then applied to an initial study of ceramic and lithic artifacts from the Kuril Islands of the northwest Pacific, where intersettlement distances and ecological productivity and predictability vary across the geographical scale of the island chain.

Introduction

It is well known that small-scale hunter-gatherer societies use several strategies to buffer resource unpredictability, among other goals. The information-based strategies documented seek to increase information about alternate resource patches and their productivity and to preserve information about rare but particularly severe resource failures and possible strategies for their mitigation (e.g., Minc 1986; Wiessner 1982). In this paper, we advance a model that simultaneously takes account of differences in the imperative for information sharing at different scales of space and time and factors in the limits and costs of maintaining such information exchange strategies (see also Whallon, Chapter 1, this volume). This model shares similarities with Whallon's (2006) recent "non-utilitarian" model of hunter-gatherer information exchange, while focusing more on mechanisms of transmission and geographical variability.

Our goal is to better predict variability in the structure of hunter-gatherer information networks as a result of adaptation to environments of differing degrees of marginality and levels of constraints on information sharing. Using initial data from archaeological research being conducted in the Kuril Islands of the North Pacific Ocean, we highlight several predictions that can be drawn from this model. This model provides a framework for understanding the evolution of important aspects of hunter-gatherer interaction patterns as well as changes in vulnerability and resilience to socio-ecological variation.

Definitions and Assumptions

We define information here as

> *a coherent symbolic code of relevance to some topic of interest or concern that can be recorded, supplemented, preserved, transmitted, retrieved, enacted, or even forgotten.*

This definition has an advantage over others (e.g., knowledge, instruction, data) in that it can apply to a wide range of domains (individual learning, social transmission, signaling, genetics) that we might wish to compare when generalizing about evolutionary processes. It emphasizes the dynamic and contextual nature of information.

In the context of information exchange, it is important to recognize the strategic context of social transmission. In exchange networks, information can be shared or denied. It can be reliably transmitted or falsified, and recipients need to evaluate their degree of trust in information sources. Recognizing the political context of information transmission is important if we want to understand the mechanisms structuring information networks.

We assume that all people monitor environmental variables and that they maintain a degree (but not an infinite degree) of flexibility to adjust their behaviors in locally optimal directions to enhance survival, well-being, reproductive success, and other more proximate goals. We are particularly interested in exploring the limits of adaptive capacity in the context of information acquisition and exchange, which will be most identifiable in marginal environments, where failure is more likely than elsewhere. Once we understand how people succeed and fail at the limits of viability, we can explore how evolutionary histories change the boundaries of marginality, making once marginal environments more viable and, in some cases, rendering less marginal environments less viable.

Information Acquisition Strategies of Hunter-Gatherer Bands

Hunter-gatherers have used a number of different strategies to mitigate environmental unpredictability. These strategies (e.g., mobility, sharing, trade) are usually understood in relation to costs and benefits associated with acquiring resources in spatio-temporally heterogeneous environments. Information flow about changing socio-environmental conditions is critical to thriving in such contexts, and anthropologists have discussed a number of strategies used by hunter-gatherer bands to facilitate this flow (Gamble 1993, 1998; Minc 1986; Wiessner 1982). Among others, these strategies include oral traditions, fluid group composition, occasional social aggregation, widespread exchange friendships, and journeying (Figure 4.1). Here, we explore these and other potential mechanisms of information acquisition and preservation as they fit into broader geographical and temporal variability.

Information exchange is embedded within and can be facilitated by social gatherings, ranging from small opportunistic meetings between two or more individuals or family groups to large megaband aggregations brought together for planned ceremonies, trade fairs, and the harvest of temporarily concentrated resources (Whallon, Chapter 1, this volume). Regardless of the scale, periodicity, or regularity of these social gatherings, the result is an expanded pool of *potential* information about the broader state of the environment and available mates and trading partners.

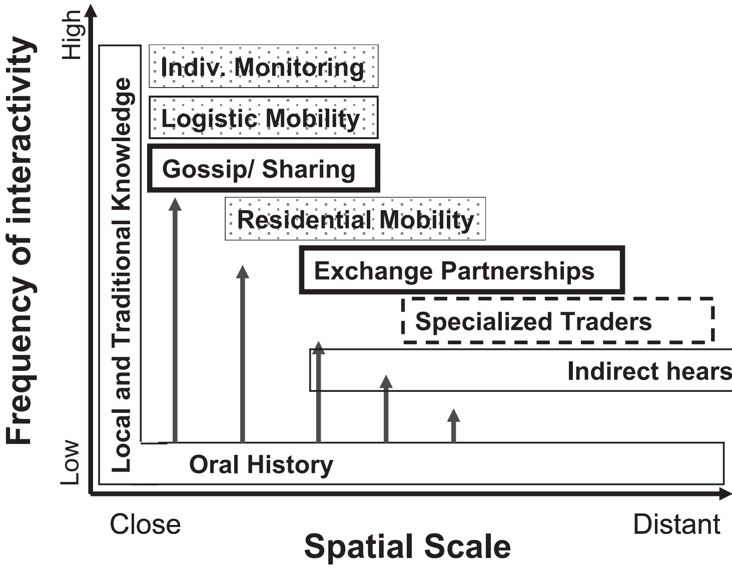

Figure 4.1. Adaptive strategies used by hunter-gatherer bands to maintain information for mitigating environmental unpredictability. The horizontal axis represents the distance over which the strategy is considered effective. The vertical axis reflects the relative rate at which the information is refreshed.

Polly Wiessner's (1982) discussion of the *hxaro* trading partnerships among the !Kung has become the standard model for small-scale hunter-gatherer information sharing beyond the microband. In the *hxaro* model, exchange partnerships serve as a pretext and social interaction as a mechanism for the sharing of environmental information. This model is particularly attractive archaeologically because the information-sharing networks are highly materialized through the exchange of artifacts.

These strategies of information acquisition emphasize the opportunity for sharing of information across different *spatial scales*. Other mechanisms have been proposed for the storage of information about environmental variability *through time and space*, such as the development and transmission of local and traditional knowledge.

Local and Traditional Knowledge as Information Storage

Local and traditional knowledge (LTK) refers here to information that is accumulated, stored, and transmitted through "micro-media" methods (storytelling/oral history and non-mass-replicated forms of literacy such as pictography, journaling, and letter writing, in literate societies). LTK can encode information about past social and environmental states, cycles, and interventions. LTK is a two-dimensional (time and place) form of information storage against which new information is balanced and to which new information is added. *Traditional knowledge* is the accumulation of information observed and shared about such topics as spatio-temporal variations and suitable strategies for exploiting and mitigating variability. Traditional knowledge can develop information about landscapes beyond local experience and store knowledge of historical relationships with neighboring social groups. *Local knowledge* is that part of traditional knowledge that relates individual experiences of local variability to a growing corpus of pooled information held more or less commonly by members of an established group and maintained through a combination of personal experience, instruction, and storytelling. Local knowledge is expected to be the most reliable and accurate form of information, due to its frequent transmission and redundancy with common, everyday experience. LTK forms the bedrock of cultural tradition that grows stronger the longer a group lives in a region and the more variability the population experiences (and survives). *Oral history* is the primary mode of social transmission that preserves LTK, and its fidelity will be based on the population of tradition bearers, the frequency of transmission events, and the consistency of contemporary information relative to the information maintained about past conditions (refreshing information counters loss of fidelity, discussed in terms of the game of “telephone” or “Chinese whispers” by Whallon, Chapter 1, this volume). Colonists to a new environment or survivors of unprecedented environmental and social changes face significant challenges in building relevant knowledge about new or significantly altered ecological settings (Fitzhugh 2004).

Social Network Theory and Relative Vulnerability to Uncertainty

Network theory provides a framework for considering the nature of vulnerability and resilience of information exchange networks (and the people who form them). Assuming comparable capacities of information flow between connected interactors, highly interconnected networks transmit larger amounts of information through multiple pathways, allowing for greater redundancy and high system-resilience to environmental perturbations experienced locally (but see Allenby and Fink 2005 regarding the vulnerability of networks containing a few hubs with higher connectivity). By contrast, low-density networks with fewer connections have a lower capacity to transmit information and are more vulnerable to similar perturbations, though they are potentially more insulated from nonlocal environmental and social impacts. Networks can vary from higher-density (resilient to local perturbations) to lower-density (vulnerable to local perturbations) structures as a function of geographic variability or changes in underlying characteristics of ecology, demography, technology, economy, and society. This systematic relationship allows us to consider spatial variation and temporal change in efforts to understand the place of information strategies in the adaptations of small-scale societies.

Information Network Model

For the purposes of the model described here, the environmental perturbations that matter to people are assumed to scale together in time and space. That is, unpredictable fluctuations in environmental conditions that are locally scaled are also the most frequent and of lowest amplitude. Less frequent but higher amplitude perturbations are also more likely to be manifest over greater areas; thus, the rarest anomalies are also the ones that will affect the largest area and will be the hardest to mitigate. At some scale of space and amplitude, no adaptive strategy will be appropriate, and catastrophic change can be expected. The important derivative of this relationship is that strategies that enable information flow across larger regions and that deal with increasingly rare and severe perturbations are more costly to maintain.

Individual monitoring of the local environment on a fairly regular basis is relatively inexpensive. It can be accomplished more or less incidentally in the course of daily activities. Observations are made of local surroundings, weather, vegetation, animal behaviors, and the skills and moods of colleagues. Social transmission diffuses information about the physical and social environment, reinforcing and qualifying individual observations. Direct observation and social transmission at the local scale are ongoing, allowing for frequent updating and redundancy in information flow (building up local knowledge). These modes of information acquisition are effective for monitoring rapidly changing characteristics of the environment at relatively close spatial and temporal scales. Redundancy allows for an increase in reliability of information and greater confidence in decisions based on that information. Redundancy also encourages honesty in social transmission, since dishonesty is easily disclosed and punished. We call the resulting network a *local* or *inter-band information network* (Figure 4.2). Local network structures provide high connectivity with low opportunity costs.

As geographic distance increases between areas of regular interaction and movement, the frequency and redundancy of information flow deteriorate. Greater degrees of logistical and residential mobility can increase the geographic area under direct observation, though with a modest decrease in the intensity of more local-scale monitoring. In foraging societies where group membership is often relatively fluid, the more socially mobile *individuals* are able to access information over a greater range than others, presumably also facilitating greater social information transfer across multiple residential groups or bands.

Multi-band social aggregations for feasts, parties, and trade fairs provide a mechanism for *supra-band* information sharing among individuals in different minimal bands. These aggregations occur most commonly in the course of other activities where patterns of movement intersect or where large resource windfalls draw bands together (e.g., Legros 1985; Lucier and VanStone 1995). Benefits of aggregation, in addition to updating information about neighboring territories, include the maintenance of reproductive networks. The information that is shared between bands should be more selective than that shared within bands, and we can expect a greater degree of effort placed in establishing and maintaining trust.

Overlapping and expanding the scale of aggregations, *hxaro*-like "friendships" are a special kind of supra-band relationship in which individuals (or families) invest significant energetic and material resources in maintaining information and mutual support networks beyond the band level (see Supra-band networks in Figure 4.2). Compared with wholesale aggregation, these egocentric friendship relationships allow for greater fidelity of information transmission between partners. Multiple ties to partners in different bands increase the diversity of information available, while multiple partners in the same band or close area increase the redundancy of information on particular regions. At greater distances, partnerships become increasingly costly to maintain, requiring more significant tokens to show good faith and trustworthiness. As a result, the costs of exchange partnerships can be measured in the material goods that have to be acquired or produced to fuel the exchange, as well as in the effort involved in traveling to visit with partners (e.g., a function of distance and terrain difficulty). These are real constraints on the number of partners any individual can maintain while they are also obligated to sustain themselves and their families on a daily basis.

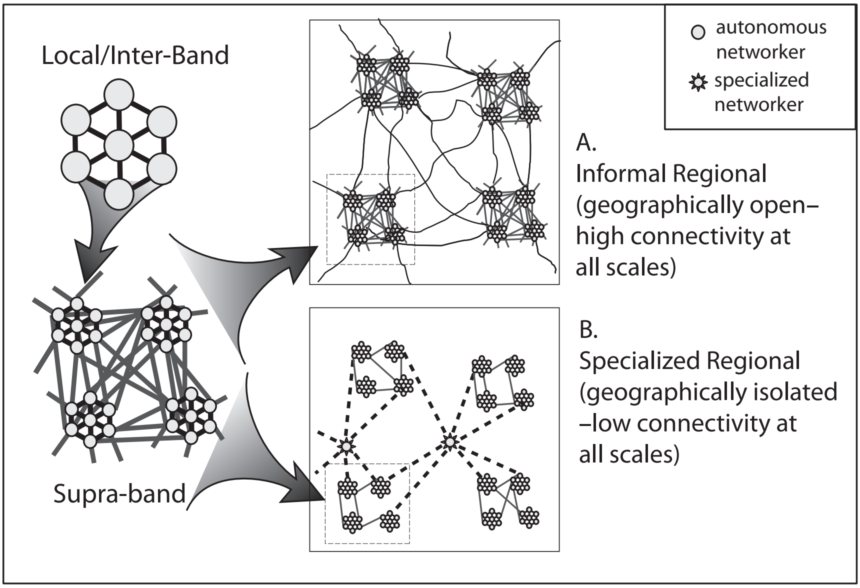

Figure 4.2. Organization of information networks operating at different spatial scales (local/inter-band network; supra-band network, and regional network) and in different extremes of network connectedness: (A) Highly connected, "informal regional" networks should be found on open landscapes with few constraints to interaction across space, in which multiple channels of information flow occur from local to supra-regional scales; (B) minimally connected "specialized regional" network should be found where significant constraints prevent easy interaction over space, in which connections are severely limited and tenuous beyond local scales. In these diagrams, clusters of circles (autonomous networkers) represent co-residential groups or "minimal bands."

Compared with local networks, supra-band information exchange networks (aggregations and exchange partnerships) are moderately connecting and have reduced content volume and reduced redundancy. Individual opportunity costs are relatively high, and fidelity of the information transmitted is reduced due to lower redundancy. Trust is expensive, leading people to invest in more costly signals of friendship. Likewise, as transaction costs increase with distance and reduced redundancy, the average number of dyadic partnerships declines, further limiting flow of effective information networks over distance. As a result of these characteristics, supra-band networks will be most effective in providing information about lower-frequency environmental variability with relatively gradual onset. Knowing which friends to turn to in an environmental catastrophe depends on knowing where conditions have deteriorated and where they are still favorable, as well as which "friends" are most likely to be "friends in need."

At scales beyond local and supra-band networks, some individuals can establish and maintain networks of information flow with relatively low connectivity, leading to lower volume and lower redundancy in information (see Regional networks in Figure 4.2:A, B). The costs of maintaining these far-flung networks can be reduced for the networker through direct subsidies provided by the groups that they visit or by permission of those groups to forage in their territories. The Australian Aboriginal traditions of "walkabout," for example, give some individuals an opportunity to directly observe and become familiar with landscapes and populations beyond the annual rounds and territorial rights of families, bands, and macro-bands (Berndt and Berndt 1999). Returning pilgrims bring with them a fresh store of information about the state of the broader world to share with their families and neighbors. The rate at which this information is refreshed is influenced partially by environmental and demographic circumstances closer to home (local food scarcity, numbers of individuals in appropriate age grades, family dependency on local labor inputs, etc.).

Moving desirable goods from one group to another serves as a particularly attractive proximate justification for acceptance and logistical support during travel away from home and in some conditions can justify the emergence of more or less *specialized traders* who devote disproportionate time and effort to maintaining networks between relatively isolated communities. The networks connected by such traders are good for maintaining information flow about low frequency and large amplitude variations. Examples of specialized traders—albeit better known from more complex societies than is the focus here—can be seen, for instance, in Mesoamerica with the Aztec *pochteca* traders (Charlton et al. 1991; Kristan-Graham 1993). We might expect to see a gradation between walkabout-style travelers (*informal regional networks*) and specialized traders (*specialized regional networks*) based on the capital investments required to travel, with walkabouts and pilgrimages more common across relatively interconnected social landscapes and where provisioning is not too capital intensive. By contrast, specialized traders might be supported more commonly where social landscapes are punctuated by difficult terrain, where travel is risky and requires specialized technology and specialized knowledge, and where provisioning is costly.

We recognize that nonlocal information is often acquired in any group through networks of communication embedded with multiple nodes or transmission events, such as trade and gossip networks. This *indirect hearsay* form of information flow permeates social life and is the primary mechanism through which individuals come to understand the larger world and its changing state. Resulting from the linkage of multiple networks of information flow (e.g., partners of partners of partners), indirect hearsay has the greatest geographical reach of all, but the lowest fidelity over distance. Indirect or down-the-line information exchange is vulnerable to increasingly biased transmission at its joints—those places in network structure where fewer independent pathways exist to carry redundant information—for exactly the same reasons that the game of telephone leads to information distortion (Whallon, Chapter 1, this volume).

Temporal and Spatial Dimensions of Variability

The foregoing discussion focuses on social and spatial scales of information acquisition and transmission. To more fully explore the importance of information strategies to people in small-scale societies, we also need to consider the temporal scale of environmental variation and how different information strategies might serve to minimize people's exposure to hardship at different scales.

Temporal variability has a generally predictable relationship to spatial variability, such that larger amplitude fluctuations tend to have the largest "footprint," requiring more extensive information networks to mitigate negative fluctuations (Figure 4.3). Local information networks and direct observation are most effective for dealing with relatively common, low amplitude shifts in resource productivity, diversity, and distribution, as these networks allow for the most frequent updating of information and the greatest flow of information about local conditions and options. Supra-band-scale networks, such as *hxaro* partnerships, are less effective for dealing with high frequency variability, both because of the reduced frequency of interaction and the higher cost of network maintenance. These networks would instead help to distribute information about inter-annual to decadal-scale variability that might require temporary adjustments or even reorganization of populations into new groups at the regional scale. Such adjustments could extend to somewhat broader scales (though often with increased intergroup conflict) by means of information collected through walkabouts and indirect hearsay over greater distances (facilitated by specialized traders and/or down-the-line social transmission). In rare cases when perturbations are strong but highly localized, mobility and broader networks should provide suitable mitigation strategies, assuming available options for relocation.

The ability to anticipate and deal effectively with high-amplitude centennial or longer-scale fluctuations is limited to strategies for preserving information about ancient experiences preserved in traditional knowledge (Minc 1986). People are most vulnerable to the longest-scale, highest-amplitude fluctuations, for which prior experience (if any) is distant in time and for which relevant information has been transmitted through the greatest number of transmitters (leading to greater opportunity for erosion of accurate content). Millennial-scale variability, such as the large-scale climate change currently affecting the Earth, approaches or exceeds the capacity of most (if not all) existing cultural information strategies to predict and mitigate effectively. Extreme hardship, as well as unprecedented opportunity, large-scale migration, social displacement or demographic expansion, colonization of new regions, and local extinctions are all expected outcomes of environmental fluctuations at these longest time scales.

It follows that, all else being equal, vulnerability to environmental fluctuations decreases the longer a group remains in a region and accumulates local

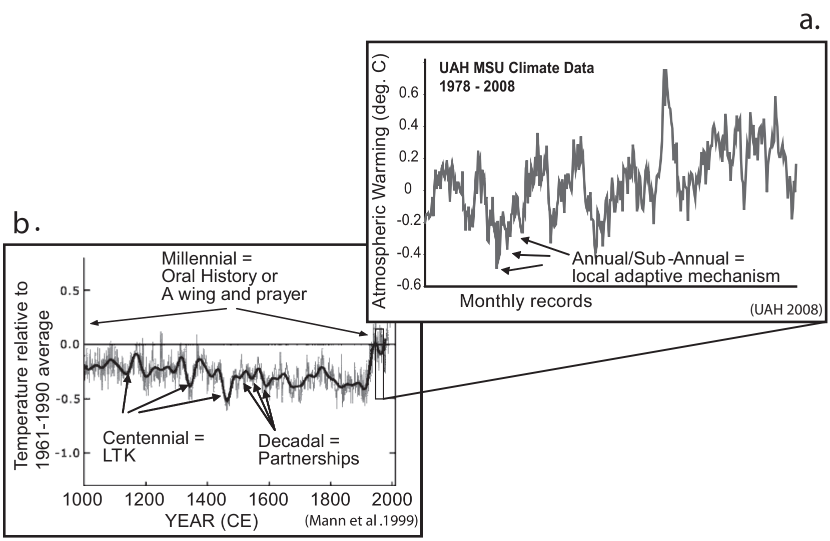

Figure 4.3. Environmental variability at different time scales, showing the inverse relationship between frequency and amplitude and the information networks most effective for different scales of temporal variability. (*a*) Monthly global temperature anomalies in the Lower Troposphere from 1978 to 2008 (data from UAH 2008) used as example of short-term environmental variability; ***(b)*** Mann et al.'s (1999) Northern Hemisphere multi-proxy paleo-temperature reconstruction ("hockey stick" model) for example of longer-term (decadal to millennial scale) environmental change.

and traditional knowledge about the variability affecting them at various spatial and temporal scales. With increased residence time, resiliency should expand from local to more regional scales and from shorter to longer cycles of variability through the accumulation of information.

Geography influences the ease with which different information networks can be implemented. Following basic principles of network theory, information networks should be most resilient (providing the greatest information by which people can adapt to environmental change) where the greatest connectivity is maintained, at all levels from local to supra-regional scales (Allenby and Fink 2005). Figure 4.2:A (informal regional network) shows a resilient social information network with maximum adaptive depth (cf. Slobodkin and Rapoport 1974). In this case, people interact frequently and with minimal constraint locally and regionally, with information of supra-regional conditions flowing into and through the network by means of relatively frequent trade interactions, walkabouts, and indirect transmission. This network structure would be supported by a relatively continuous social landscape, with few physical or social barriers to interaction and short, effective distances between interactors. Figure 4.2:B (specialized regional network) illustrates a vulnerable social landscape in which interaction is costly at all scales due to low population densities, and where interactions involve high opportunity costs. Following the predictions sketched in Figure 4.4, people on such a precarious landscape should put the greatest value in maintaining information networks, despite the greater costs involved in doing so, up to the point at which such connections are no longer sustainable.

Predictions

The relationships outlined in the model allow us to consider the ways that changing social, geographic, and environmental conditions should influence the nature and degree of investment hunter-gatherers place in information network strategies. Figure 4.4 identifies the kinds of information strategies expected to develop under different combinations of environmental predictability and the costliness of maintaining networks at different scales.

Political Networks

In situations of high environmental predictability (low uncertainty and variability assuming sufficient average productivity) and low interaction cost, we

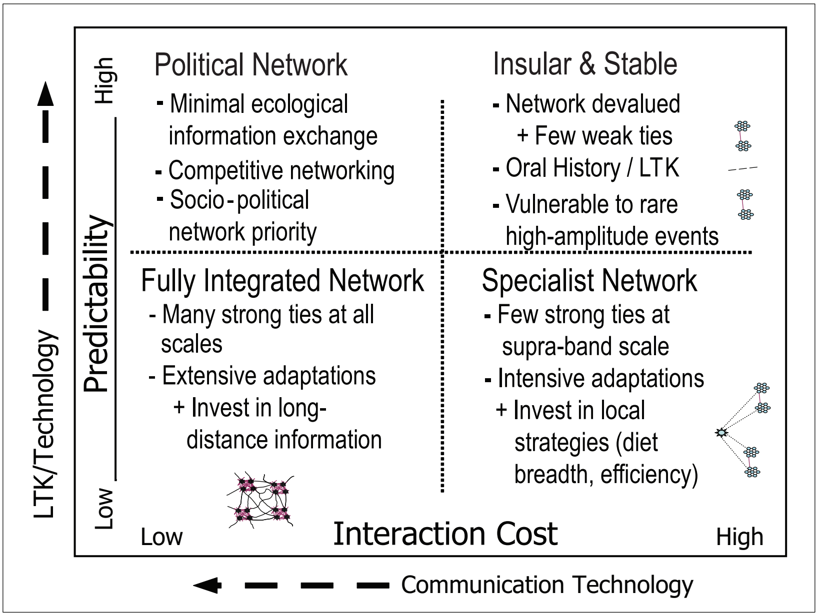

Figure 4.4. Information networks expected for different combinations of environmental predictability and costs of information network maintenance. As a simplification, this scheme ignores the third dimension of productivity and assumes that in all cases productivity on average is sufficient to support whatever population density resides on that landscape.

expect information networks to be externally focused on sociopolitical over environmental content. In these cases, because of the predictable nature of the environment, people should focus their information networking investments/interests in developing social and political relationships, either competing for opportunities to improve their situation relative to others, or attempting to limit their interactions as a defense mechanism against opportunitistic advantage takers.

Fully Integrated Networks

Where environmental predictability is low but interaction costs are also relatively low (and average productivity is sufficient), we expect egocentric networks with many strong ties to emerge. Because of the relatively low cost of interactions relative to the value of information, people would invest in a diverse range of local and regional networks, maximizing their access to information at all scales and creating a network structure of high interconnectivity and resilience. In other words, a set of nested networks at different spatial scales is produced, with many strong ties up to the supra-band level and informal regional integration (walkabouts, etc.).

Specialist Networks

By contrast, a more vulnerable situation occurs where interaction costs are high but environmental predictability is low (and productivity on average is sufficient). In these cases, fewer people can afford to invest in diverse information strategies, and the network should become increasingly specialized, with smaller numbers of interactors maintaining fewer strong ties. Others would invest more heavily in more intensive local strategies (such as expanding diet breadth, improving technological efficiency, etc.) to mitigate unpredictability. The resulting network structure would be one of low connectivity and high vulnerability. We would expect this kind of network to be more prone to failure, compared with an informal regional network, especially early in the period following initial colonization or after a major social or environmental change.

Through time and under circumstances of relative social and environmental stability, we expect a successful population to increase their local knowledge and ability to mitigate variability locally, allowing them to become less dependent on extensive networks, but perhaps rendering them more vulnerable to rare perturbations (Fitzhugh and Kennett 2010). Increased technological effectiveness can both reduce the costs of communication (e.g., by improving the safety or facility of engaging in communication networks) and increase the predictability of environmental outcomes (e.g., through development of mass harvesting and storage technologies, or better mechanisms for tracking or securing resources). Technological developments, however, also often lead to unintended consequences, such as altered system parameters (prey populations, human population densities, etc.) and dynamics, in ways that render accumulated knowledge less relevant to future variability.

Insular and Stable Networks

Where there is high environmental predictability and sufficient local productivity to support settlement but also high interaction costs in connecting settlements, we expect networks to be minimal and adaptations to be internally focused. Under these circumstances, investment in the high cost of interacting with and maintaining information networks is less warranted, given the predictable nature of the local environment. On the other hand, while this kind of insularity may be economically efficient, given short- and medium-term environmental variability, it would make communities more vulnerable to unprecedented or very infrequent negative environmental fluctuations. Communities maintaining this kind of network structure might generate archaeological signatures characterized by long periods of stability and independent cultural developments, punctuated by catastrophic loss or abandonment.

THE KURIL ISLANDS

The Kuril Islands in the northwest Pacific Ocean provide an interesting case for exploring the adaptive imperative for information sharing at different places and points in time throughout the island chain. The Kuril archipelago (Figure 4.5) is an active volcanic island arc spanning the Okhotsk Sea–Pacific Ocean boundary from Hokkaido to southern Kamchatka. The Kuril Islands comprise 160 Quaternary terrestrial and 89 submarine volcanoes, with 32 of the volcanoes known to have erupted in the past 300 years (Ishizuka 2001). Tephra layers present throughout the islands indicate that prehistoric volcanic activity was a regular occurrence.

The Kurils become more geographically isolated toward the center of the island chain, and vary in size from 5 km^2 to 3,200 km^2, with the northernmost and southernmost islands generally much larger than those in the central region. For the purposes of this paper, we divide the Kurils into three geographical zones: southern (Kunashir, Iturup, and Urup), central (Chirpoi to Matua), and northern (Shiashkotan to Shumshu). In spite of their mid-latitude location, the Kuril Islands experience subpolar conditions in winter due to strong northwesterly winds (Leonov 1990). Sea ice covers up to one-third of the Sea of Okhotsk by the end of the winter season and typically reaches the southern Kuril Islands from the west. With partial ice-free ocean upwind, heavy snow is common from November to March. Summers are characterized by dense fog and mild southerly winds (Rostov et al. 2001).

Marine and anadromous fish, marine mammals, and birds are common throughout the Kuril Islands. Sea otter (*Enhydra lutris*), northern fur seal (*Callorhinus ursinus*), and sea lion (*Eumetopias jubatus*) frequent the shores and bays of the islands. As of the mid-twentieth century, few land mammals were present in the Kurils, with most concentrated on the larger islands close to Hokkaido and Kamchatka (Hacker 1951). Recent biogeographic surveys of the Kuril Islands have found that southern-source land mammals and freshwater fish extend north only to Iturup, while freshwater fish and mollusks from the north have made it south only to Paramushir, rendering the majority of islands in the center of the island chain relatively impoverished in these taxa and lowest in overall species richness (Pietsch et al. 2003).

Today the marine food webs in this region are supported by Arctic Ocean nutrients carried into the region from the Bering Sea by the cold Oyashio current. These nutrient-rich waters are supplemented by dissolved iron from the Amur River outflow into the western Sea of Okhotsk. These ingredients converge especially off the southern Kurils and northeast Hokkaido and lead to high primary productivity in the spring, following the melting of Okhotsk sea ice (Chiba et al. 2008; Heileman and Belkin 2008; Kasai et al. 2009; Mustapha et al. 2009; Qiu 2001). Farther north up the Kurils, the primary productivity is today much more limited than in the southern islands, and we can expect this relative pattern to have persisted in the past, despite possible fluctuations in the overall productivity of the system, tied to changes in the

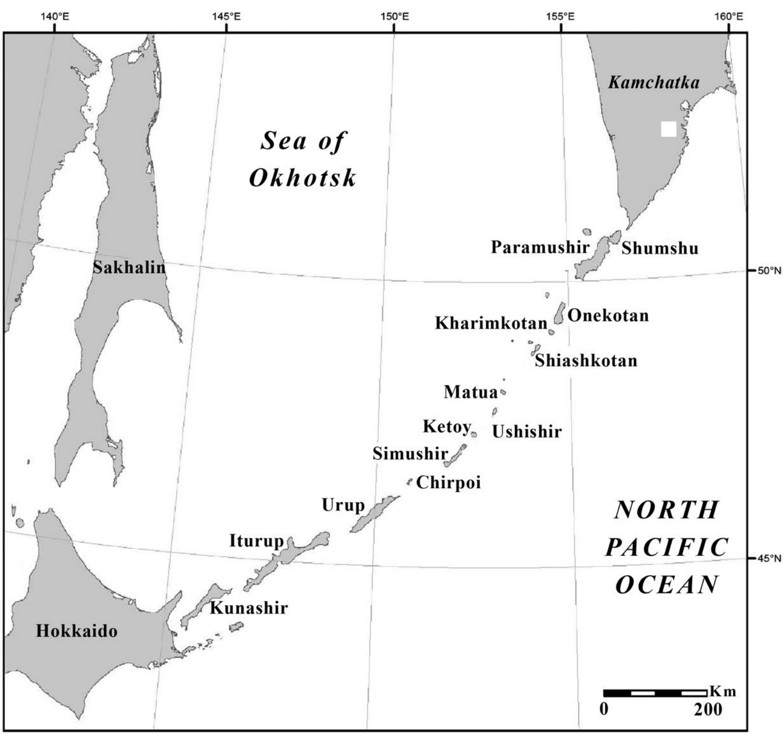

Figure 4.5. Map of the Kuril Islands.

North Pacific low pressure system and the corresponding strength of the Oyashio current. Only upon reaching the eastern and western coasts of Kamchatka do we again see predictable hotspots of primary productivity. As a result, the marine ecology of the Kurils can be characterized as having an abundant and diverse southern zone and a relatively deplete central and northern zone. Terrestrially, the south is also the most productive and ecologically diverse, followed by the northern islands of Paramushir and Shumshu, which have small numbers of Kamchatkan fauna.

Model Predictions for the Kuril Islands

In the Kuril Islands, two key variables will affect the vulnerability of a population to specific environmental fluctuations. The first is the inherent productivity and variability of the environment in which people live; the second is the facility through which supra-band and larger-scale networks can be maintained. These variables are largely independent of each other, but both are tied in part to geography, in part to demography, and in part to technology. Given the linear orientation of the Kuril Island chain and the regional differences in ecological diversity that are present, information network strategies should shift dynamically with cycles of island colonization, occupation, and abandonment. In the southern parts of the island chain, settlements would have been able to develop in closer proximity under conditions of greater ecological productivity and diversity, as well as greater availability of suitable settlement locations to support larger population densities. Higher ecological diversity would also have resulted in lower vulnerability to perturbations in any single resource or suite of related resources. Due to the low interaction costs between more closely spaced settlements, these groups would have been externally focused and highly interconnected. However, the more predictable and productive nature of their environment should place an emphasis on networking for sociopolitical purposes, more so than ecological information exchange (= Political Networks).

The Kuril Islands can be classified as an island environment demonstrating subpolar climate variations. The most northern latitudes of the Kuril Islands have lower ecological diversity than the southernmost islands, while also being prone to rare sea-ice incursion from the Okhotsk side of the Kamchatka Peninsula. (The southern islands get pack ice more predictably for a month or so in peak winter, due to the counterclockwise flow of the Sea of Okhotsk.) The low ecological diversity makes the northern Kurils more ecologically unpredictable than the southern islands, but probably less so than the central islands. The greater unpredictability of resources should encourage network structures that invest in access to longer-distance information in order to mitigate unpredictability. Because Kamchatkan groups would be relatively accessible to northern Kuril residents (travel costs are less than in the central islands), the information network model suggests many strong ties between these areas. Thus, the northern regions are most likely to demonstrate a more integrated set of network relationships at all scales (= Fully Integrated Networks).

The central Kuril Islands present different challenges in colonization and maintenance of information networks. In this region, where ecological diversity is at its lowest and distances between neighboring populations would be the most costly to maintain, we would expect people living in these remote regions to invest more heavily in maintaining a few, but strong, network ties to compensate for their local vulnerability. These ties would be essential early in a colonization phase, before locally sufficient population densities and local knowledge are developed (see Fitzhugh and Kennett 2010). If information networks persist after initial colonization with no reduction in interaction costs, populations may come to depend upon specialists to maintain network relationships. In this case, network specialists link groups that are inwardly focused on adapting to local environmental conditions (= Specialist Networks).

Alternatively, in times of ecological plenty, when the local human population density is low, interaction costs high, and productivity/predictability of resources high, residents of the central Kurils may be able to weather most unpredictable fluctuations without the support of a wide network. This outcome would be expected with an expansion in local knowledge and internally oriented investments in localized adaptations (such as expansion of diet breadth or technological efficiency). The information network model suggests that networks may be devalued in such cases, leading to only a few weak ties with other groups (= Insular/Stable Networks). While optimal in certain circumstances for short- and medium-range perturbations, this strategy would render populations most vulnerable to the very rare, high-amplitude crises that occur beyond the scope of LTK adaptation.

The Kuril Islands: Cultural History

Terrestrial Hunter-Gatherers

The earliest archaeological remains in the Kuril archipelago are found at the sites of Yankito and Kuibyshevo (Iturup Island) and Sernovodskoe (Kunashir

Island) and date to around 7000 B.P. (Samarin and Shubina 2007; Vasilevsky and Shubina 2006; Zaitseva et al. 1993). Archaeological materials from the Sernovodskoe show early relationships between the southern Kurils and Hokkaido, with large, cord-marked ceramics characteristic of the Early and Middle Jomon periods of Japan dating from at least 7000 to 2500 B.P. (Vasilevsky and Shubina 2006). While little is known about the adaptations of these earliest Kuril occupants, we assume that they lived much as their Jomon cousins did in Hokkaido. These early groups lived in small and highly mobile populations subsisting primarily by terrestrial hunting and gathering, which was supplemented by small amounts of fish and shellfish (Imamura 1996; H. Okada 1998; Y. Okada 2003).

Marine Hunter-Gatherers: Epi-Jomon

The inhabitants of Hokkaido shifted from terrestrial foraging to an increased reliance on marine mammal hunting (whale, seal, sea lion) between 5000 and 3000 B.P. (Niimi 1994). The Late Jomon and Epi-Jomon periods are recognized as the first consistent occupation of the Kuril islands (Fitzhugh et al. 2002; Niimi 1994; Yamaura and Ushiro 1999). The Epi-Jomon occupation of the Kurils appears to be one of the first and most expansive settlements of the region, with large numbers of sites extending north of the Bussol Strait (between Urup and Simushir) into the more remote central islands. Yamaura (1998) suggests that increased sea mammal hunting may have been related to cooler climatic conditions and increased populations of sea mammals in the area around Hokkaido and the Kuril Islands. Increased sea mammal populations, along with technological specializations, would have improved the overall return rate of sea mammals and favored population expansion into the central islands.

Marine Hunter-Gatherers: Okhotsk

The Okhotsk culture flourished during a time of significant social and economic change across East Asia (Hudson 2004). The Okhotsk period is usually divided into three distinctive stages (Amano 1979 in Hudson 2004:294). The first stage identifies the initial expansion from south Sakhalin Island into the islands of the Japanese archipelago, including Rishiri, Rebun, and northern Hokkaido. This stage is characterized by a heavy reliance on marine resources as well as breeding of pigs (Yamaura 1998). The second stage is identified as an eastern movement of Okhotsk culture to the northeastern corner of Hokkaido and into the southern Kuril Islands (Hudson 2004:294). During this stage, the Okhotsk culture, similar to its Epi-Jomon predecessor, expanded from the southern islands through the central islands and to the northernmost Kuril island of Shumshu. The third stage is identified by high population pressure on Hokkaido, leading to the assimilation of the eastern Hokkaido Okhotsk with their Satsumon neighbors and increasing the separation of northern Okhotsk groups from cousins in the Kuril Islands. After 800 B.P., the Okhotsk culture is replaced or assimilated on Hokkaido and, perhaps later, on the Kuril Islands by or into Ainu cultural groups (Yamaura and Ushiro 1999).

Ethnographic Hunter-Gatherers: Ainu

The Ainu presence in the Kuril Islands is first noted in ethnohistorical accounts where distinct Kuril Ainu cultural and linguistic groups are distinguished (Kono and Fitzhugh 1999). The Kuril Ainu are said to have lived throughout the island chain in relatively large pit-house villages as well as smaller seasonal camps (Fitzhugh 1999). Kikuchi (1999) suggests that the Ainu movement from Hokkaido into the Kuril Islands would have likely taken place during the fourteenth or fifteenth century A.D.; these tentative dates seem to coincide with radiocarbon dates obtained by the Kuril Biocomplexity Project (Fitzhugh et al. 2008). During the early eighteenth century and into the nineteenth century, the Russian-American Company settled the Kurils with transplanted Alaskan and Siberian sea mammal hunters (Shubin 1994). The Japanese occupation of the Kurils during the twentieth century forcefully displaced a number of Ainu populations, and World War II saw the fortification of the islands by the Japanese and then Soviet military and the complete removal of remaining Kuril Ainu to Hokkaido (Stephan 1974).

Refinements in Culture History: Initial Results of the Kuril Biocomplexity Project (KBP)

KBP teams documented occupations from each of the culture historical phases that are known to have been present in the Kuril Islands. Based on existing radiocarbon dates (Fitzhugh et al. 2002; Zaitseva et al. 1993) and new dates generated by the KBP (Fitzhugh et al. 2008), several dates between 4250 and 2300 B.P. suggest a small but persistent occupation of the southern Kurils during the Middle to Final Jomon periods of Japan. Earlier occupation is suggested by Early and Middle Jomon diagnostic ceramics found at various locations on Kunashir and Iturup (Samarin and Shubina 2007). Numerous radiocarbon dates from the northern and central islands range from 3450 B.P. to 2450 B.P. and suggest persistent activity on these islands for the first time within these dates. Through diagnostic ceramics found in the central island of Rashua, the earliest colonization of these islands seems to be directly linked to Final or Epi-Jomon cultures from Hokkaido. In the northern islands, we are so far unable to resolve whether the earliest occupation of Shumshu Island occurred from a culture of the Kamchatka Peninsula to the north or from a culture from the Japanese islands to the south.

A surge of occupation of the Kuril Islands begins in the Epi-Jomon period and is represented by a significant increase in the number of radiocarbon dates for this period and the distribution of Epi-Jomon ceramics through much of the island chain. Diagnostic Epi-Jomon ceramics are common in many archaeological sites from Kunashir to Shiashkotan, and Epi-Jomon pottery is tentatively reported from the northern Kuril Islands of Paramushir and Shumshu (V. O. Shubin, personal communication).

The Okhotsk-period occupation of the Kuril Islands is well represented throughout the island chain. Okhotsk-type materials are found as far north as the southern tip of Kamchatka (Dikova 1983), and the Okhotsk-period presence in the Kuril Islands suggests that these people were prepared to adapt to the environmental and ecological variability they would have experienced across the length of the island chain. Based on KBP radiocarbon dates, the end of the Okhotsk period falls around 700 B.P., roughly coeval with the time when Okhotsk populations are replaced by the Ainu on Hokkaido.

Evidence of Ainu-period occupations is relatively scarce throughout the Kuril Islands. Ethnohistoric accounts (Krasheninnikov 1972) and earlier archaeological research (Baba 1937, 1939; Baba and Oka 1938) documented Ainu settlements across the length of the island chain, while systematic survey over three field seasons of KBP have found very few Ainu sites relative to the earlier periods. While historical accounts suggest significant Ainu occupations, we are evaluating the possibility that Ainu colonization of the central and northern Kurils occurred late in the Ainu period and may have been less substantial and more mobile than earlier occupations (Fitzhugh et al. 2008).

Evaluating Model Predictions

Ceramic Technology

The Kuril archipelago lies on the periphery of two major prehistoric ceramic producing centers. To the south lay the Jomon cultures of Japan and to the west, the cultures of the Amur River, both of which exhibit some of the oldest known pottery in the world (Jordan and Zvelebil 2010). The earliest ceramic vessels in the Kuril Islands correspond to the Early Jomon period (7000–5000 B.P.) and are located exclusively in the southern islands nearest to Hokkaido (Vasilevsky and Shubina 2006). The influence of Hokkaido ceramic styles is strongly evident in the Kuril Island ceramic assemblage, with a vast majority of ceramic artifacts from the Kuril Islands stylistically similar to ceramic traditions found on Hokkaido (Epi-Jomon, Okhotsk, and Ainu). The similarity of Kuril pottery to ceramic traditions on Hokkaido suggests spatial and/or temporal relationships between the cultures of the two areas. The main goal of current and future research on ceramic artifacts is to use predictions derived from the information network model to help refine understandings of the spatial and temporal interactions between inhabitants of the Kuril Islands and Hokkaido.

Drawing from the information network model, we expect inhabitants of the Kuril Islands to engage in various adaptive network strategies based on the (technologically mediated) interaction costs associated with geographic location and environmental predictability. Given the variability in interaction costs related to the geography of the Kuril archipelago, the information network model would predict that the manufacture and transmission of ceramic artifacts might differ in various regions based upon the network strategies employed by inhabitants of each region. For example, in regions characterized by significant inter-island distances and low environmental predictability (such as the central Kurils), we expect limited movement of ceramic artifacts outside of the local region, as groups tend to focus on local adaptations with the potential for long-distance ties through a specialized network. Alternatively, in regions characterized by lower interactions costs and moderate levels of environmental predictability (e.g., the northern Kurils), we expect movement of ceramic artifacts across multiple spatial scales (local, supra-local, regional, and long distance) related to the gathering of regional ecological information. Regions with low interaction costs and high environment predictability (most closely approximated here by the southern Kurils) would also demonstrate movement of artifacts across multiple spatial scales; however, the movement is more likely to relate to the flow of social or political information, rather than ecological information, given the high environmental predictability. Therefore, the expectation for ceramic artifacts in the southern Kurils would be the increased movement of ceramic styles associated with forms of social or political information across multiple spatial scales.

The evaluation of predictions derived from the information network model was of central interest in pilot research focusing on the location of manufacture and the transmission of ceramics. Using ICP-MS (inductively coupled plasma-mass spectrometry) methods, 200-mg samples of 58 ceramic vessels were submitted for elemental composition analysis at the Institute of the Earth's Crust, Siberian Branch of the Russian Academy of Sciences, Irkutsk, Russia. Ceramic samples were chosen from various spatial and temporal ranges. The sample was a mixed-age assemblage, with a majority of ceramic samples not identified to a specific cultural period (41) but also including culturally identified samples from the Epi-Jomon (10), Okhotsk (5), Tobintai (1), and Ainu (1) periods. Spatially, the ceramic samples represent all three regional groups, including the southern (27), central (20), and northern (11) islands.

Using a combination of principal component analysis to identify key elements (Nb, Mo, W, Zn) and hierarchical cluster analysis to identify initial cluster groups, eight ceramic source groups were identified. Source group composition appears to be strongly related to the geographic position of sites in the island chain, as six out of eight ceramic source groups have significant affiliation to a particular geographic region. For example, ceramic source groups (CSG) 1, 4, 6, and 7 all have over 90% of sites located in the southern region, whereas CSG-3 has 100% of its sites located in the central region, and CSG-2 has 67% of sites located in the northern region. Two ceramic source groups (unidentified) do not have a significant majority of sites that are characteristic of a specific region (CSG-6: 50% southern; CSG-8: 50% central).

In order to relate ceramic sourcing data to the predictions of the information network model, we attempted to characterize the aggregated regional source groups (southern, central, and northern) by the geographic distance between sites identified in each regional source group (Table 4.1). The identification of distances between ceramic source group sites is an attempt to understand the scale of networks (local band, supra-band, regional, interregional) in each region of the Kuril Islands. Representative distances for each type of network scale were arbitrarily chosen and set at the following: local band (< 40 miles), supra-band (40–100 miles), regional (100–200 miles), interregional (> 200 miles).

The preliminary interpretation of ceramic sourcing data from the Kuril Islands generally fits with the predictions of the information network model. The model suggests that with the habitation of marginal ecological areas characterized by high interaction costs (central islands), network ties

Table 4.1. Distribution of Network Ties between Sites with ICP-MS Analyzed Ceramics

	Southern (14, 25) (CSG-1, 4, 5, 7)	Central (3, 6) (CSG-3)	Northern (5, 9) (CSG-2)	Unidentified (7, 12) (CSG-6, 8)
Local band	29%	100%	20%	21%
Supra-band	10%	0%	0%	6%
Regional	5%	0%	14%	9%
Interregional	48%	0%	66%	65%

NOTE: Sites are grouped by regional source group. The total number of sites represented by each regional source group and the total number of ceramic samples within each group are provided next to the regional source group headings (e.g., 14, 25). Six samples were considered outliers and did not correspond to any source groups.

will tend to focus toward local and supra-band scales, with primary investment in adaptations to local conditions and potential for various long-distance ties to maintain flows of ecological information. Alternatively, areas with more predictable environments and lower interaction costs (larger island size) will tend toward multiple-scale networks, emphasizing either the flow of social and political information or ecological information, depending upon environmental predictability. As identified in Table 4.1, ceramic sourcing data suggests multiple-scale network interactions among sites in the southern and northern regions, with insular ties characterizing sites in the central region (Figure 4.6). Further, qualitative analysis suggests that the southern ceramics were more highly decorated and had a greater diversity of design styles, suggesting more sociopolitical significance. While the current data is not sufficient to highlight specific contexts of colonization, isolation, or political networking, the integration of ceramic sourcing data with lithic data (see below) provides suggestive insights within the context of the information network model, which will be pursued further in future research. The next step in our ceramic studies will focus on increasing the spatial and temporal resolution of regional ceramic source groups, with analyses of larger sample sizes and improvements in the chronological control over ceramic proveniences through radiocarbon dating and directly through luminescence dating.

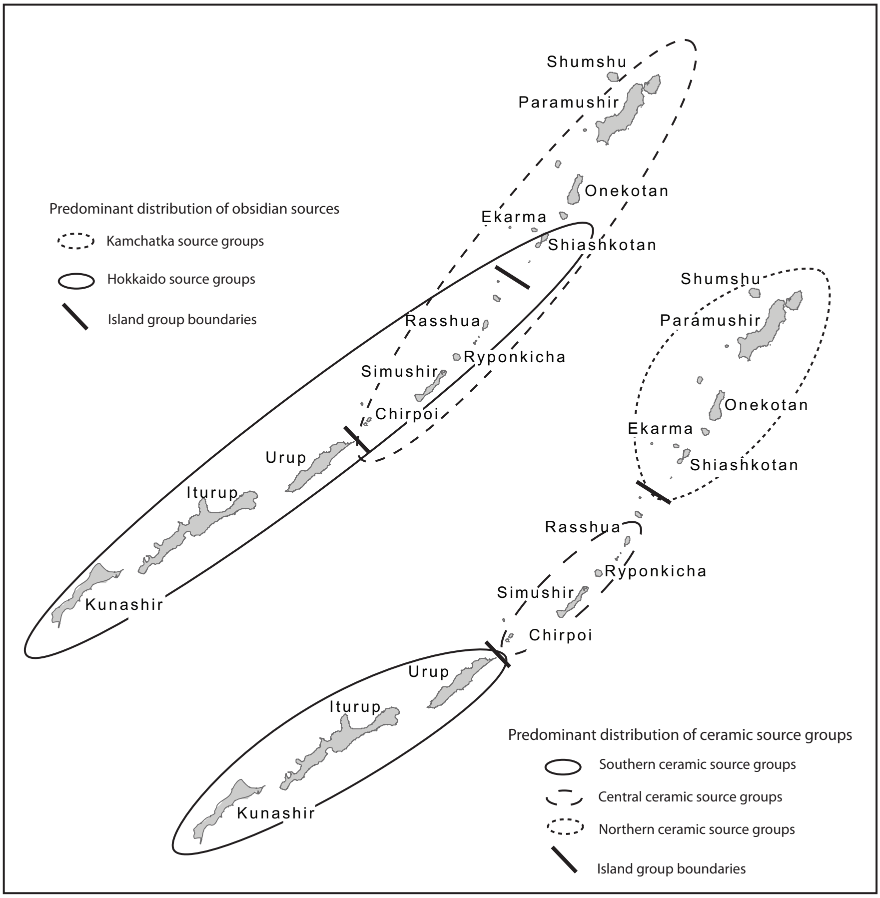

Figure 4.6. Maps of the Kuril Islands showing the general distributions of obsidian from Hokkaido and Kamchatka sources, and zones of shared ceramic geochemical similarity.

Lithic Technology

Lithic artifacts recovered through KBP excavations include a number of tool types (projectile points, knives, scrapers, and drills), but there are currently no culturally diagnostic tool forms or typologies. Lithic raw materials represented among the tools types and tool production debitage include obsidian, basalt, chalcedony, and a variety of different colors of chert (Fitzhugh et al. 2004). Although lithic artifact assemblages from across the Kuril Islands include tools and flakes made from obsidian, there are no geologic sources of obsidian in the Kuril Islands that are known to have been used prehistorically (Phillips and Speakman 2009). Nonlocal obsidian brought to the central Kuril Islands may initially have come through migration and colonization events as groups moved through the islands in search of marine resources and/or group fission sequences. We tentatively accept the discovery of local ceramic manufacture in different island regions as an indication that the Kurils were occupied more or less year-round, at least in the Epi-Jomon and Okhotsk periods (from which the majority of archaeological deposits were found). If this conclusion holds, then we can treat the long-term presence of nonlocal obsidian in Kuril archaeological sites as material traces of social connections that enabled obsidian trade.

Based on predictions of the model specific to the initial colonizers of the central islands, we would expect to see evidence of ties maintained to parent communities in the form of nonlocal obsidian from whichever source area people were migrating (Hokkaido or Kamchatka) in the colonization levels of excavated sites with obsidian artifacts (in the case of the Kurils, based on ceramic typologies, there appear to have been at least three separate colonization events, all from Hokkaido). An information network tied to maintaining access to long-distance, nonlocal obsidian could be classified as a specialist network, though obsidian itself may simply be an index of the degree of interactions occurring over space, in which obsidian was one of many materials circulated, along with information. As groups developed wider-ranging, more regional network connections, the diversity of different obsidian sources in obsidian assemblages should increase as people gain access to obsidian from additional sources from beyond the distal end of the island chain (in Kamchatka, in this case). The information network may transition to either the fully integrated or political network, based on the predictability of other ecological resources and the population density in those areas that are most interconnected (the ends of the islands).

Source provenance analysis of nearly 1,000 obsidian artifacts from Kuril lithic assemblages has demonstrated that obsidian from volcanic sources on Hokkaido and Kamchatka were widely used for stone tool production in the Kuril Islands (Phillips and Speakman 2009). The general pattern of obsidian source distribution indicates some geographic correlation between source area and archaeological site locations. In the southern Kurils, obsidian from four Hokkaido source groups is dominant, making up over 95% of the obsidian assemblage. Conversely, obsidian assemblages from central and northern island sites are dominated by Kamchatka obsidian source groups, which represent 71% of the central island obsidian artifacts and 97% of northern islands obsidian artifacts. In the central islands, three Hokkaido sources make up a combined 25% of the obsidian assemblage, indicating maintenance of connection to Hokkaido (though diminished, when compared with the southern island assemblage). Central island access to Hokkaido sources may have been intermittent and dependent on the ability of central island inhabitants to incur the cost of investing in the maintenance of southern-oriented relationships. However, this minimal connection appears to have been sufficient to keep updated cultural information flowing in from the south, as seen in ceramic decorations.

Given the geographic proximity of the southern and northern Kuril Islands to Hokkaido and Kamchatka obsidian sources, respectively, the extension of obsidian trade or transport networks from local source areas to adjacent islands is not surprising. Lithic assemblages from these areas should show a more even distribution of obsidian relative to other types of lithic raw materials through time. In the southern islands, the greater breadth of lithic resources available and the lower cost of access to Hokkaido obsidian sources are representative of more predictable lithic raw material resources. This is congruent with the overall characterization of the southern islands' greater ecological productivity and diversity, and their ability to support higher population densities, which would be indicative of a more politically oriented information network. In the higher latitude, subarctic northern islands, less environmental predictability and productivity and apparently lower population densities would mean a continued focus on integrated networks as an adaptive strategy. As groups of people originally from Hokkaido and the southern Kuril Islands persisted in the central islands, they may have found it too costly in terms of time and energy, and too risky in terms of boat navigation, to maintain primary access to Hokkaido obsidian sources across the Bussol Strait, the widest strait between islands in the Kuril chain and a recognized biogeographic barrier between the southern and central islands (Pietsch et al. 2003). Oddly enough, securing access to obsidian sources in Kamchatka, presumably through network exchange, may have provided a more economical and reliable alternative to Hokkaido obsidian, thus fostering social connections to the Kamchatkan mainland. Although networks related to the access and trade of obsidian from sources in Kamchatka are less well known, inhabitants of the central and northern Kurils used Kamchatka obsidian extensively (Figure 4.6). With a growth in population density in the central Kurils, the development of a down-the-line obsidian procurement system from Kamchatka into the central islands could have facilitated a locally integrated information network composed of many shorter, tighter local ties, and only connected outside of the larger region indirectly via down-the-line relationships.

DISCUSSION

Preliminary findings from ceramic and lithic geochemical analyses, taken together, suggest that geography was important to the kind of social networks created and maintained in the Kuril Islands, irrespective of chronological attribution. (Geographical patterning in ceramics and lithics in terms of deposit ages is a more involved study currently under development.) In the context of an archaeological record most closely affiliated culturally with Hokkaido (Jomon/Epi-Jomon, Okhotsk, and Ainu), the ceramic and lithic sourcing studies indicate strategic responses to degrees of geographical isolation, ecological predictability, and productivity.

As obligate maritime hunter-gatherers, Kuril settlers were primarily dependent on the ecological productivity of the marine ecosystem. While that system is buffered from the most extreme swings of climatic fluctuations by its maritime context, geographical variation in island size and inter-island distance, extent and complexity of near-shore ecozones, and the dynamics of oceanographic currents influenced the needs for and nature of networks to mitigate environmental variability. While the data sets we have explored here are small and our conclusions preliminary, the patterns in the ceramics and obsidian data complement each other.

Collectively, these data indicate that the southern Kuril Islands of Kunashir, Iturup, and Urup were the most closely connected with one another and with Hokkaido in exchange of obsidian and in the manufacture of ceramics. This most closely approaches the low-cost, high-predictability cell in Figure 4.4, though we do not propose that hunter-gatherers living in the southern islands were unaffected by environmental variability. Nevertheless, it is telling that of all the Kuril Islands, only the southernmost have evidence of fortified defensive sites during Okhotsk and Ainu times (Samarin and Shubina 2007), and our finding that ceramics from this region are the most elaborated is also consistent with a more politically oriented social pattern. We suggest that this difference relates to the greater interdependence required of people living in the central and northern islands, a condition predicted based on the lower primary productivity and greater need for inter-island alliances.

The northernmost islands of Paramushir and Shumshu were also fairly well connected to the adjacent mainland, in this case Kamchatka. As already noted, the stronger material connection to the north is seen in obsidian trade despite strong cultural affinities to Hokkaido. Nevertheless, the northern islanders experienced reduced marine productivity and a less dense mainland population with which to trade. Environmental predictability would have been moderate as a result of the lower productivity, though farther north, on the east and west coasts of Kamchatka, marine productivity increases (Sea Around Us Project, n.d.). The obsidian trade with Kamchatka implies a reasonable access to network partners to the north and the facility of moving north onto Kamchatka when times were challenging (or vice versa), which supports expectations of a fully integrated network. Ceramic data further support this view of interaction in the last few centuries before Russian contact, as distinctive Ainu *naiji*, or inner-lugged pottery, was used up the east coast of Kamchatka as far north as Avacha Bay and the modern city of Petropavlovk-Kamchatsky (Dikov 2003). There is no evidence at present of the emergence of political competition in the northern islands, as there is in the south, and we expect that people in the northern Kurils and southern Kamchatka experienced predominantly mutualistic interactions.

Unsurprisingly, the central Kurils are the most insular, making pottery from local sources and obtaining obsidian from both ends of the chain. Interestingly, the vast majority of obsidian in the central islands is of northern origin, suggesting greater facility of exchange with neighbors to the north than to the south. Prior research also suggested that the central islanders utilized more conservative lithic reduction strategies, implying limited access to quality raw materials (Fitzhugh et al. 2004). This implies a significantly increased cost to interaction over distance *in both directions*. Evidence of locally manufactured ceramics in the central islands further supports this relative insularity. The central Kuril islanders seem to have most often operated somewhere between the Specialist and Insular Network modes, maintaining minimal cultural connection to related populations to the south and somewhat more significant economic interactions with people to the north, while doing as much as possible locally to minimize long-distance interaction costs. Occupation of the central Kurils at all must have been largely possible only because of the relatively abundant populations of fur seals, sea lions, and sea birds, especially in summer months. This seasonal abundance, however, is vulnerable to perturbations, and with limited ecological diversity, alternative resources are not readily available. Zooarchaeological evidence from the small central island of Chirpoi indicates that residents typically exploited the limited range of available taxa (most that would be passed over in a more diverse and productive ecosystem) as compared with taxa from Shumshu and a site in southern Sakhalin (Fitzhugh et al. 2004:107–115). Thus, despite the availability of marine mammals to support maritime hunter-gatherers in the central islands, isolation and the low ecological diversity (and overall low primary productivity) made it necessary for residents to maintain social ties to the outside world in order to have predictable access to food as well as to potential marriage partners.

Conclusion

Initial results from the Kuril Biocomplexity Project demonstrate the utility of the information network model for developing testable hypotheses about the nature of information networks across gradients in geographical isolation and environmental productivity and predictability. Kuril ceramic and lithic assemblages represent just two forms of evidence for material network interaction and exchange that can be considered evidence of information network organization. While we have hypothesized that information networks should be dynamic in the face of changing variables of cost and predictability, we have not, in this paper, attempted to evaluate dynamic changes in networks as a result of shifts in environmental conditions (e.g., climate change), developments in the facility of transportation or communication (e.g., technological improvements in boats), or changes in the content volume and quality of local knowledge and similar variables that alter the nature of interdependence among potential network partners.

As our analysis of the Kuril data proceeds, we hope to be able to address issues of chronological change in ceramic and lithic source variation, manufacturing, function, and style in the context of environmental, demographic, and cultural changes that should alter network strategies dynamically throughout the evolution of Kuril occupation history. A critical focus of this expanded effort will be the ways that network strategies changed from colonist to descendant communities and in the run-up to abandonment of part or all of the Kurils at various points in the occupational history of the island chain. The nature and status of information networks in the central Kurils may have allowed people to retreat from the center of the chain in the face of long-term ecological unpredictability or in the aftermath of a large catastrophic event; or perhaps the lack of strong networks was a factor in the potential extinction of local groups that had no safety net in times of loss.

Clearly, information is critical to the long-term sustainability of relatively insular hunter-gatherer populations. The information network model provides a framework for predicting different networking strategies that could have been pursued in response to differing degrees of isolation and environmental predictability. Expansion of this model could put more focus on issues of productivity, reproductive strategy, and other goals of social interaction that no doubt complicate many social networks, even in relatively remote and harsh conditions. The model could be expanded to consider gradations of political-ecological networking, with implications for transitions to less egalitarian societies, as implied by the short discussion of political networks in this paper. Finally, we believe that the application of social network analysis (SNA) tools to archaeological data sets holds great promise in efforts to better understand hunter-gatherer variation in the past.

Acknowledgments

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5 Environmental Knowledge among Central African Hunter-Gatherers: Types of Knowledge and Intracultural Variations

Mitsuo Ichikawa, Shiho Hattori, and Hirokazu Yasuoka

Abstract

With its simple tools and the diverse and complicated nature of resources, hunting-and-gathering involves information-intensive technology, which naturally requires hunter-gatherers to have deep and wide-ranging knowledge of the environment. Such knowledge includes practical information about animals and plants, skills in procurement techniques, as well as knowledge of folktales, taboos, and ritual performances related to the environment. The first two require empirical observations and technical information, whereas in the latter, expressive or normative aspects are more important. These different types of knowledge are often interconnected; empirical and technical knowledge is incorporated into the knowledge of ritual practices and storytelling, and vitalized there, whereas the latter, with cultural values and lively images, facilitates the acquisition, transmission, and elaboration of empirical knowledge of the animal and plant world.

While these types of knowledge are mostly shared and standardized among the members of a community, there are other types of knowledge, such as knowledge of the unpredictable distribution of animals in dense forests or of the use of medicinal plants, which largely depends on personal observations and experiences. Though such knowledge has, to some extent, an empirical basis, it is less standardized and shows a higher degree of intracultural variation.

Keeping these characteristics in mind, this study describes various types of knowledge about animal and plant resources among Central African hunter-gatherer groups (known as "Pygmies") and analyzes the characteristics and interrelationships of different types of knowledge. It also examines intracultural variations in different types of knowledge and the acquisition processes through which such variations are generated, and discusses the implications of these results for hunter-gatherers' long-term adaptation.

Introduction

Hunter-gatherers generally depend on simple tools for their subsistence under diverse and complicated environmental conditions. They, therefore, employ information-intensive technology, which naturally requires them to have deep and wide-ranging knowledge of the environment they utilize. In particular, detailed knowledge of animals and plants on which they depend is necessary for maintaining their subsistence and culture. Practical knowledge of the distribution, ecology, and behavior of the animals and plants, the utility of the resources, and procurement techniques and skills are all indispensable to their hunting-gathering lifestyle.

There are also other types of knowledge: knowledge of folktales, taboos, and ritual performances related to the environment. Unlike practical knowledge, these are generally expressive, metaphoric, or normative, but also play important roles in their culture. While these types of knowledge differ from one another with regard to the roles they play and the meanings they convey in the group's material and spiritual life, they are often interconnected and mutually enriched by the other types of knowledge. For example, practical and technical knowledge, which is usually based on close, empirical observations, is incorporated into the knowledge of ritual practices and storytelling and is vitalized there with vivid images. Ritual knowledge, with its cultural values and lively images, facilitates the acquisition, transmission, and elaboration of empirical and practical knowledge. The interconnection of these different types of knowledge was illustrated in the works of Megan Biesele (1993) in her study on the folktales of the San hunter-gatherers in the Kalahari.

In this article, we first describe some of these different types of knowledge, and their interrelationships, taking examples from the knowledge of plant and animal resources of the Mbuti hunter-gatherers in northeastern Congo and of the Baka hunter-gatherers in Cameroon. Both of these peoples are living in the Central African rainforests. We show some of the characteristics as well as some of the intergroup and inter-individual differences of these types of knowledge. We then examine the factors for generating these characteristics, with special reference to the process of acquiring the knowledge, and the social backgrounds that influence this acquisition process. Finally, we discuss the implications of these characteristics in the knowledge system for long-term hunter-gatherer adaptations to the environment.

Different Types of Knowledge among Central African Hunter-Gatherers

Practical Information about Resources

The tools used for subsistence activities by the Central African hunter-gatherers are generally simple: they include knives of various sizes, spearheads, bows and arrows, machetes, clubs, and digging sticks. Some people, such as the Mbuti in the Ituri Forest and Aka in Central Africa and Northern Congo-Brazzaville, use nets for collective hunting. According to Leroi-Gourhan (1973), these simple tools are better considered as just an "extension of the body" for manipulating the environment. They are effective and efficient, particularly for prehistoric humans who were, unlike other predatory carnivores, weak predators without sharp teeth and claws and without strong sensory organs or running and chasing ability. In order to use these tools efficiently, however, their users also had to have rich and precise information on the ecology and behavior of the target animals.

In hunting-and-gathering practices, a variety of information is required and actually used. First, information of resource utility is essential—that is, whether or not a resource is useful, for what purpose it is used, and how it should be processed before use. Such information is indispensable for the proper use of resources. Then, information about how useful resources are distributed in the forest plays a vital role in foraging activities. This is best illustrated by the hunter-gatherers' nomadic movements. For example, the Baka hunter-gatherers in Cameroon spend at least part of the year in the remote forest for a long-term foraging expedition, called *molongo*, which often continues as long as several months without returning to the village site. During *molongo*, the Baka subsist by hunting and gathering alone. In particular, two species of wild yams, *Dioscorea semperflorense (esuma)* and *Dioscorea praehensilis (safa)*, both with annual stems, are most important, providing them with more than 60% of their energetic intake during the *molongo* period (Yasuoka 2004, 2006).

Figure 5.1 shows the nomadic pattern and campsite locations during the *molongo*. The Baka have precise knowledge of where large patches of these two species of wild yams are located, and they stay there for a long time, often for more than a month. By contrast, they stay for much shorter periods, several days at the longest, where there are no such concentrations of wild yams. Here they depend on wild yams with perennial stems, and honey. However, they have no information about the distribution of these resources, which are sparsely and rather randomly distributed in the forest. The nomadic pattern during the *molongo*, therefore, reflects the distribution patterns of their key food resources.

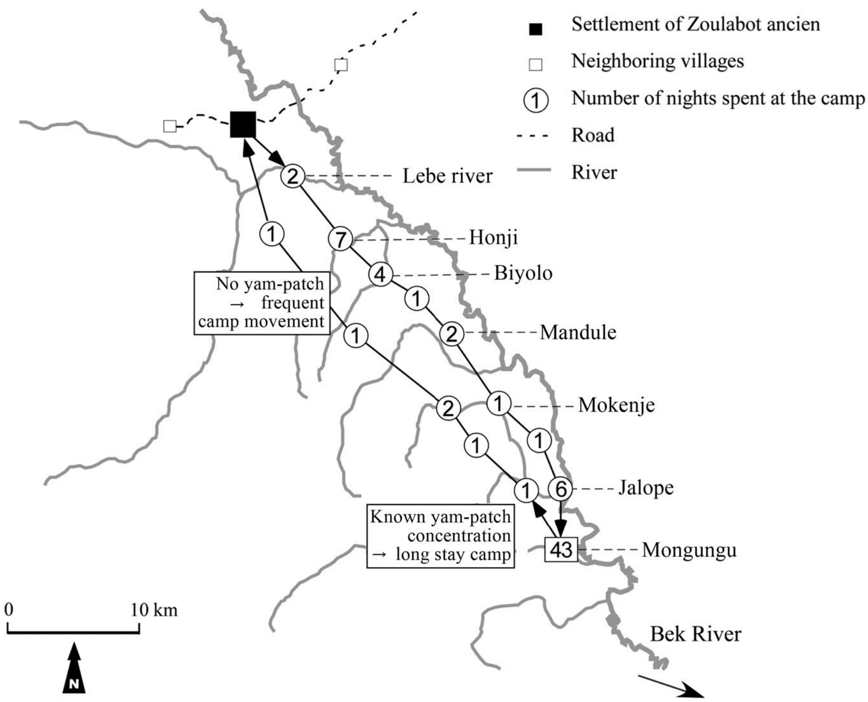

Figure 5.1. Itinerary of *molongo* (long-term hunting expedition). Knowledge of distribution of yam patches affects the nomadic pattern and campsites during *molongo* of the Baka hunter-gatherers in Cameroon. A random distribution produces a different nomadic pattern than a patchy concentrated distribution (modified from Yasuoka 2004, 2006).

In collective net hunting, a principal hunting method employed by the Mbuti in the Ituri Forest of Congo-Kinshasa (DRC), hunting grounds (the places to set nets) are selected almost randomly in the forest (Ichikawa 1983). This is because the Mbuti have little information on the actual location of animals in the forest. The major target animals of net hunting are forest antelopes (duikers). These animals live either solitarily or in pairs and are thought to be distributed randomly, or more or less evenly, in the forest (Ichikawa 1983). Some are nocturnal and hide themselves in the dense bush; they are invisible in the daytime, which makes it difficult for hunters to locate the animals before they start beating the forest. Consequently, they encircle a forest area of approximately 2 to 3 hectares, with 8 to 10 nets totaling 400 to 500 m in length, without knowing whether or not animals will be found in the net circle. Hunters usually attempt several rounds of collective netting in a day; each round takes about an hour, and the next round is attempted at a distance of only 5 to 10 minutes' walk from the previous round. When they occasionally catch sight of an animal, or its fresh traces, they set the nets to encircle the bush in which the animal is thought to be hiding. This indicates the importance of information on animal distribution in the forest, though such information is not usually available. They therefore set nets more or less evenly in the forest. As shown in Figure 5.2, there is a strong correlation of hunting yields with the total areas encircled by the nets in one day's hunting, which are represented here by the number of nets cast (hunting rounds) in the day's hunt multiplied by the square of the number of nets used in the hunt.

This is in sharp contrast to the hunting strategies practiced in savanna areas, where most of the larger animals are gregarious and found in specific places, such as waterholes and grazing/browsing ground. In other words, where animal distribution is unpredictable but supposed to be even, hunting yield is more stable, as in the case of net hunting in the forests. Conversely, where animal distribution is uneven, and concentrated in unknown places, as in the case of larger savanna herbivores, hunting yields fluctuate considerably. In the latter type of environment, information about an animal's distribution and location is a key to successful hunting.

Accurate knowledge of animal ecology and behavior is also important to the success of hunting. Hunters generally know well what wild animals feed on in the forest. The Efe hunters in Ituri often make a scaffold, called a *keki*, in a tree, for ambushing their prey, which approach to feed on fruits in their productive seasons. They also know the behavior of giant forest rats inhabiting an underground nest, and plug up all the exits, send smoke in from one of the exits, and catch the suffocated animals by digging in the nest. By the

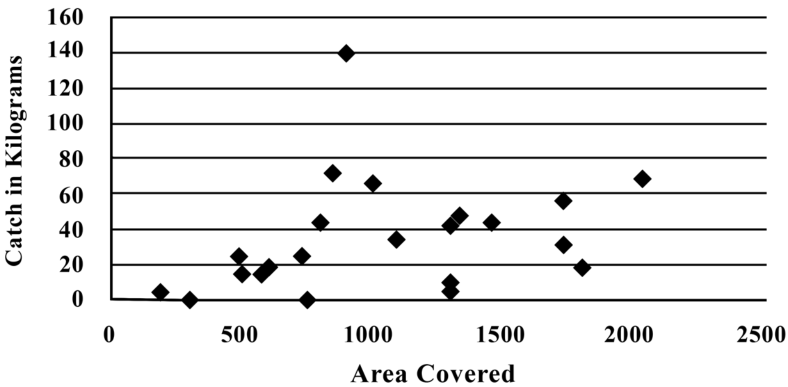

Figure 5.2. Correlation between the catch and the area covered by nets in day's hunt. The vertical axis shows the catch in kilograms, and the horizontal axis shows the area covered by the day's hunt in square meters, calculated as the square of the number of nets (which represents the area covered by an attempt) multiplied by total number of attempts in a day (data from the Appendix in Ichikawa 1983).

faint noise made by the animal, they can precisely pinpoint where the animals stay in the long, complicated underground tunnels.

In searching for natural beehives, the Efe (as well as their southern neighbors, the Mbuti) depend on the buzzing sound; they know the bees buzz in early morning around the nest, which makes it easy to find them out. They also examine the soil that contains dead bee bodies, killed by some ants, to find the beehive in a tree standing nearby. The fatty, winged termites are one of their favorite foods; they collect these termites at the time of their mating flight, which usually takes place in a few minutes at dawn in the late rainy season. This requires extremely precise knowledge of the timing of their mating flight. When the mating flight season comes, they often visit the termite mounds, which they have found and marked to show their ownership, and carefully observe the termites' behavior in the nest mound to check the timing of mating flights. When they find the termites are ready for the flights, they go to the mound the previous evening and prepare for the termites' flight, which usually takes place just before the dawn (Ichikawa 1982).

Most important and basic is knowledge about the utility of resources—that is, about which animals and plants can be used, and for what purposes (food, medicine, material culture, and the like). Knowledge of utility is indispensable to proper use of resources. Examples from the Mbuti hunter-gatherers show that, in addition to over 200 animal species eaten, they use more than 100 plant species for food. For medicinal use, more than 200 plant species are regarded as useful for curing and preventing various diseases. Plants are also used as materials for making houses, tools, clothes, ornaments, and other material culture. The Mbuti use more than 300 species for these purposes (Terashima and Ichikawa 2003).

Knowledge of Non-Practical Uses

Plants and animals also play important roles in the spiritual life of hunter-gatherers, which in turn is crucial for maintaining their culture and cultural identity. While animals are important sources of protein and fat, they are also believed to cause various diseases if they are not eaten properly. Such animals are called *kuweri* among the Mbuti, *eke* among the Efe, or *ekila* among the Aka (Ichikawa 1987, 2007; Lewis 2008). These animals are thought to be "bad animals" or "dangerous animals." Among the Mbuti, for example, parents avoid eating genets because they believe this can cause a bad fever in their small children. The Mbuti say that genets cause such a severe disease because of their fierce eyes and strong smell, which are characteristics of "dangerous animals." Pregnant Mbuti women avoid the giant rats; because the rats normally stay in an underground nest, the Mbuti fear that child delivery may be delayed. In the stomachs of dwarf crocodiles there are small stones, gastroliths, which the Mbuti use as ritual medicine for protecting their children from illness and other dangers in their lives, and they avoid eating the crocodile meat for fear that it may cause severe diarrhea in their children.

Comprehensive research on such food avoidance practices among the Mbuti shows that 43 mammal species out of 57 recorded in the study area are avoided by pregnant women and their husbands and by parents whose children are still breastfeeding. They fear that these animals may cause diseases and other disorders in their small children.

Most of these animals have either strong smell (animals with scent glands), fierce eyes (characteristic of carnivores), spines (porcupines), anomalous features (e.g., tree pangolins with fish-like skin who live in trees like birds, and chevrotains which frequent the river), or some other conspicuous physical features or habits. The Mbuti feel uneasy about these characteristics and fear that they may cause health disorders, particularly in their dependent children. By observing these avoidances, the Mbuti remind themselves of the dangerous state of their children (or unborn children in the case of pregnant women) and try to behave more carefully in their daily lives.

It is interesting to see that these food restrictions are sometimes disregarded. In such cases, specific measures are taken for prevention and cure. If their children fall ill, and it is thought to have been caused by a "bad animal," they immediately try to cure it by applying "medicine," which is specific to the animal that "caused" the illness. Generally, a part of the animal, a piece of bone or fur, or a part of the plants eaten or inhabited by the animal, is used for prevention and cure of such an illness.

It is clear in these cases that ritual knowledge and practices are closely linked to Mbuti empirical knowledge; they give special meanings to an animal's (or plant's) shape, smell, and other physical characteristics, ecology, and behavioral habits, and incorporate them into ritual practices. Their rich empirical knowledge of animals and plants are used for preventive and curing measures.

The habits of animals are also vividly represented in the narratives of everyday experiences and in folktales, which comprise, along with dancing and singing performances, one of the major entertainments among hunter-gatherers. Particularly in the evening time, when few other amusements are available in a forest camp, people enjoy the storytelling performed by elders. Animals are personified in the storytelling, which is also based on minute observation of the animal habits and ecology. Also, through this storytelling, knowledge of animals is transmitted to the young, even before the young actually encounter them in the forest.

A Mbuti folktale of the tree pangolin and tree hyrax, which once lived side by side in the same tree, is a good example of how empirical and practical knowledge is combined with expressions in storytelling. In this folktale, a tree pangolin, a quiet and slow-moving animal, always complains about the noise (scream) that its neighbor, a tree hyrax, makes every night. Both of them are finally found and caught by a Mbuti hunter, because of the noise made by the hyrax. This folktale, narrated with vivid mimicry of the two animals, illustrates how empirical knowledge of these animals' habits is essential to the folktale, which in turn vitalizes the empirical knowledge in the expressive narrative. Moreover, such folktales facilitate closer observations of the animals and contribute to increasing the store of empirical knowledge about the animals, as Biesele (1993) pointed out in her study of San folktales. It is natural that we pay more attention to the animals that are already familiar to us from their personified behavior in the folktales.

Description and Analysis of Indigenous Knowledge: AFLORA Project

We have developed a database of wild plant uses in tropical Africa, in which indigenous knowledge of plants is described, classified, and coded for quick retrieval. This project, called AFLORA (AFLORA Committee 1988; Terashima et al. 1991), is primarily meant to preserve indigenous knowledge of plants (ethnobotanical knowledge), which has been accumulated and transmitted through centuries of observation and interaction between humans and the floral environment. It also enables us to quickly retrieve the information on the plant uses of particular taxa, areas, and ethnic groups.

The unit of information in the AFLORA database is a "record," which corresponds, in principle, to a set of data collected about one plant specimen by a researcher during a specific research period among a specific ethnic group. Included in the record are scientific name, life form, habitat, frequency, and other botanical information, along with ethnographic information such as the vernacular name, etymology, use, and other ethnobotanical information (Ichikawa et al. 2001; Terashima and Ichikawa 2003). When fully documented, a record consists of a total of 27 information fields, as shown in Table 5.1.

The data is specimen-based rather than taxon-based. We arrange the data in this way in order to facilitate one of our major research interests, intercultural and intracultural comparison. In other words, we are as much interested in cultural variability and diversity in plant use as in the material bases (nutritional values, bioactive substances, etc.) of the plants. Besides the information in a text form, some records contain visual data (photographs, drawings) as well (Ichikawa et al. 2001).

Intergroup and Intragroup Variations in Knowledge

In comparative ethnobotanical studies based on this database, we found important characteristics of indigenous knowledge. There are considerable intergroup and inter-individual variations (differences) in the subjects' knowledge of plants. We describe the extent of these differences, examine the ways in which these variations are produced, and discuss the implications of these findings for understanding hunter-gatherers' knowledge and long-term adaptation.

We conducted a comparative study of the vernacular names and use of plants among four different groups of hunter-gatherers (two Mbuti groups and two Efe groups) living in a similar forest environment of the Ituri Forest (Ichikawa and Terashima 1996; Terashima and Ichikawa 2003). This study showed that considerable differences do exist among the four groups. While some differences are found in the uses of plants for food and material culture, the highest variability (degree of differences) is exhibited in the use of plants for medicinal and ritual purposes, as shown in the lowest similarity indices in the composition of plant species between the different groups (Table 5.2).

Table 5.1. Information Items (Fields) included in Each Record

1	ID number of the record given by the person who reported this record
2	Species name (scientific name)
3	Family name (scientific name)
4	Common names in English, French, Swahili, or other lingua franca
5	Date of the collection of the specimen
6	Collector(s) of the specimen
7	Area information such as region category, typical vegetation, etc.*
8	Location: detailed information on the location of the research
9	Specimen information: the place and state of the specimen
10	Identification: the person or institute that identified the plant
11	Plant form such as tree, herb, shrub, liana, etc.
12	Environment: micro-habitat where the plant was found
13	Frequency: general observation on the frequency of the plant
14	Other botanical information
15	Ethnic group with which the ethnobotanical information is concerned
16	Vernacular names given by the ethnic group
17	Etymology of the vernacular names
18	Usage type: usage and plant categories
19	Usage: details of usage written in free text style
20	Informant(s): the name, age, ethnicity and sex of each informant
21	Chemical substances contained in the plant
22	Figure or photograph, when available
23	References
24	Remarks
25	Record author: the person who reported the record
26	Date of registration of the record into AFLORA database
27	Latest update date

* For the details of regional categories and vegetation types, see Terashima and Ichikawa 2003.

Table 5.2. Similarity Indices* of Food (top), Material Culture (middle) and Medicine (bottom) between the Four Groups

	MWB	NDY	ADR
TTR	0.52	0.36	0.34
	0.20	0.16	0.16
	0.26	0.11	0.11
MWB		0.44	0.40
		0.21	0.19
		0.19	0.21
NDY			0.43
			0.20
			0.15

Similarity index (S.I.) = N(a, b)/(N(a) + N(b) – N(a, b)), where N(a) and N(b) represent the number of species used in groups a and b, and N(a, b) = the number of species used in both groups. Only the records in which species names are identified are included in the calculation. (Data derived and modified from Terashima and Ichikawa 2003.) TTR and MWB are the two Mbuti groups (bands), and NDY and ADR are the two Efe groups (bands), all living in the Ituri Forest, Democratic Republic of Congo.

Higher similarity indices in the plants used for food and material culture seem to be natural, because there are commonly acknowledged material bases for the plants used for these purposes. Plants used for food generally have high nutritional value and palatability. Plants used for construction and making tools also have common physical characteristics, such as strength, elasticity, durability, and ease of working (Ichikawa and Terashima 1996).

The diversity in plant use may reflect characteristics of the botanical environment, which itself exhibits great diversity. The flora of African tropical rainforests is less diversified than that of Southeast Asia or South America, but it still contains from several dozens to a hundred woody plant species per hectare, or 2,000 to 3,000 plant species in a large region (see, e.g., Jacobs 1981; Richards 1964). This diversity of the plant world is reflected in the diversity of plant use among the four groups. In spite of the overall biological diversity, the number of plants of the same species may be limited. This means that the species composition in a small area is likely to differ from place to place, even if the general environment is similar throughout the forest. While the same species may not be available in the nearby forest, there are other species with similar characteristics in the forest. In other words, the people have many choices for all needs, whether ritual, medical, or nutritional. Such floral diversity provides the people with a basis for the differences in the use of plants for specific purposes.

Unlike the plants used for food and material culture, differences in most of the medicinal plants could not be explained by their material basis, nor could they be simply attributed to the diversity of the floral composition. There are other, cultural or social factors for the diversity of the knowledge.

As to the social factors for the differences, Ichikawa and Terashima (1996) suggested that there is no strong social force toward unification or standardization of knowledge in these societies, which is partly due to the lesser degree of centralized authority, lack of systematic school-like education, or any other authoritative social systems. All of these social characteristics would otherwise facilitate standardization of the knowledge system. We examine such social factors in more detail in the last section.

Differences are also found at the individual level, as Hattori (2007) reported recently. She collected about 600 plant species among the Baka hunter-gatherers in Cameroon, each with detailed ethnobotanical information. For 90 commonly found species, she compared the knowledge possessed by 10 adult Baka informants who belong to different sex and age categories, and she found considerable differences do exist in their knowledge. In particular, the knowledge of medicinal and ritual plants showed the greatest variation: knowledge of less than one-fifth of such plants was shared by six or more informants. By contrast, the knowledge of plants used for food and material culture showed much less variation, with more than three-quarters of food plant uses shared by all the 10 informants (Figure 5.3). These tendencies are similar to the above-mentioned intergroup differences in the Ituri Forest case. Like the results from the intergroup comparison, higher inter-individual similarity in food and material culture seems to be natural; there are commonly acknowledged material bases for the plants used for food and material culture.

As to the factors affecting the higher degree of difference for the medicinal plants, Hattori (2007) argued that it is due to the process in which such knowledge has been transmitted. Figure 5.4 shows the relationships of persons from whom the knowledge of medicinal plants has been acquired. More than 80% of the knowledge was acquired from parents, and most of the remaining part from elder siblings, grandparents, and other elders. Typically, individuals learn about the medicinal plants when they are treated with

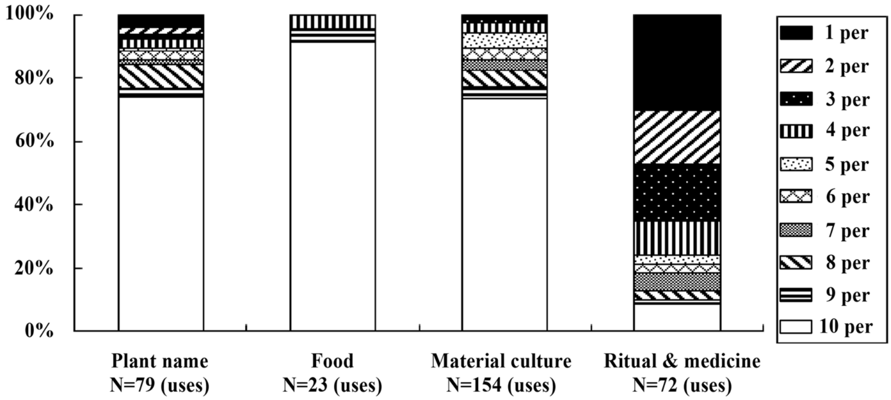

Figure 5.3. Individual differences in the knowledge of plant uses among the Baka in Cameroon. Different use categories show different degrees of shared knowledge (i.e., the percent of plants about which knowledge is shared by 1 to 10 informants). Knowledge of medicinal plants shows the highest degree of individual variability. "N" represents the total number of uses reported by the 10 informants for each category. The original data were obtained from interviews with 10 informants on 90 plants (see Hattori 2007).

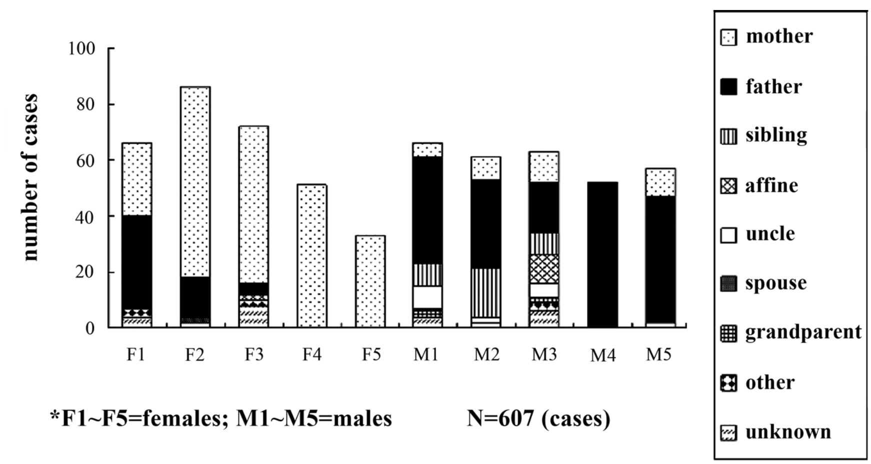

Figure 5.4. "Vertical" transmission of knowledge on medicinal plants. The figure shows the persons from whom the knowledge of medicinal plants is acquired and the number of uses (cases) each individual acquired. More than 80% of cases are acquired from parents.

these plants by their parents or other elders, or when they witness treatments done for other people. As a result, the knowledge of medicinal plants is more or less of a personal nature, reflecting the life history of a person.

In addition, the differences in medicinal and ritual uses of plants are maintained or even reinforced by the culture's highly individualistic attitude toward knowledge of other people; they often let other people do things in their own ways, saying that "each person has his or her own medicine," effective for his or her diseases, as Hattori (2007) described in her previous paper.

IMPLICATIONS OF INTRACULTURAL DIFFERENCES IN INDIGENOUS KNOWLEDGE

The characteristics of hunter-gatherers' knowledge are summarized below:

1. Forest hunter-gatherers in Central Africa have extensive, and often extremely elaborate, knowledge of forest environments, which plays important roles in their foraging activities.

2. Their knowledge covers a wide range, from material and technical aspects to ritual and other non-material aspects of their culture, and these different types of knowledge are often interconnected and reinforce one another.

3. However, their knowledge is not uniformly shared, and there are intracultural differences, both on group and individual levels, particularly for the plants used for medicines, rituals, and other non-material purposes.

4. Such differences are probably generated through the knowledge transmission process, which is "vertical," typically from parents (or older generation) to children, in a small group through actual practices.

5. High variability in knowledge may be one of the characteristics of the knowledge acquired outside of school-like education or any other authoritative system that would "standardize" the knowledge of a society.

The last two points suggest that indigenous knowledge among hunter-gatherer societies is often closely associated with personal experiences and is therefore of a personal nature, as we have seen in the case of medicinal use of plants by the Mbuti in DRC and the Baka in eastern Cameroon.

What, then, are the implications of such differences in knowledge for hunter-gatherers' culture and their long-term adaptation? As in most hunter-gatherer societies, the Mbuti and Baka do not have a formal place or opportunity to teach their children about their forest environment. The knowledge is transmitted mostly during their daily activities—that is, through participating in actual practices. Boys learn mainly from their fathers and elder brothers and other close relatives, and girls mainly from their mothers and elder sisters, during hunting, gathering, tool-making, and other subsistence-related activities, or in medical treatments, ritual performances, and other activities in the forest and camps. Plays, particularly the mimicry play of adults' subsistence activities, also provide an important opportunity for acquiring knowledge (Kamei 2006) for those who are still too young to participate in actual subsistence-related activities. These practices typically take place in small groups in highly different environmental settings and social contexts.

Children in these societies early acquire an extensive awareness of plants; even a child of 10 years of age knows several dozen names of plants and their utility. However, they rarely have opportunities to visit other distant groups, and they do not exchange much information with the members of distant groups. Information about animals and plants, then, is most often transmitted "vertically," from generation to generation, within a small group of people. As a result, diversity in the knowledge of plants between groups is likely to be maintained and often increased (see Hewlett and Cavalli-Sforza 1986 for the discussion of "vertical transmission of knowledge").

The everyday experiences of individuals are, of course, talked about among the members of a band (residential group). For example, in the evening around the central hearth of a camp, people talk about the events they have encountered in the forest, sharing their experiences with other group members. In particular, practical information on the availability and utility of forest resources is quickly transmitted. On the other hand, some types of knowledge remain more or less on the individual level. As mentioned earlier, individuals often have different knowledge of the plants used for medicine for curing a disease, or ritual medicines for hunting luck. Such knowledge was acquired through past experiences—through actual treatments for the illness, or through supposed relationships of cause-and-effect. As individuals understand these experiences in different ways, knowledge of medicinal plants is more or less of a personal nature, reflecting the individual life histories.

Individuals' knowledge may later be shared with other members of the community and then transmitted from generation to generation as common knowledge. In this case, "ethno-science" is established within that group. Shared knowledge between groups, however, requires "communication" and/or "structure" that enables them to standardize the information/knowledge. In loosely organized societies, such as those of the Mbuti and Baka, it is not easy to extend such knowledge, in a standard system, to a social level larger than a residential group or a band. The Mbuti and Baka societies have a non-centralized social organization and a low level of social integration. There is no strong motivation for reinforcing cultural homogeneity, nor for social integration of groups larger than the band as a unit of daily life. There is no intellectual authority, no rigid ritual procedure, no strong cultural or social force for unification. Their society lacks mechanisms to establish a consistent and standardized system of knowledge. Thus, their knowledge of plants and animals, especially for those plants without specific material bases, remains diverse, as long as the various groups maintain their non-centralized social structure and unsystematic intergroup communication.

There are, however, positive aspects to the diversity in plant use. Such diversity is enabled by the rich botanical environment, such as the Central African rainforests, where people have many choices for their needs, particularly for the plants used for ritual or medical purposes.

Through examination of the diversity of plant use, we can also gain insight into the characteristics of both individual and group knowledge systems. Their knowledge is associated with vivid personal experiences which are highly context-dependent and free from authoritative standardization. Thus, we can gain access to the personal and vivid relationships of hunter-gatherers with their environments, which are easily translated and incorporated into rituals, folktales, and other aspects of expressive culture. The knowledge is vitalized there, and facilitates, in turn, the empirical observation of the environment.

Another point is that, in the case of medicinal plants, various treatments are often employed at the same time; or various plants are mixed in a single treatment. Within this treatment strategy, it is difficult to understand which plant is actually effective. The implication of such an approach seems clear: in an unpredictable situation and absent a clear understanding of causal relationships of plants with their medical effects, maintaining diversity in knowledge has adaptive value. This is not strange to us, since similar situations are widely acknowledged in biology. In the evolutionary process, a species in an unpredictable and changing environment is more likely to succeed by maintaining such diversity. In other words, hunter-gatherers with higher intracultural variations may be likely to survive better under changing environmental conditions.

6 Where is That Job? Hunter-Gatherer Information Systems in Complex Social Environments in the Eastern Kalahari Desert, Botswana

Robert K. Hitchcock and James I. Ebert

Abstract

This paper addresses ways in which hunter-gatherers acquire and disseminate information on the natural and social environments in which they reside. Drawing on data from long-term fieldwork among Kua and Tyua San hunter-gatherers and agropastoralists in the eastern Kalahari Desert, Botswana, an effort is made to explain how these groups obtain and utilize various kinds of information. Hunter-gatherers and their neighbors in the Kalahari gather, store, and disseminate large amounts of information on natural resources, landscapes, the distributions and actions of other groups, significant events, the locations of potential jobs and income-generating opportunities, and potential risks and threats. Kua and Tyua San and their neighbors acquire and use information to ensure their social and economic security in a complex and fluctuating ecosystem. We examine some of the social, economic, ecological, and political dimensions of information use in the context of shifting adaptive strategies. As we demonstrate, the goals of information acquisition and information sharing, and of the purposeful failure to disclose information, vary considerably. We conclude that the long-term viability of hunter-gatherer and part-time foraging groups is based as much on social information as it is on knowledge about the distribution of natural resources.

INTRODUCTION

This paper addresses ways in which hunter-gatherers acquire and disseminate information on the natural and social environments in which they reside. Drawing on data from long-term fieldwork among Kua and Tyua San hunter-gatherers, herders, crop producers, and laborers in the eastern Kalahari Desert, Botswana, an effort is made to explain how foragers and part-time foragers obtain information and how that information is disseminated. Based on our assessment, we conclude that the long-term viability of foraging and food-producing groups is based as much on social information as it is on knowledge about the distribution of natural resources.

As Flannery (1972:400) notes, human systems are characterized by exchanges of (a) matter, (b) energy, and (c) information. Crucial to the success of human adaptations is information (Dukas 1998; Kaplan and Hill 1992: 186–187, 196–197; Kelly 1995:97–100, 150–153; Whallon 2006, this volume, Chapter 1). Information and observations on the state of the natural environment and the activities of other people are often used to facilitate decision making on the part of groups and individuals. The role of information in systems of mobility, aggregation, and dispersal is important among hunter-gatherers and other populations who are dependent on natural resources for their livelihoods.

Human adaptations include mobility strategies that are geared toward mapping people both onto resources and other people. There are a number of factors that condition the ways in which people position themselves on the landscape and move over it. Mobility strategies are organizational responses to the structural properties of the natural and social environment (Binford 1980, 2001; Hitchcock 1982:189–203; Kelly 1995). Movements are undertaken for a variety of purposes, some of them relating to the need to exploit spatially and temporally variable resources as well as to obtain information on the distribution and activities of other groups and, in some cases, to share information with them.

Moves are also made by groups and individuals in order to obtain environmental or social information. Biesele (1978), Funk (2004), Hegmon and Fisher (1991), and Smith (1991) discuss information systems among foragers. Whallon (2006) examines the role of information in hunter-gatherer mobility systems and demonstrates how flows of information provide a kind of safety net for people. He sees some mobility strategies of band-level societies as being "non-utilitarian" in nature, geared toward obtaining and exchanging crucial social information which helps to maintain social alliances and ensure social security.

Information is shared by human societies in a number of different ways. Much human communication is done through speech and language. There are also ways of conveying information that include facial expressions, such as raised eyebrows or pursed lips. Hand gestures are sometimes used by people to communicate information to other people. This is done, for example, by hunters when they are sneaking up on prey and want to communicate to their fellow hunters what the animal they are targeting is doing (Howell 1965:184–185). Parents teach children how to act through modeling behavior and by correcting them. The young also learn social and technical skills in cultural contexts in which direct information is transferred to them, as occurs, for example, during initiation ceremonies and rituals in many societies.

Liebenberg (2001) describes in detail ways in which signs of animals such as tracks and dung are interpreted by !Xoo San in the southwestern Kalahari Desert region of Botswana. Animal tracking in the bush by Ju/'hoansi San in the northwestern Kalahari is described by Biesele and Barclay (2001) and Stander et al. (1997). Learning about tracking is useful not only because people can determine where prey animals are and what condition they are in, but they can also learn about the presence of predators or other people.

Kalahari residents share information about their habitats and the organisms and materials in them. They provide people with updates on resource abundance, distribution, and quality, and they note the land-use patterns of other groups utilizing those resources. Information on the state of the environment or the presence and activities of other people is used to assist people in decision making. Options concerning where and when to move and about site selection for residences and specialized activities are also based in part on people's culturally transmitted knowledge about the history of places on the landscape. It is important to remember, however, that people do not have complete information about resources, habitats, and other groups.

This paper considers ways in which information is utilized by the Kua and Tyua San of the eastern Kalahari Desert region of Botswana in southern Africa. Hunter-gatherers and their neighbors in the Kalahari gather, store, and disseminate large amounts of information on natural resources, the locations and actions of other groups, significant events, landscapes, and potential risks and threats. We address some of the ways in which Kua and their neighbors acquire and use information to ensure their social and economic security in a complex and fluctuating ecosystem. We also examine some of the social, economic, ecological, and political dimensions of information use.

THE STUDY AREA AND STUDY POPULATIONS

In 1975–76, the University of New Mexico Kalahari Project carried out interdisciplinary investigations of populations and habitats in the eastern Kalahari Desert (Western Sandveld) region of Botswana (see Figure 6.1). Archaeological, ethnoarchaeological, ethnographic, ethnohistoric, and ecological surveys were conducted over a period of some three decades, beginning in 1975–76, with subsequent visits in 1980–82, 1985, 1990, 1995, 2000, and 2005. During the course of these investigations, data were recorded on the demography, mobility, and socioeconomic and ritual activities of foraging and agropastoral populations in the eastern Kalahari. We also recorded environmental data, including rainfall, temperature, wildlife sightings, plant availability, and solar radiation inputs (Ebert et al. 1976; see also Smithers 1971; Thomas and Shaw 1991). In addition, information was obtained through personal communications with residents of the region, from government and non-government organizations, and from media coverage of events in the east-central Kalahari.

The people we studied most closely were the Kua, San peoples numbering several thousand who are part of the Eastern Khwe populations who occupy the east-central and southeastern Kalahari Desert regions (Barnard 1992:117–131; Hitchcock 1978, 1982, 2004; Valiente-Noailles 1993; Vierich 1981). The Kua are found in areas extending from the eastern portion of the Central Kalahari Game Reserve south to the Kweneng District, and east to the edge of the Kalahari in what is now known as Central District (see Figure 6.2). At the time of our study, some Kua pursued subsistence-oriented hunting and gathering, while others had mixed economic systems involving a combination of foraging, herding, crop raising, and wage labor in the livestock industry, in mines, and in towns (Hitchcock 1982:125–137). A sizable number of adult males worked as herders (*badisa*) for other people, receiving in exchange for their labor, food, cash, and sometimes domestic animals, including cattle and small stock (sheep and goats). We also studied Tyua San, some of whom had been brought from their homes on the Nata River in

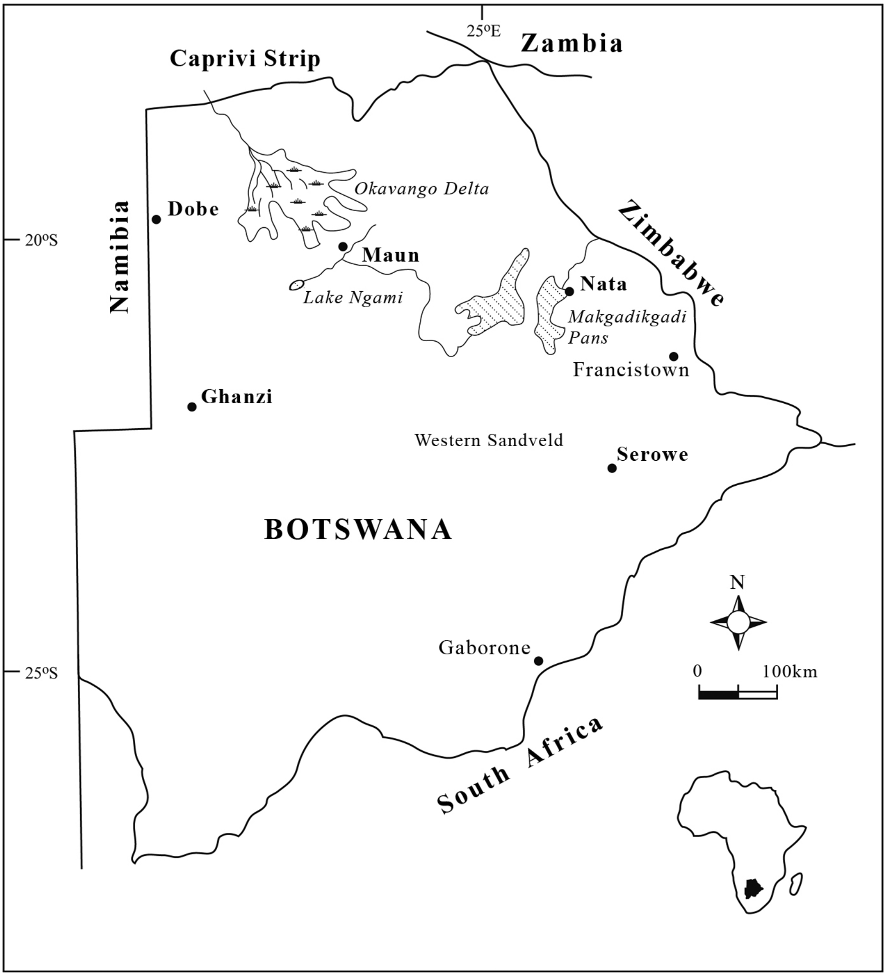

Figure 6.1. Map of the Republic of Botswana in southern Africa showing the location of the western Sandveld region (the east-central Kalahari).

northeastern Botswana to the east-central Kalahari by wealthy cattle owners. In some ways, the Kua and Tyua can be described as what Wilmsen (1989a) has termed "pastoro-foragers."

The Kua and Tyua are but two of over 20 different ethnic groups occupying the east-central Kalahari. The majority of the people in the region were San from several different sociolinguistic groups: Kua, Tyua, G//ana, and Teti. Other groups included Bakgalagadi, Bamangwato, Kalanga, Pedi, and Herero (Hitchcock 1978:219). The nature of the relationships among the various groups in the eastern Kalahari varied. In some cases, the relationships were symbiotic while in others they were competitive. The intergroup relationships also changed over time. Of the various groups occupying the eastern Kalahari, San and Bakgalagadi were the ones most often employed as herders on the cattle posts of the other groups. San and Bak-

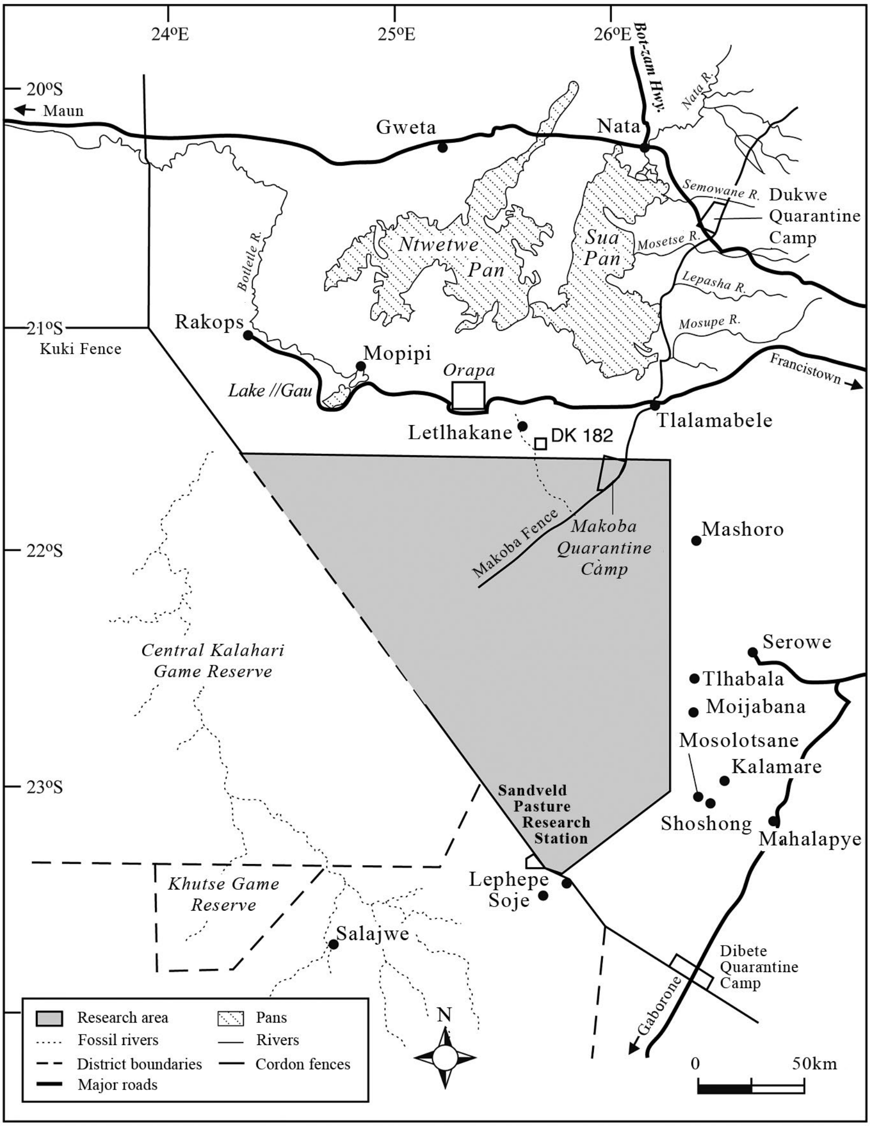

Figure 6.2. Map of central Botswana showing the western Sandveld (eastern Kalahari) research area where the study took place.

galagadi women sometimes worked in the fields of other groups in exchange for a portion of the crop produced, in a system known as *majako*. Some people worked as domestic servants, while others worked in specialized activities, serving as full-time hunters or guides for other people, as beer brewers, and as traditional healers.

In the eastern Kalahari in the mid- to late 1970s, some of the Kua and Tyua were organized into bands, groups of families and other people who lived together at least part of the year and who cooperated in foraging, child care, and other activities. Sharing of food was usually done within nuclear families, but one nuclear family alone was not enough to sustain gathering, which is often arduous. In general, bands usually have enough adult women to guarantee companionship and mutual help for gathering trips, enough men to cooperate in hunting, and sufficient numbers of mature adults to engage in stay-at-home child care.

There were two kinds of groups in the eastern Kalahari which can be distinguished for purposes of analysis: (1) "intact bands" of full-time foragers and (2) part-time hunter-gatherers organized into family groups. The "intact bands" tended to be ones that were heavily dependent on foraging and visited cattle posts only occasionally. Table 6.1 presents information on the sizes of foraging bands in the eastern Kalahari in 1977–78. There was a total of 13 foraging groups, with population sizes ranging from 14 to 44 and averaging approximately 28 people, close to the "magic number" of 25 people discussed by participants in the "Man the Hunter" conference in 1966 (see Lee and DeVore 1968).

Those Kua and Tyua who lived on cattle posts had a slightly different pattern from the groups that relied on mobile foraging for much of their subsistence. There were family groups of Kua and Tyua who had members working on cattle posts but who continued to forage for wild plants and animals. These family groups tended to remain stationary most of the year. The individuals who worked at the cattle post went out on logistical forays with their animals to grazing areas, to visit other people, or to take meat to the owner of a domestic animal that had died. They also paid visits to other groups living on the peripheries of cattle posts and towns in order to renew friendships, share information, or engage in economic exchanges. Table 6.2 presents data on the part-time foraging groups living at cattle posts in the eastern Kalahari. As shown, there were 29 such groups which ranged in size from 5 to 26 people and averaging 12 people.

It is interesting to note that some long-standing cattle posts, ones that had been in existence for 30 or more years, had workers who came from the

Table 6.1. Population Data for East-Central Kalahari Foraging Groups (Intact Bands)

Survey Number	Location	Number of Households	Population Size
W18a	Mosetharobega (a)	2	14
W18b	Mosetharobega (b)	6	28
W20	Metsimonate	4	42
W24	Uwe-Abo	4	30
W33	Ramokgophane	7	23
W60	Yeena	8	40
W63a	Bae (a)	3	19
W63b	Bae (b)	3	16
W73	Khwee	9	42
W92a	Diphala 1	3	14
W92b	Diphala 2	5	22
W96	Pulenyane	7	44
W144	Makhi III	5	31
TOTAL	13 groups	66	14–44 (365)

same family, with sons inheriting the herder and pumper positions from their fathers. These individuals trained younger members of their family in how to herd, track lost cattle, and care for domestic animals and in how to operate the technology associated with cattle posts (e.g., borehole pumps). They often passed the jobs down from one generation to the next. They liked to stay in specific places as long as they were well treated and able to sustain themselves. Hunter-gatherers, as well as part-time foragers and livestock owners and employees, all had what Silberbauer (1994) refers to as "a sense of place."

In the 1970s, Kua hunter-gatherer groups moved several times from one residential location to another during the course of a year in order to gain access to water, plants, and animals, or to visit other groups. Kua mainly moved during the dry season and tended to aggregate in larger groups in single localities during the dry season, a pattern similar to that of the G/wi and G//ana in the central Kalahari (Silberbauer 1979, 1981b; Tanaka 1980). This pattern is

Table 6.2. Population Data for East Central Kalahari Part-Time Foraging Groups (Family Groups)

Survey Number	Location	Number of Households	Population Size
W7	Bo/o	2	8
W8	Gaugo	3	20
W12a	Ana-O (a)	2	12
W12b	Ana-O (b)	3	17
W14	Debeegptsu	1	8
W15	Kelele	4	22
W17	Kukamane	1	6
W37	Tsantsarane	1	7
W39	Monkgaphokoje	2	7
W41	N//au/nau	2	9
W55a	N/ebe (a)	2	6
W55b	N/ebe (b)	3	17
W55c	N/ebe (c)	1	9
W55d	N/ebe (d)	1	5
W56	Kgagotsie	1	7
W57	Nyamakatse	2	18
W58	Mmasogo	2	17
W72	Kgaka	2	10
W77	Sebere	2	17
W85a	Khuse (a)	1	8
W85b	Khuse (b)	2	10
W105	Nkamelang	1	6
W108a	Kamkwa (a) No. 1	1	14
W108b	Kamkwa (b) No. 2	1	17
W111	Chumkooe	1	9
W114	Maletswae Well	3	26
W115	Nkarangwe	2	14
W118	Tshepe	2	19
W132	Piijinaa	1	10
TOTAL	29 camps	52	5–26 (355)

in an average year. Interestingly, the Kua believed that if boreholes and cattle posts were established in their areas, they had priority in seeking employment opportunities there, and people from other groups had to get their permission before seeking jobs in these places.

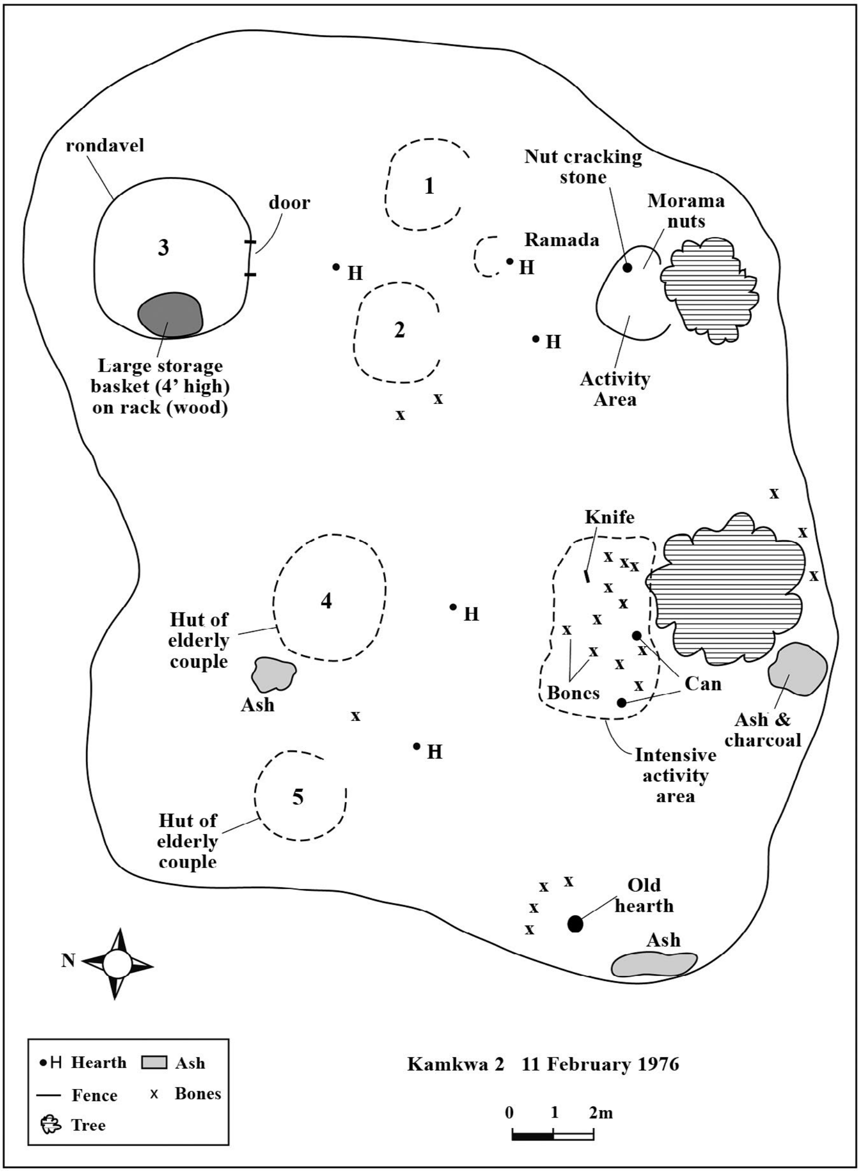

Figure 6.3. Ethnoarchaeological map of a family group camp at Kamkwa (Site No. 2) in the western Sandveld region, Botswana.

distinct from the Ju/'hoansi of the northwestern Kalahari, who in the 1960s and 1970s aggregated around permanent water sources in the dry season and were mobile in the wet season (Lee 1968, 1969, 1979; Marshall 1976; Yellen 1977). The mobility and land-use patterns of the Kua differ from those of both the Ju/'hoansi and the G/wi and G//ana of the central Kalahari because of the presence of boreholes. The range sizes and population densities of 15 Kua groups are shown in Table 6.3. It can be seen that the range sizes average 626 km^2 and the population densities are generally higher than those in other parts of the Kalahari. The areas of land over which people moved averaged between 104 and 1,370 km^2 in size. In general, population densities in the eastern Kalahari were very low, though there were localities with large concentrations of people, as seen, for example, in towns on the edge of the region or sometimes at pans when groups from several different areas came together for social purposes, such as trading or taking part in initiation ceremonies.

To get some idea of what the residential and logistical sites of intact hunter-gatherer groups and part-time foraging "family groups" in the Western Sandveld region looked like, we mapped some 30 different localities that were either occupied currently or had been utilized in the recent past. We also interviewed the people who had lived in or used the places in order to determine who had been there, how many people had been there, how they were organized, and what kinds of activities they engaged in. Figure 6.3 shows an ethnoarchaeological map of a family group camp at Kamkwa Site No. 2 (W108b in Table 6.2). A total of 17 people lived there, including an elderly couple, their children, and their grandchildren. The elderly couple was involved full-time in foraging, while one of their sons was a pumper at the Kamkwa borehole. The wife and children of the pumper engaged in some agricultural work where they were able to get a portion of the crop produced, and they got some of their food from the bush.

Landscapes in the undulating plains of the northern and eastern Kalahari were not homogeneous; rather, they were heterogeneous, and people utilized them differentially, depending on a whole series of factors, including season, natural resource type and density, group size and composition, the health and nutritional status of the population, and technology available to the population. People in the eastern Kalahari relied on extensive knowledge that they had accumulated over time as a result of their experiences, combined with what they had been told by their parents, friends, and members of other groups. The Kua, like other San, maintain a detailed geography, a kind of mental map, of their area which consists of knowledge of the various Kua groups' territories, each of which has a name and a detailed history.

Table 6.3. Range and Territory Sizes of Foraging and Food-Producing Kua Groups in the East-Central Kalahari, Botswana

Location	Range Size (km^2)	Number of People	Population Density (persons per km^2)
Khwee 1	1,100	42	0.038
Khwee 2	1,370	36	0.026
Diphala	940	22	0.023
Ana-O	1,025	29	0.028
Go/o	890	19	0.021
Makokgophane	675	23	0.034
Pulenyane	925	36	0.039
Piijinaa	425	44	0.104
Man/u	475	57	0.120
Kamokwa	400	39	0.096
Tutu	104	13	0.125
N//aun//au	205	27	0.132
Nyamakatse	186	20	0.108
Mmasogo	314	17	0.079
Kalele	355	30	0.085
Totals: 15 locations	104–1,370	13–57, 454 total, average of 30 people	0.021–0.132 persons per km^2

Among the Kua and other San of the Kalahari, land use tends to be communal, with members of kin groups having access to areas that can be described here as "territories." The Kua territorial unit is called a *no*. These are units of land that contain natural resources upon which people depend, including water, wild plants, and trees for shade, fuel wood, and construction, and materials used in the manufacturing of tools and other goods. In general, the size of the territory is based on the types and amounts of resources it contains, which theoretically at least should be sufficient to meet the needs of a group

An important feature of the eastern Kalahari is the presence of pans, low-lying areas in which water, salts, and clays accumulate. These pans were often the focal points of human settlement and land-use systems, and they sometimes supported cattle posts where livestock owners kept their domestic animals. Pans were also used for specialized purposes, such as ambush hunting of animals that came there to drink or to consume the mineral-rich earth they contained. In a sense, pans can be seen as "islands" or "oases" that were crucial to the subsistence and settlement systems of the societies that utilized them (for a discussion of "islands" on the Great Plains of the United States, see Kornfeld and Osborn 2003). Kua and other groups in the eastern Kalahari point to specific pans as being "sacred places," because, they say, they were the locations where many historically important events took place and because, as some people noted, "their ancestors were buried there." Pans were also seen as fallback locations, places where people could go in times of stress.

The resource that is of supreme importance to all populations in the study area is water. In the eastern Kalahari, which lacked permanent springs at least in the recent past, people had to use innovative strategies to obtain sufficient water on which to survive. Water is found in the rainy season in the pans and, in some cases, in the low-lying areas between dune ridges, in places known as *mekgacha* or *molapos*. There are places on the east-central Kalahari landscape, often near pans, where people suck water out of the sand. According to informants, there were only certain places in the Kalahari where it was possible to obtain water in this way. Kua would identify promising places that they thought might hold water. Several criteria were used in identifying likely places: (1) the presence of pans, (2) soil type, (3) vegetation type, especially the presence of camel thorn trees (*Acacia erioloba*), and (4) evidence of animals' digging. This information was maintained carefully by individuals, who shared it sparingly with other people.

David Livingstone (1857:59) notes that people in the eastern Kalahari deliberately hid from outsiders the places where they obtained water, filling pits with sand and sometimes building fires over the spots to disguise them. Information on the location of sip-wells was a closely guarded secret, according to some of the people we interviewed. The information on their locations was generally not shared with other groups, unless a group were in dire straits, as occurred, for example, in 1877 when a group of Afrikaaners crossing the eastern Kalahari ran into serious trouble and a number of them died of thirst (Hitchcock 1978, vol. II:132). The San who came across the survivors showed them how to obtain water from the ground in the area of Maletswae.

Another source of water in the eastern Kalahari is melons, which local people depended on during times of the year when there was no surface water. Another source of water, which sometimes requires extensive effort to obtain, is tubers (e.g., *Raphionacme burkei*, [Kua: *bi:*] and *Coccinia rehmannii*, [Kua: */a*]), which Kua dug up with the aid of digging sticks or shovels. The problem with these tubers, according to informants, is that they are sometimes bitter, and the work involved in exploiting them is often quite arduous. Succulents are also used as sources of moisture and for medicinal purposes, one example being *Hoodia* spp., (e.g., *Hoodia gordonii*), which was used to allay thirst while the San were on long treks for gathering or hunting purposes or moving from place to place.

Plant resource knowledge is often shared among people, but there are cases where specific kinds of information about plants are kept to small groups. Healers, who use plants for medicinal purposes, tend to share this knowledge with apprentices or, in some cases, with other healers, but they do not generally share it widely. Hunters who use certain kinds of plants for poisoning arrows tend to keep that knowledge to themselves. Some Kua who utilize beetles for arrow poison (notably, *Diamphidia nigro-ornata*) only share the knowledge about where to find these beetles with other men, but generally not with women or children.

Kua invest considerable energy in learning where to find plants and how to procure and process them. In order to encourage the production of desirable plants—for instance, melons and root- and nut-bearing plants such as *morama* (*Tylosema esculentum*)—Kua and other groups employ fire. Fire is utilized in a number of different ways in the eastern Kalahari. In some instances, fire is used to burn off grass and shrubs as a preventive measure so that residences are not destroyed by raging bush fires. Fires are also used to scare off predators and to get rid of ticks that affect both people and animals. Informants noted that fire breaks are sometimes created to protect groves of trees that are known to respond poorly to hot fires, one example being *mogorogorowana* (*Strychnos cocculoides*). Fire was sometimes used to disguise the tracks of hunters who were concerned that their activities might result in problems for them, not least of which was the chance of being arrested for engaging in hunting. Fire was also used as a signaling strategy; two people we interviewed noted that they set fires when they were lost, in the hopes that other people in the area would come to rescue them.

In the 1970s, prior to the seasonal breakup of hunter-gatherer groups, the localities to be occupied by the various family units were surveyed. The resources available in the areas to which people might move were assessed carefully, as were the current states of occupancy, use, and sentiments about resource sharing among groups that had rights to that area. Once this process was complete, the relative advantages and disadvantages of the alternative places were exhaustively discussed prior to reaching consensus on what options should be pursued. If the areas were occupied by other groups, individuals would be sent to ask if they could visit and use the resources there. Kua family groups and bands would share information about the state of the resources in various areas and the activities, resource use patterns, and opinions of the groups occupying them. Valiente-Noailles (1993:55) was told by a Kua from Menoatshe in the Central Kalahari Game Reserve, "We also move around to visit. Just visiting." The visits provided people with opportunities to acquire information of various types. In some ways, this kind of information sharing system served as a means of spacing groups out over land. It also helped to reduce the threat of competition, and contributed to people maintaining, at least to some extent, subsistence security. As Takada (2006) points out, information was crucial in determining the pathways that people could take in places like the central Kalahari.

Users of fire must know its potential and its effects. In the eastern Kalahari, fire is sometimes used to burn off small patches which later grow green shoots that attract game. People will set up hunting blinds near these places, and then they conceal themselves there and wait for animals to show up to consume the fresh green forage. In November 1975, one of us, Jim Ebert, found two brush blinds near a small pan north of Mosetharobega in the eastern Kalahari Desert. Subsequent interviews of some of the residents of a newly established borehole near Mosetharobega failed to shed any light on the blinds, as the people there maintained that they only hunted animals by stalking them, not by ambush.

Some of the mobility in the eastern Kalahari was social and, as such, was essentially "non-utilitarian," as Whallon (2006) has described for Mesolithic Europe. There were cases, for example, where Kua left places because of a death, or they visited other locales to take part in ceremonies and rituals. There were also cases where people went to other places in search of specific kinds of beads that were not available locally; they did this so that they could trade for or purchase beads that they could then give to relatives or trading partners in order to maintain long-term reciprocal and exchange relationships (for excellent discussions of these kinds of relationships, see Wiessner 1977, 1982). We also observed instances where Kua would travel in to the Central Kalahari Game Reserve to trade for arrows, even though they already had arrows themselves. When asked why they did this, they said it was because they liked the projectile point styles of the G/wi, and they believed that they would bring them good luck in hunting and social exchange.

HUNTING AND HUNTING LAWS

An important political factor affecting mobility and resource exploitation in the eastern Kalahari relates to wildlife conservation laws. The government of Botswana, like that of many African countries, has laws geared toward the protection and utilization of wildlife and for setting aside protected areas (Spinage 1992). Some species, such as giraffe, were considered conserved animals and could not be hunted. In 1979, the government of Botswana passed legislation that allowed for subsistence hunting (Hitchcock 1996; Hitchcock and Masilo 1995). This legislation was repealed in the late 1990s and was replaced by laws forbidding subsistence hunting but stipulating instead that local people had to seek citizen hunting licenses from the Department of Wildlife and National Parks.

Hunters used a variety of strategies to obtain game. One strategy was to use bows and arrows tipped with poison. Poison had a number of advantages, one of them being that it allowed hunters to hit an animal almost anywhere on its body and still make a successful kill, as the poison would likely enter the bloodstream and cause the animal to slow down and eventually die. Hunters would follow the animals they had hit with an arrow (or preferably, two or more arrows). To do this, they had to be able to track the animals until they came upon them. In some cases, they arrived too late at the site where the animal stopped moving, as predators such as lions or hyenas were already present. In these situations, people would wait to gauge how satiated the predators were before attempting to run them off the carcass. If they miscalculated, especially with lions, they might find themselves at risk. There were stories about hunters who tried to scare lions away from kills they were eating who themselves were attacked and injured or killed.

We witnessed several instances in which Kua ran down animals, some of which they had not hit with an arrow. In most cases, the hunters kept up the pace of running for an extended period. The individuals who did this were males who averaged about 35–50 years of age. Some of them did not stop to drink any water. Two picked up melons (*Citrullus vulgaris*) while they were on the trek. We were also told of several individuals who found some Hoodia plants; they cut the succulent open with a knife, popping the pieces into their mouths and chewing vigorously. One of the critical constraints hunters faced when they ran after game animals was thirst, and the use of melons and

Hoodia served to extend their pursuit time. Larry Bartram, who worked in the eastern Kalahari in 1985–86, also saw Kua San run down game. As he noted:

> A more physically demanding method of pursuit hunting was sometimes employed by Kua hunters in the hot dry season. Occasionally a hunter or group of hunters working together left camp in search of a fresh spoor, carrying nothing more than clubs or digging sticks. Through the use of tracking skills, at which we could only marvel, the hunters relentlessly pursued their quarry. The animal was not always in sight, but the hunters were always on its trail, keeping it moving. Such tenacious pursuit eventually forced the animal to collapse from pain induced by the intense heat of the sand, as well as from its inability to lie down in the shade and ruminate. When the hunters caught up with the incapacitated animal, it was clubbed to death with a digging stick. It should be noted, however, that this technique worked only during the hottest part of the year, and it was a method generally employed by younger hunters in their physical prime. Finally, although men were observed departing from camp during this season carrying their bow-hunting equipment, we recorded no instance of a kill made with bow and arrow. (Bartram 1993:63)

George Silberbauer, who worked in the central Kalahari from 1958 to 1966, saw various techniques used by hunters. These were, in order of frequency, shooting with bow and poisoned arrow, snaring, catching springhares by hook, running down, spearing, clubbing, and meat robbing (Silberbauer 1981a:206). He goes on to say that the technique of running down animals is seldom used by individuals alone, given the complexity of following the quarry (Silberbauer 1981a: 215–216). Similar observations were made of !Ju/'hoansi hunters in the northwestern Kalahari by Wilmsen (1989b:226–235) and by !Xoo hunters in the southwestern Kalahari by Hans-Joachim Heinz (personal communication 1995, 1997). Kua hunters used all of these techniques, and in a number of cases they combined them, as was the case, for example, when they chased prey on horseback with spears and dogs. They also engaged in ambush hunting, in part, they said, because game scouts were rarely out at night.

One of the most important changes that we saw among the Kua in general was a reduction in the frequency and effectiveness of hunting. Young people generally do not engage in it any longer, preferring instead to work for wages or to depend on commodities provided by the government or by borehole owners. In 2002 with the resettlement of hundreds of G/ui, G//ana, Kua, and Bakgalagadi outside of the Central Kalahari Game Reserve, special game licenses were no longer allocated to people (Hitchcock 2002; Hitchcock and Babchuk 2007). Today in Botswana, people who wish to engage in hunting must get a regular citizen's hunting license and take part in an auction, much along the lines of what is seen in the United States. People do still hunt, of course, but it is a riskier prospect, in that they can be arrested for hunting without a license, something that has happened in a number of cases in the eastern and central Kalahari in the past several years. Jail sentences for violating hunting laws can be stiff, and there are cases where people suspected of violating hunting laws were mistreated physically (Mogwe 1992).

People in the eastern Kalahari were generally aware of the hunting laws and were careful not be caught if they engaged in hunting. They would sometimes go out on forays to look for evidence of Department of Wildlife and National Parks game scouts or police in their areas, such as vehicle tracks. They would also visit other communities and ask them if they had any knowledge of the presence of government authorities. The penalty for failing to notice the presence of government officials was arrest and jail terms for illegal hunting, even if the hunters had their licenses. As several game scouts told us, "We make the arrest and then ask questions later." Under these conditions, the number of people engaging in wildlife exploitation declined considerably.

Having knowledge of tracking was seen as important. Some elderly Kua said that they were concerned that the young were not learning tracking skills, which put them at risk, not just in terms of being able to procure wild animals for food but also because it increased their risks of being arrested for hunting illegally.

HERDING AND EMPLOYMENT

Different types of pastoralism and agropastoralism exist in the east-central Kalahari. For purposes of this chapter, pastoralism is the practice of maintaining herds of cattle. Some Kalahari herding peoples, including the Bamangwato and other Tswana, engage in absentee pastoralism, whereby they employ people to herd and manage their livestock, visiting the cattle posts only occasionally. Tswana agropastoralism includes a combination of livestock possession and agriculture, with livestock sometimes being kept around the homestead but moved away during planting, crop production, and harvest seasons. Herero, a number of whom reside in the eastern Kalahari, tend to be full-time pastoralists, living with their herds and doing little, if any, agriculture. Other pastoralist pursuits include the herding of small stock (primarily goats) and supplementing their diet with foraging, as is the case, for example, with some Kua and some poor Bakgalagadi in the eastern Kalahari.

Numerous factors affect the ownership of livestock and access to pastoral products. In cases where people herd other peoples' livestock, they may be allowed to drink the milk and eat the meat of deceased animals. Under some circumstances, the use of livestock (e.g., for plowing) and livestock products (milk, meat, horns, hides) are restricted to only those people employed on a cattle post. In still other cases, livestock products are supposed to be available only to the cattle owners, and as a result, they are not accessible to the herder or cattle-post worker. In some ways, commercialization of the livestock industry in Botswana has led to a decrease in access to livestock products for the poor.

Herd accumulation is a goal of many local people in the east-central Kalahari. There are a number of ways in which people can accumulate livestock: they can obtain them through working for other people, in a system known locally as *sejara*, where payment is made in the form of one calf per year. Or they can purchase livestock with cash they earn through working on the cattle posts, in town, or in the mines, or through the sale of goods such as handicrafts. There are also cases where people find lost livestock in the bush and, if no one claims them, keep them for themselves. It is not easy for a herder who works for someone else (a *modisa*) to accumulate livestock. In some cases, livestock owners will not allow herders to graze their animals on their cattle posts, and there are cases where livestock owners actively restrict herders from accumulating animals of their own.

Herds are managed in a number of ways in the eastern Kalahari. In some cases, the cattle are watered at a borehole or well and then left to wander off on their own to graze. In other cases, the animals are taken out to specific grazing areas and watched over by individuals to prevent them from getting lost or being taken by predators. Some herders use a kind of revolving grazing pattern whereby areas that have been utilized by cattle for several days or more are left to rest, and the animals are moved to other places.

Tswana and other agropastoralists sometimes divide their herds, allocating some of them to cattle managers, often in different places, in an agistment system known in Botswana as *mafisa*. This way, cattle owners can spread their risk and reduce their own labor costs. At the same time, it should be pointed out that Kua rarely were allocated *mafisa* cattle to care for; rather, they were pressed into service by cattle owners who gave them payments in kind (e.g., maize meal, blankets, clothing, sugar) or, in some cases, cash. Informants in the eastern Kalahari pointed out that they often did not get paid regularly, nor were they given the food and other goods they were promised by the cattle owners who employed them.

A major reason for logistical mobility on the part of individuals in the east-central Kalahari was to look for a job. People went to cattle posts and ranches in search of employment, seeking work as livestock herders, borehole pumpers, cattle-post managers, blacksmiths, fence-builders, or carpenters. People also visited the two mining towns in the eastern Kalahari, Orapa and Letlhakane, in the hopes of finding work as miners, laborers, drivers, sorters, or gardeners. Several people worked for the Ministry of Agriculture as fence menders and as overseers of cattle at the quarantine camp at Makoba. In the past, when Bamangwato, Kalanga, or European hunters came into the eastern Kalahari in search of game, Kua would sign on as trackers and guides.

Some eastern Kalahari Kua received livestock as payment for their labor on cattle posts. Others invested the wages they earned from their work on cattle posts and ranches or in the mines in the purchase of livestock. The vast majority of Kua in the east-central Kalahari did not own any livestock (Hitchcock 1978:280). Some Kua owned small stock (mainly goats but also sheep) as well as donkeys and, in some cases, horses. One of the problems faced by some Kua livestock owners was that sometimes they were not allowed to graze their animals on the cattle posts where they were working. This meant they either had to move their animals to another location, which was not easy to do, or they had to divest themselves of their animals through sale, consumption, or giving them to other people.

Kua avidly sought information about the working conditions on cattle posts before they opted to take a job. They wanted to know whether the cattle-post owner was generous with food and other goods, whether he or she paid wages regularly and allowed herders to utilize the cattle for plowing and for milk, and whether the herder would be allowed to have family members on the cattle post. Stories about the mistreatment of herders and their family members by cattle owners were exchanged widely. There were cases in the past in the eastern Kalahari in which herders were beaten or even killed for perceived transgressions, such as allegedly allowing cattle to go missing while under their care. Individuals sometimes visited cattle posts when their owners were not there, ostensibly to see friends, and they used that opportunity to find out about job possibilities and also how they might be treated if they opted to move there.

The numbers of jobs available on cattle posts and ranches have varied over time, but in recent years, they have declined. Table 6.4 presents data on livestock-related employment for a sample of cattle posts and ranches in the

Western Sandveld region of Botswana. It can be seen that there have been changes in the average pay to livestock employees. If one considers inflation, net wages have gone down over time. The availability of jobs for unskilled workers has declined as well.

In the late 1970s and 1980s, when commercial cattle ranches were allocated to individuals and small groups of cattle owners under leasehold tenure, in a program known as the Tribal Grazing Land Policy (TGLP), Kua who had been living on the cattle posts that became leasehold ranches were encouraged—some would say forced—to leave the ranches (Campbell et al. 2006; Hitchcock 1978). In response to this situation, some Kua moved with their animals to villages or towns on the peripheries of the Western Sandveld, but this was a risky strategy. Livestock theft rates were high around villages, and people came under pressure from relatives and villagers to kill their animals and share the meat. The result was that many of the Kua who originally had cattle, goats, and sheep ended up losing all of their animals. They had little choice but to seek other sources of income, depend on relatives, or resort to Botswana government food relief and cash-for-work programs.

Table 6.4. Livestock-Related Employment Data for a Sample of Cattle Posts and Ranches in the Western Sandveld Region of Botswana

Date of Research	Number of Jobs per Location	Salary (Range and Monthly Average)	Reference
1975	7	P5–P18, P10	Ebert et al. 1976
1977	7	P2–P30, P12	Hitchcock 1977
1978	5	P2–P35, P9.39	Hitchcock 1978:324
1987	6	P10–P40, P21	Interview data
1988	6	P12–P45, P23	Interview data
1991	5	P40–P60, P50	Campbell et al. 2006:221
2005	4	P35–P65, P40	Interview data
2008	3	P25–P50, P35	Central District Administration

NOTE: P = pula, the Botswana national currency. In December 2008, the exchange rate for pula was US$1 = P4.55.

CHANGE IN THE EAST-CENTRAL KALAHARI

Today the Kua face greatly circumscribed mobility options because of population growth, habitat shifts, technological changes (such as the introduction of fencing and boreholes), and changes in land tenure systems. As Reid et al. (2008:14) put it, "Landscapes are divided into parts through physical barriers, such as fences, and administrative barriers, such as political boundaries and social norms." What has occurred in the east-central Kalahari is a process of fragmentation, the process whereby natural systems are dissected into spatially isolated parts (Galvin et al. 2008; Villard 2002). Fragmentation results from both human actions (e.g., by building fences) and natural processes (e.g., floods or fires) that can create barriers that dissect natural systems (Hobbs et al. 2008:25).

The movements of people in the eastern Kalahari have been restricted by the establishment of protected areas, notably the Central Kalahari Game Reserve, which was declared a game reserve in 1961 (Hitchcock 2002; Silberbauer 1965). They were also restricted by the erection of veterinary cordon fences which were used to control the movements of livestock and livestock products as a means to contain hoof-and-mouth disease. The establishment of commercial cattle ranches under Botswana's Tribal Grazing Land Policy in the 1970s and 1980s also reduced the amount of land available for Kua and other local people.

A comprehensive understanding of arid and semiarid savanna ecosystems and their dynamics is necessary for humans to make decisions regarding land management and livelihoods (see Galvin et al. 2008). Drought, which is common in the eastern Kalahari, has the effect of speeding up many of the interactive processes that occur among populations residing, cooperating, and in some cases competing in the ecosystem. Drought often leads to decreases in the amounts and types of plant resources available, leading to greater competition among users. People respond to droughts and other environmental challenges in a variety of quite innovative ways, some of which are aimed at minimization of risk and maximization of information flow.

Major problems affecting people in the eastern Kalahari, according to local people in the region, have been significant declines in the water table, more frequent droughts, and changes in the composition of plant and animal communities. Some people blame the drop in water levels on the increased number of water points, especially boreholes. Boreholes have been drilled in the eastern Kalahari over the past several decades, particularly during the drought period of 1961–1965 (Campbell 1979; Hitchcock 1978).

Local people say that water in sip-wells and shallow wells in calcrete areas declined in areas where boreholes were drilled. They also say that droughts are more common today than in the past.

To cope with declining surface water and land access brought about by the presence of other people, Kua sometimes have had to move to places that have permanent water, often to villages and towns where they must compete with other people for water and other goods. In some parts of the Kalahari, including the Western Sandveld region, cattle and other livestock have contributed to local habitat deterioration. Campbell and Child (1971) have attributed the changes in faunal distributions and numbers to the impact of humans and their animals on the Kalahari ecosystem. There is no question that major reductions in population numbers and changes in distribution patterns have occurred as a direct result of human activities.

Besides hunting and grazing of livestock, the erection of veterinary cordon fences to prevent the spread of hoof-and-mouth disease has had a significant impact on wildlife populations. The cordon fences have cut off the movement of nomadic species, which no longer have access to their dry-season ranges. In 1964, it was reported that wildebeest were dying along the east–west-trending Kuke Fence, which forms the northern border of the Central Kalahari Game Reserve (Silberbauer 1965:20). Smithers (1971:3) noted large numbers of wildebeest carcasses along the Makalamabedi Fence in 1965. A large die-off of wildebeest occurred in the Lake Xau area, just to the north of the Western Sandveld region, in 1970 (Child 1972). A similar die-off was observed in that same area in the late dry season of 1980 (Mark and Delia Owens, personal communications, 1981).

Hartebeest and eland in emaciated condition were seen along a new cordon fence stretching across the Western Sandveld from Makoba to Makoro in mid-1981. Many of these animals fell prey to hunters who simply walked up to them and clubbed them to death. Others were shot or speared from ambush locations close to trails and water points. It is important to note that these die-offs are not a recent phenomenon in the Kalahari. Ethnohistoric sources record large-scale mortality among wildlife populations (Campbell and Child 1971). It is possible that contemporary die-offs may be more localized and thus more spectacular than was the case in the past.

The expansion in the number of wells and boreholes increased the availability of water for domestic purposes, for livestock, and, in some cases, for watering small gardens. The spread of water points coincided with an expansion in livestock numbers and densities. As the numbers of livestock in an area increase, there are often concomitant reductions in the numbers of wild plants available, and as a result, gathering yields decline. This is because cattle consume some of the same resources that people do (see Table 6.5). Kua remarked frequently about the problems they faced from cattle: not only did cattle consume plants that they themselves relied on, but the animals also came into their compounds and ate the roofs of their houses and even consumed clothing that was hung out to dry. In some instances, people responded by killing and eating the cattle that plagued them, an option that did not endear them to cattle owners. There have been cases in the eastern Kalahari where individuals were arrested for having dispatched a cow and were given stiff jail sentences.

As cattle numbers increase, resource changes may occur, although this point is disputed (see some of the papers in Galvin et al. 2008 and Sporton and Thomas 2002). Some of the changes are due to the removal of plant cover (e.g., grasses), which leads to an increase in surface albedo (reflectivity); this process, in turn, may result in higher soil temperatures and a localized reduction of rainfall, exacerbating drought conditions (Otterman 1977). In areas where livestock are introduced, wild herbivores are affected in various ways (Coughenour 2008; Oesterheld et al. 1992). As Brandenburgh (1991) notes, when cattle are brought into a new habitat, they systematically consume grasses first, as they are primarily grazers and grass is their preferred food. This results in the reduction of wild species such as springbok, which are grazers. After grasses become scarce, cattle will then turn to the less palatable woody plants and shrubs and move into the niche exploited by the grazers and browsers, driving them out. Browsing animals keep the woody plants in check, thus preventing bush encroachment, at least to some extent. The spread of shrubs at the expense of grasses has the effect of reducing environmental productivity. Contributing to these changes are shifts in fire regimes and the frequency and severity of bush fires.

The loss of biodiversity in local plant and animal communities has impacts on human populations, since these losses affect the ecosystem goods and services upon which people ultimately depend. In the past, wild plants and animals were crucial to people's livelihoods. Today, people seek wild plants and animals mainly as buffering resources to supplement other kinds of foods and goods. The reductions in the availability of wild plants and animals have increased the risks for local people. Kua and others in the eastern Kalahari have had to resort to alternative strategies to obtain food and income. These strategies include moving to new places, seeking employment from non-government organizations involved in community-based natural resource management, ecotourism, and other kinds of programs, including ones promoting the procurement and sale of high-value plants such as grapple plant (*sengaparile*, Devil's Claw, *Harpagophytum procumbens*) and *morama* (tsin bean), and, when under severe stress, selling off valued possessions, begging, and depending on Botswana government relief programs.

A question often asked by Kua in the eastern Kalahari was "Where is that job?" Looking for a job was something that occupied large numbers of people, especially men but also women and sometimes children. Children worked in the fields of their parents and other people, and there were cases where they were pressed into service as herders, particularly of small stock. Children also helped their parents get water, collect wild plants, fuel wood, and building materials. Many of the jobs in the area were related to the livestock industry (e.g., those involving herding, borehole pumping, and fencing construction). High-value jobs were those in the mining industry, the safari industry, the government of Botswana, and the Central District Council. Table 6.6 summarizes the various jobs that people had over the past three decades in the east-central Kalahari. The economy in the region was complex; it was dominated by three major sectors: livestock, mining, and government services (Campbell et al. 2006; Hitchcock 1978; Perkins 1991; Perkins and Thomas 1993; Sporton and Thomas 2002). Unemployment levels were high and salaries relatively low in many jobs, so many people opted to diversify their subsistence and income strategies. Job-seeking could be a frustrating experience, but there was little choice in an area that had relatively few positions available and many people willing to do the work. Still, despite the scarcity of jobs, when considering whether to move to a place to take a job at a cattle post, people sought avidly to find out what the reputation of the cattle post owner was. If the owner mistreated his employees, by withholding pay or beating them for allegedly allowing animals to go missing, they preferred not to risk going there. Information on cattle-post owner behavior was an important factor in decision making.

The chances of Kua and Tyua getting jobs in the livestock sector have gone down in recent years because they have to compete with members of other groups, notably Ndebele, Kalanga, and Shona, who have left their homes in Zimbabwe since 2000 as a result of political and economic pressures and moved into Botswana. These individuals are often willing to do livestock-related work for relatively low pay.

Sometimes Kua visited places where there were large fields to seek work in agriculture. Dryland crops were produced in some of the fossil river valleys (e.g., the Letlhakane Valley) and in areas of productive soil near pans

Table 6.5. Wild Plant Species Important to Humans and Utilized by Cattle

Species Name	Portion Used by Humans	Importance	Portion Used by Cattle	Forage Rating
Acacia spp.	–	–	Forage	Good to poor
Acacia erioloba	Gum	Slight to moderate	Forage	Good to poor
Acacia erubescens	Gum	Slight to moderate	Forage	Good to poor
Acacia fleckii	Gum	Slight to moderate	Forage	Good to poor
Acacia giraffae	Pods, gum	Slight to moderate	Pods and seeds	Good to poor
Acacia hebeclada	Gum	Slight to moderate	Forage	Good to poor
Acacia mellifera	Gum	Slight	Forage	Good to poor
Acacia tortilis	Gum	Slight to moderate	Forage	Good to poor
Bauhinia esculenta	Fruit and tubers	Great	Forage	Good
Bauhinia macrantha	Beans and root	Great	Forage	Good
Boscia albitrunca	Berries, leaves, fruit	Slight to great	Forage	Good
Citrullus naudinianus	Fruit (melon)	Great	Forage	Good
Combretum spp.	Gum	Slight	Forage	Good
Cucumis spp.	Fluid and bulb	Moderate	Forage	Intermediate
Cyperus papurus	Stem	?	Forage	Poor
Grewia spp.	–	–	Forage	Good
Grewia avellana	Fruit	Moderate to great	Forage	Good
Grewia bicolor	Fruit	Moderate to great	Forage	Good

Table 6.5. Wild Plants Species Important to Humans and Utilized by Cattle (*continued*)

Species Name	Portion Used by Humans	Importance	Portion Used by Cattle	Forage Rating
Grewia falcistipula	Fruit	Moderate	Forage	Good
Grewia flava	Fruit	Great	Forage	Good
Grewia flavescens	Fruit	Moderate to great	Forage	Good
Grewia occidentalis	Fruit	Great	Forage	Good
Grewia retinervis	Fruit and seeds	Great	Forage	Good
Panicum spp.	Seeds	Slight	Forage	Good
Terminalia sericea	Leaves	Moderate to great	Forage	Intermediate to good
Vigna dinteri	Tubers	Great	Forage	Good

Note: Adapted from Brandenburgh (1991:106, table 9), with forage assessment by the Animal Production Research Unit, Ministry of Agriculture, Botswana.

(e.g., Lebung Pan). A variety of crops were grown, including maize (*Zea mays*), sorghum (*Sorghum bicolor*), millet (pearl millet, *Pennisetum typhoides*), beans (*Phaseolus mungo*, mung bean, and *Phaseolus acutifolius*, teppary bean), and melon (sweet melon, *Cucumis melo*). Some people also produced cowpeas (*Vigna unguiculata*), tobacco (*Nicotiana tabacum*), and pumpkins (*Cucurbita pepo*). In the eastern Kalahari, agriculture was a risky business, since seasonal and annual droughts and damage to crops by livestock and wild animal represented serious constraints.

While people did raise crops on cattle posts that were located close to boreholes or pans, they were sometimes forbidden to do so by cattle-post owners. This situation became more common after the Botswana government announced the Tribal Grazing Land Policy (see Peters 1994 for a detailed discussion of the impacts of this land reform and livestock development effort). Once individual borehole owners were able to get leasehold rights over the

Table 6.6. Employment and Income-Generating Activities Engaged in by Kua and Tyua San of the Eastern Kalahari Desert, Botswana

1. Hunter	24. Harvester (*majako*), seasonal agricultural laborer
2. Gatherer (collector of wild plants) — Thatching grass — Poles for building — Termite earth (clay) for mud houses — Medicinal plants (e.g., *Hoodia* spp.) — Firewood — *Mopane* worms and other high-value products	25. Health assistant, health educator 26. Community development worker 27. Artists', photographers' model 28. Game scout 29. Brick producer 30. Soldier 31. Assistant remote area development officer
3. Crop producer	32. Butchery assistant (meat processing)
4. Livestock herder	33. Beekeeper
5. Craft producer	34. Beer brewer
6. Fisher	35. Road crew member
7. Tourism-related worker	36. Store employee (shop assistant)
8. Traditional healer	37. Tribal police officer
9. Fence construction	38. Teacher
10. Domestic laborer (maid, servant)	39. Carpenter, woodworker
11. Guide for travelers	40. Headman, traditional authority
12. Skin preparer, leather worker, butcher	41. Baker, cook
13. Mechanic	42. Agricultural demonstrator
14. Miner	43. Musician
15. Transporters (load-carriers)	44. Tailor, sewing, knitting
16. Stonemason	45. Poultry/egg producer
17. Veterinary cordon fence guard	46. Well digger, water dept. worker
18. Cattle post (*moraka*) worker	47. Enumerator (survey worker, census taker)
19. Archaeological field crew member	48. Janitor
20. Truck, tractor driver	49. Community game guard
21. Borehole pump operator	50. Petrol station attendant
22. Church minister, church assistant	51. Mobile trader (hawker)
23. Cooperative officer	52. Journalist

land around their water points, they began tightening up on the ways in which land was used, and herders working for the water-point owners were often required to stop raising crops and grazing their own animals on the land. People who had resided on cattle posts for generations had to seek alternative means of making a living, and some of them turned to migrant work in villages and towns, while others left the region altogether.

Conclusions and Archaeological Implications

In the eastern Kalahari, human-induced and natural factors have led to significant changes in the social and natural environment. Habitat deterioration has occurred in some areas, resulting in a reduction in resource availability for people, livestock, and wildlife. The transformation of the area from grassland savanna to commercial cattle ranching has made the area less suitable for wildlife and for people who forage for their livelihoods. In the mid-1970s there were still places on the landscape where Kua could hunt and gather and engage in social interactions with other Kua. As the landscape was divided into ranches and dissected by new roads and fences, mobility and foraging options became restricted. Kua range sizes and natural resource dependence were reduced, and some Kua moved into small areas inside the commercial ranching areas that were set aside by the government of Botswana as communal service centers and settlements, one example being Malatswae in the Western Sandveld region.

As Hobbs et al. (2008:29) noted, "Isolation of habitat fragments can compress the scale of interaction between consumers and ecological and social resources they require to survive and reproduce." Adjustments in group size and composition, shifts in mobility strategies, changes in diet breadth, technological innovations, job-seeking and job changes, and information sharing were all employed as responses to the environmental and socioeconomic problems posed by fragmentation and habitat transformation in the complex and highly variable eastern Kalahari ecosystem.

In the Western Sandveld region, the spatial extent and scale over which social exchanges and resource exploitation played out were compressed, leading to an intensification of social interactions and intragroup and intergroup conflicts and competition. In these contexts, Kua had to go to great lengths to obtain and disseminate information, as was seen, for example, when people looked for tracks to determine where game scouts and police were operating and when they went to towns and mines to find out about job opportunities. Information was disseminated in a number of ways. It was communicated to people in discussions around the fire; it was passed along to neighboring groups verbally and sometimes in the form of written notes, and these days it is disseminated to others via cell phones and radios. Communication systems among foragers, food producers, and wage workers in the eastern Kalahari are both dynamic and complex. The long-term viability of eastern Kalahari populations is clearly as dependent on social and political information as it is on knowledge about the distribution and availability of natural resources.

It is useful to consider some of the lessons of the Kua case in the larger context of hunter-gatherer and agropastoralist archaeological and ethnographic studies. The eastern Kalahari, like many other places in the world, has witnessed considerable change over time in climate, vegetation, fauna, and human adaptations. The geomorphological and archaeological records of the eastern Kalahari are complex, as are the ethnohistoric and ethnographic records. The evidence in the region indicates long-term utilization by foragers, agropastoralists, and the animals upon which they have depended.

If we look at specific places in the eastern Kalahari, such as Lebung Pan, we see evidence of occupation and utilization by groups operating with different livelihood strategies over long time periods. One can anticipate that places around the pan were used for a variety of purposes, including residential occupations, gathering camps, ambush hunting locations, curing ceremonies, rainmaking, beer parties, dances, agriculture, cattle posts, initiation rites, menstrual seclusion, stone material exploitation, and sharing and exchange of information, goods, and services. Given the large numbers of people who utilized the pan in various ways over time and given the things that occurred there, areas around the pan represent composites of behavioral and natural events and processes. In this sense, the archaeological record at any "site" can be expected to be a complex, overlapping composite of many occupations, uses, and natural formation processes that occurred over lengthy periods of time (Binford 1978, 1980, 1982, 2001; Ebert 1992). What this means is that archaeologists and anthropologists must consider the archaeological and ethnographic records at different temporal and spatial scales. It is only through a large-scale, landscape-oriented approach to the archaeological and ethnographic records that the repositioning of occupations, functions, and "alternating adaptations"—the components of human systems—can be discerned, measured, and understood.

If we look at the archaeological and ethnographic records of the eastern Kalahari, we see that Kua, Tyua, and other people do everything everywhere, not just in camps or sites, but across the landscape. We also see that the things that they do at a place at any one time are related to what occurred there before and after each time that they visited that place. The various activities they engaged in (and were careful *not* to engage in) were influenced by the knowledge and information that they had about specific places, which they had obtained from their ancestors, their kin, their friends, and from other people, including, in some cases, government officials.

We believe that it would be useful to carry out a research program in a region that takes into careful consideration both ethnographic and archaeological measurement scales. To engage in such a research program, we feel it would be useful to conduct not only "distributional archaeology" (Ebert 1992) but also "distributional ethnography," building upon the work of Binford (1978, 2001), Funk (2004, this volume, Chapter 2), and Wiessner (2002). We need to look at the eastern Kalahari today, but we also need to assess the ways the region appeared before there were cattle posts, fences, roads, and other kinds of facilities there.

We have compiled a table (see Table 6.7) that outlines information on observations that can be made at different scales (ethnographic and archaeological). Doing both ethnographic and archaeological work at the same time can present opportunities for greater understanding of the past and the present. It is apparent that some of the changes that we see in the archaeological record of the eastern Kalahari occurred in the context of mobility and social organizational shifts and movements into new environments, as occurred, for example, during the Middle Stone Age and, more recently, during the Iron Age (Lane et al. 1998). In both of these periods, we see new kinds of technological items, some of them relating to symbolic display (e.g., beads). Ostrich eggshell and glass beads were important exchange items in the eastern Kalahari, as were arrows. These items reflected information that had both social and economic significance. Clothing, such as breech cloths, also had social and economic significance, reflecting social identity on the one hand and, in the opinions of some individuals, poverty on the other. It is interesting to note that Kua who wished to avoid arrest for hunting violations removed their breech cloths and wore trousers, some of which they obtained from other groups in the region or from stores in the towns where they worked.

In the eastern Kalahari, there was significant variability in the kinds of places that were occupied and the lengths of time that they were used. In the historic period, there is evidence of land uses along fossil river valleys, around pans, and on the tops of hills and ridges with good views of the surrounding

Table 6.7. Ethnographic and Archaeological Measurement Scales

	Phenomena Observable in Both Living and Archaeological Contexts	Ethnographic Measurement Scale	Archaeological Measurement Scale
1.	Population mobility, aggregation, and nucleation	Direct behavior observation and interviews	Artifact, debitage, and debris concentrations and scatters
2.	Task-group composition and division of labor	Interviews, direct observation, behavior measurements (time allocation)	Functional analyses of sites and activity-specific artifact assemblages
3.	Spatial patterning of artifacts and features	Ethnographic observations, recording of material concomitants of activities and cultural and natural formation processes	Activity-area patterning, geographic measurements of intrasite patterning of artifacts, nearest neighbor analysis, multivariate scaling, GIS (geographic information systems)
4.	Mobility of human populations	Observation and scaling of types of logistical and residential mobility	Projection of ecological and behavioral indicators into the past
5.	Mobility of artifacts and objects	Observation of flows of materials and people, for example, through sharing, reciprocity, and long-and short-term exchange systems	Measures of curation of tools (Binford 1978, 2001), multiple uses of tools, stylistic investments in tools (see Wiessner 1983, 1984) and ornaments

NOTE: This table was adapted from work by Alison Rautman (personal communication).

landscape. We have to be careful, however, in extrapolating from observations of present living behavior to archaeological behavior before cattle posts. When cattle were introduced into the region, which likely was around 2,000 years ago, foragers found new opportunities for subsistence (milk, meat), draft power for agriculture, and herding. They also found themselves in some ways at the mercy of the livestock economy. Those who were able to accumulate livestock could, if they wished, pass them on to the next generation, allowing for intergenerational transmission of wealth and the status that goes with it.

Some people gathered outside cattle post or ranch fences or boundaries in outer rings, camping while they searched for jobs, obtained information about how the cattle-post owner treats employees, and sought to learn about other places to get information. Later on, when cattle posts were transformed into commercial leasehold ranches, residents and hangers-on were required to leave the ranches, and they moved to larger settlements and towns or migrated out of the area. In recent times, with changes in the organization of labor and the availability of skilled immigrant workers, Kua and Tyua have found themselves being outcompeted, and they have had to resort to new and different types of activities. In these contexts, information sharing about job opportunities and sources of income, food, and other goods is crucial. The lack of information (e.g., from the government about its plans for the area) has led to people losing access to land and resources when, had they known about what was coming, they could have adjusted their strategies accordingly.

Human decision making is influenced strongly by the behavior of others. Information on what other people are doing and what they know is useful to individuals, allowing them to weigh alternatives (Danchin et al. 2004). We need to track carefully the behavior and perceptions of humans and the processes that affect them over both short- and long-term periods if we are to gain a greater interdisciplinary scientific understanding of the varied ways in which information contributes to human adjustments to cultural, political, and environmental change.

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7 BORROWED NAMES AND INDEXICAL FUNCTION IN THE NORTHERN UTO-AZTECAN BOTANICAL LEXICON

JANE H. HILL

ABSTRACT

The names of plants and animals are an obvious site for the encoding of information. When considered both as isolated constructions and as systems, plant and animal names in hunter-gatherer languages exhibit properties different from those encountered in the languages of cultivators.[1] *Fowler and Turner (1999:419–420) summarize these as follows: (1) Hunter-gatherer ethnobiological classification systems are relatively shallow, with few "species" terms (that is, genera are monotypic) and no "varietal" terms. (2) Hunter-gatherer ethnobiological classification systems have relatively few taxa at the generic rank compared with systems attested from cultivators. In addition, hunter-gatherer ethnobotanical nomenclature, the topic of this chapter, may be relatively unstable, in accordance with the following generalization: (3) Names for wild plants seem to be less retained over time than are names for domesticated and semi-domesticated plants (Balée 2000).*

If we understand ethnobiological nomenclature as a set of labels for the categories known in the hunter-gatherer world, this relative impoverishment of nomenclatural systems appears paradoxical. Hunter-gatherers have been shown to possess extremely rich and detailed knowledge of their environments, so we would predict that their ethnobiological terminology would reflect this and be at least as complex as that found among cultivators. A general semiotic approach, suggested in this chapter, may help to resolve this paradox.

The literature on ethnobiological nomenclature has developed almost entirely within a "referentialist" framework. I define "referentialism" as an emphasis on the denotational or labeling function of language. Balée (1994), Berlin (1992), and Brown (1985) all address the paradox of hunter-gatherer ethnobiological nomenclature from this point of view. They maintain that these nomenclatures do indeed directly reflect hunter-gatherer knowledge of the environment. In the case of plant names, they suggest that hunter-gatherers simply do not need to know as much about plants as cultivators do. Ellen (1999) takes a slightly different approach. He argues that hunter-gatherer ethnobiological lexicons reflect the social organization of knowledge rather than its amount and specialization. He assigns to the lexicon the role of labeling "shared" or collective knowledge, contrasting this with knowledge possessed by individuals, which might be far more complex than the shared set. He suggests that lexical labels for polytypic species and varieties, absent in hunter-gatherer systems, may have an important function in relatively large cultivator groups, where they facilitate the sharing of collective knowledge. In contrast, Ellen maintains that the "social, demographic, and mobility circumstances of nonagricultural peoples" place particular importance on personal experience and on "substantive knowledge" (of complex total patterns such as life histories and distributions of resources), which are not necessarily "reflected in shared lexica" (1999:109).

Restricting our attention to the referential or denotational function of language neglects the many other ways that language works within human communities (see Silverstein 1976 and 1979 for detailed discussion). In the present paper, I suggest that a broader semiotic perspective that includes attention to the indexical function of ethnobiological labels may shed new light on the paradox of hunter-gatherer ethnobiological nomenclature. By indexical function, I refer to the ways in which language is grounded in its contexts of use, but also actually projects new contexts and creates new information. For instance, "Nicotiana" and "tobacco plant" mean nearly the same thing. But in any utterance of "Nicotiana," English speakers hear a "scientific" stance and authority. In contrast, when someone says "tobacco plant," we do not necessarily hear the voice of science. A semiotic approach that includes indexical as well as referential functions regards the language employed to articulate information in hunter-gatherer communities as irreducibly multifunctional, combining environmental and technical content with signals about how this knowledge is embedded in human relationships.

Of special importance in semiotic theory is the insight that "indexes" point to the necessity of their referents. For instance, smoke is a sign of fire that requires the presumption that fire is present, even if it cannot be seen or heard. That is, indexicality endows labels with world-creating properties.

I argue here for attention to indexicality in the study of hunter-gatherer information systems, using the case of labels for important plant genera in Northern Uto-Aztecan languages that have been borrowed from other languages. Such borrowed labels create a paradox within the larger paradox of seeming impoverishment of hunter-gatherer nomenclature. Since loanwords are unanalyzable in the borrowing language, they cannot add to its sum of denotational information, unless they provide a label for an entirely new item. In the cases that I consider, the borrowed names for *Nicotiana* (tobacco) and *Datura* (the source of an important hallucinogen) must have replaced native names for these well-known plants.

Northern Uto-Aztecan (NUA) languages are a subfamily within the larger Uto-Aztecan (UA) family of languages (Hill 2001; Manaster Ramer 1992). NUA-speaking communities include one group of cultivators, the Hopi. The hunter-gatherer communities in NUA speak the several Takic languages and Tübatulabal in California, and the Numic languages of eastern California and the Great Basin. The ancestral community of the NUA, Proto-NUA or PNUA, probably can be identified with the archaeological Western Basketmaker II, late-archaic maize cultivators located on the Colorado Plateau from the Virgin River to the Four Corners area by late in the second millennium B.C. (Hill 2008). The expansion of these groups must have involved several episodes of "agricultural regression" (Balée 1994) as these cultivators moved into diverse ecological zones, including the California deserts, the southern Sierra Nevada, and the Great Basin, which lay beyond the limits of a climatic regime that permitted maize cultivation with archaic techniques (Hill 2003). In the case of some Southern Paiute groups, this regression took place within the last 200 years (Roberts and Ahlstrom 2003:21).

The patterns of nomenclature in NUA hunter-gatherer groups as reported by Fowler (1972) are consistent with principles 1–3 in the Abstract, in spite of the probable status of these groups as secondary hunter-gatherers resulting from an agricultural regression. Balée (1994) has identified a similar modification of the lexicon for the Guajá, speakers of a Tupi-Guarani language, who were cultivators until about 1760. The Guajá biosystematic lexicon is much shallower and smaller than that of their close linguistic relatives the Ka'apor, who are cultivators.

Nicotiana (tobacco) and *Datura* (Jimsonweed, toloache), two genera of medicinal and hallucinogenic plants that are distributed very widely in the Americas, were of the highest importance in NUA communities. These plants were used in medicine and spiritual practice, and, in the case of tobacco, as a recreational drug. Economically important species of *Nicotiana* and *Datura* were found throughout the territories occupied by speakers of Uto-Aztecan languages. However, names for these plants in NUA were frequently borrowed from languages that are not Uto-Aztecan, and were in turn loaned among the NUA languages themselves. Within a strictly denotational or referentialist framework, the presence of these borrowed names is mysterious. Unlike binomials (for instance, "sugar maple"), they provide no information about the plant other than a simple label. That is, they are "simple primary lexemes," like English "oak" or "elm." When we attend to the indexical function of such labels, however, it is immediately clear that loan vocabulary and other primary-lexeme neologisms are especially likely to turn up as labels for plants of high salience and importance.[2] The primary lexeme serves as an *index* of this salience, and of the literally *sui generis* status of the referent, which is not a "kind of" any larger category. Furthermore, a borrowed primary lexeme, coming from a foreign language, can signal, at least in the early period of use (and perhaps for a much longer time, depending on local ideologies of language), that speakers are what Helms (1988) called "long-distance specialists," experts in the exotic and mysterious with its peculiar force in medicinal and spiritual practice.

NUA ethnobotanical nomenclature exhibits several major strategies for lexical encoding. One strategy extends ancient UA nomenclature to new plants. Several genera are labeled throughout the large UA range with stable and ancient primary lexemes that conform quite closely to Western taxonomic genera. In these cases, people moving into new ecological zones simply adapted their old generics to the most similar species in the new environments. Two such stable etyma, which can be reconstructed by the Comparative Method in historical linguistics to Proto-Uto-Aztecan (PUA), as signaled by the prefix **, are ***pakan-* "common reed, *Phragmites* spp." and ***to'i* "Cattail, *Typha* spp." The latter word was borrowed from Nahuatl into Spanish, and later into English, as "tule." These two names appear in nearly all languages of the UA family, from Nicaragua to Idaho. This stability may reflect the very distinct forms and habits of plants in these two genera, along with their large size (Hunn 1999), their economic importance, and their crucial association with water sources in arid landscapes.

A second group of widespread etyma exhibits less stability in meaning. In this group, words may shift taxonomic levels, or shift to include new genera, sometimes eventually losing their original referent entirely. An example is PUA ***wokon*, used for *Pinus* spp., especially the tall forest pines, throughout the Uto-Aztecan range. However, the etymon is not entirely stable. For instance, in Northern Paiute the word is polysemous, referring not only to *wogo̲-pi* "long-needled pines, Jeffrey Pine," but also to the the biome *wogo̲-pi* "forest," which includes *kata̲a-bi* "fir," *tapa̲a-pi* "cedar," *wija̲* "oak," and *so̲o-bi* "aspen"(Fowler 1972:62). In Tïmpisa Shoshone (Panamint), the meaning of cognate *wongko-pin* is extended to spruce and fir as well as to the tall pines (Dayley 1989). Southern Paiute *okom-py* includes both the tall pines and Douglas fir, *Pseudotsuga* spp. (Fowler 1972:101). In Kawaiisu, *woho-dyby* is the grey pine, *P. sabiniana* (this tree is also *wokoh-t* in Kitanemuk in the Takic languages), while *P. ponderosa*, usually the referent of the local reflex of ***wokon*, is called *jyvi(m)-bi*. But Kawaiisu retains the reflex of ***wokon* in its word for the seed of *P. ponderosa*, *woho-bara* (Zigmond 1981).

In a third strategy, old PUA or PNUA names can appear with modifying morphology to label new plants. Consider, for instance, some derivations from ***pakaN* "*Phragmites* sp." Luiseño and Cahuilla, Takic languages, have reflexes of Proto-Cupan **paaxankish* "rye grass, *Elymus condensatus*," from *paaxa-ankish* "reed-like." The label expresses the similarity (perhaps in function; Bean and Saubel [1972] report that rye grass was used for roofing material) of this species to prototypical reeds. Another example is Luiseño *paxmal*, "a kind of greens," glossed by J. P. Harrington as "clover" (Elliott 1999). This construction probably meant "child of reed," with *-mal* from PUA ***mara* "child of a woman." Such a term is a likely encoding of an understanding of small greens that grew in association with reeds in damp places.

While these are rare, we also find examples of transparent binomials that are formed using old UA lexical materials. A Kawaiisu example with **paa-*"water" is *paa-'avaanary-by* "water dock, willow dock, *Rumex salicifolius*," which exists alongside unmodified *avaanary-by* "curly dock, *Rumex crispus*, *R. hymenosepalus*." Zigmond (1981:5) observes that the first plant is listed in botanical manuals as favoring wet places. This is one of the very few cases in the NUA languages of a polytypic genus.

The final lexical strategy, which I will highlight in this essay, is the use of borrowed words to yield new primary lexemes. I became interested in these when I identified a suite of at least seven or eight plant names that were probably borrowed from Proto-Kiowa-Tanoan into Proto-NUA, perhaps as long ago as 3000 B.P. (Hill 2008). Notably, these borrowed words include the NUA labels for some of their most important economic plants, including plants that are also found in the Sonoran Desert south of the Colorado Plateau and so must have been known to the NUA pioneers before their episode of contact with speakers of Proto-Kiowa-Tanoan. For instance, PNUA **typat*, "pinyon pine, *P. monophylla*, *P. edulis*; the nuts of these pines" was probably borrowed from Proto-Kiowa-Tanoan (PKT). This word was a simple primary lexeme in the source language, and it continued to be one in PNUA.

However, some of the words in this suite of loans were not simple primary lexemes in their source language, PKT. For instance, the probable source for PNUA **k^{w}ijV-~*k^{w}inV-*"oak spp." is PKT **k^{w}ę* which means "oak," but also "hard material." A word closely reflecting the probable PKT source for PNUA **jampa* "yamp, *Perideria* spp., *Carum* spp." is Tewa *namp^{h}u* "earth tuber," which describes the most important product of this plant, the edible root, invisible on the earth's surface. But these PKT lexical items, transparently meaningful to speakers of their source language, became "simple primary lexemes" in PNUA.

This habit of borrowing names for important economic plants may hint at the functional role of these labels. Why didn't PNUA speakers create their own compounds that meant "hard wood" or "earth tuber"? Why borrow meaningless foreign words? Within the strictly referentialist/denotationalist perspective that dominates the literature in ethnobiology, such borrowing is a mystery, since it loses information. In contrast, a binomial compound constructed from the lexical material native to the target language should be more useful, conveying a more precise knowledge. However, from a broader semiotic perspective, one that emphasizes that words have other functions beyond denotation or reference, we can begin to address this mystery.

One hypothesis that such a position suggests is that the very "primaryness" of these foreign words, their unanalyzable, undecomposable materiality, permitted them to function for speakers as "indexical icons" (Agha 2007). "Icons" stand for their objects by resemblance. The indissoluble word is an icon for an indissoluble category. The unanalyzability (the indissoluble sound pattern) of the foreign word is an icon for the *sui generis* status of the plant, as distinctive from all other plants, and important either because it is a new resource, or an old resource being endowed with new meanings. The new word, breaking with the source language, stands for the breakthrough into that new meaning. Furthermore, as an index, such a primary lexeme presupposes the existence of the category that it stands for, and, in the baptismal moment (repeated each time a speaker learns the word anew), creatively projects that category into the world. New word formations using UA morphology would not accomplish this, nor would the adaptation of existing vocabulary, as in the extension of ***wokon* "tall pine" to diverse species of conifers. Loanwords have an additional important indexical function. As long as they are recognizable as foreign, they function as social indices, such as signaling that their users are "long-distance specialists" (Helms 1988), who control alliances and sources of knowledge from outside their immediate community of co-linguals and perhaps gain status by demonstrating these resources.

In order to explore these hypotheses, I look at names for *Nicotiana* spp. and *Datura* spp. These were certainly never new to NUA speakers in any environment. They are common plants and are important in medicine and ritual throughout the Americas. In NUA, they are interesting because they present several different patterns for the distribution of loanwords.

The PUA word for "tobacco, tobacco plant, pipe" is ***piipat*.[3] This form is reflected in the Sonoran languages, including Tepiman and Taracahitan, and in the NUA languages it is the primary word for "tobacco" in Hopi and throughout Takic in California. However, in the other NUA languages, we find diverse neologisms for "tobacco."

The first of these neologisms is a loan from some Yokutsan language. While the ancestral Proto-Yokutsan community may date to as recently as 1,500 years ago (Golla 2007), the word is ancient in central California, since it can be reconstructed for the proto-language of a deeper California language family, Yok-Utian, which includes Yokutsan along with the Costanoan and Miwokan languages. Proto-Yok-Utian probably dates to the Middle Holocene (Callaghan 1997). The reconstructed forms are shown in (1):

(1) Proto-Yokuts **pam'o~*pa'om* "to smoke (tobacco or pipe)"; Proto-Eastern Miwok **pa'my* (with Stem 2 **pa'ym*); Lake Miwok **p'oma* "to puff, suck pipe" (Callaghan 1997:42).

A Yokuts word reflecting the etymon in (1) was loaned into Western and Central Numic languages.[4] The reflexes of the loan are shown in (2):

(2) Northern Paiute *pu̱i-bahmu* "Nicotiana" (and also "manzanita berries," which were mixed with tobacco), Western Mono *pamo̱-pI* "cigarette, Native tobacco," Tümpisa Shoshone *pahom-pin* "tobacco," Shoshone (Big Smokey Valley) *pahmun* (Crapo 1976), Shoshone (Owyhee) *puhi-bahmu* (Fowler 1972:82); Shoshone (Duck Valley, Gosiute) *pahun* (Loether 1998); Comanche *pahmu* (Robinson and Armagost 1990).

The *pui*, *puhi-* prefix in Northern Paiute and Owyhee Shoshone means "green"; the Southern Paiute word below in (3) also has a binomial with "green." But the rest of the word is a primary lexeme.

The words in (2) are not regular cognates within Numic. ("Cognates" in the theory of the Comparative Method are words that are similar in meaning and relatable by regular sound correspondence, like English "hound" and German *Hund.* Such lawfully related groups of words are considered to be descended from a single common ancestral word that was used in the proto-language.) Instead, the irregular resemblances in (2) suggest that this word spread among these Northern and Central Numic languages by borrowing, or perhaps was borrowed from Yokuts more than once.[5] The irregularity suggests that the word did not enter the Numic languages until after the beginning of the second Numic spread. The first Numic spread is the movement of Proto-Numic into the southern and eastern foothills of the Sierra Nevada and the Mojave Desert, probably by 2,500 years ago, and its breakup into Proto-Western, Proto-Central, and Proto-Southern Numic. The second is the move along the Sierra Crest and into the Great Basin, which probably began about A.D. 600 (Garfinkel 2007), and divided the three groups into the California languages and the Basin languages.[6]

Southern Numic languages have a neologism for tobacco formed with native-language materials, shown in (3). The root (the part of the word before the suffix) also appears in a verb that can be reconstructed as **qo7a-* "to make fire." Thus the word in (3) is a derived noun meaning something like "the plant that is set on fire."

(3) Proto-Southern Numic **qo'a-pi* (or **qo'a-py*) "*Nicotiana* sp.": Kawaiisu *ko'o-py* "*N. attenuata*" (the less desirable native tobacco), Chemehuevi *ko'a̲-p(i)* (Press 1979); Southern Paiute *sagwa̲-gwo'a-py* (Fowler 1972: 104; where *sagwa* means "green"); *Ute qo'a̲-py* (Givon 1979).

A second loanword, restricted in some languages to *Nicotiana bigelovii*, the large-leaved *Nicotiana* considered to be the most desirable species, is widespread in NUA languages and is again clearly Yokutsan in origin and ultimately traceable to Proto-Yok-Utian. Yok-Utian reconstructions appear in (4):

(4) Proto-Yokutsan ***so:kan (~*so:kin)* "to smoke tobacco, tobacco"; Proto-Costanoan **$ukmu*; Bodega Miwok and Marin Miwok *$ukum*; Lake Miwok *$umki* (Callaghan 1997:41)

This form for "tobacco" and "smoke tobacco" is closely related to another word, for "pipe," e.g., Proto-Nim-Yokuts **sukmaj*, Proto-Northern Yokuts **sukut*, again with probable cognates in Costanoan and Miwokan. In the

Yok-Utian languages, these words constitute a set of derivations involving "smoke," "tobacco," and "pipe" that must have been morphologically transparent to their speakers.

The Yokutsan word in (4) turns up throughout NUA, including in Hopi, Tübatulabal, several California Numic languages, and Gabrielino, as shown in (5). In these languages, the words are simple primary lexemes. No relationship between the name of the plant and its uses, transparent in Yokutsan, can be retrieved from these names. With the exception of the Tübatulabal word, they must have looked "foreign" to speakers of the NUA languages, since they lack the expected non-possessed noun suffixes.[7] The loans apparently spread through these languages after the breakup of NUA. For instance, the Hopi word is almost certainly a loan from Southern Numic.[8]

(5) Tübatulabal *sho'ogonht* (Voegelin 1938:36); Owens Valley Paiute (Western Numic) *sa:go:* (Voegelin 1938:38, citing Kroeber 1925: 627); Koso (Central Numic) *sohon* or "shogun" (Voegelin 1938:38, from Kroeber 1925:627); Tümpisa Shoshone (Central Numic) *soka* "a tobacco chaw" (Dayley 1989); Kawaiisu (Southern Numic) *so'o(n)dy* "*N. bigelovii*"; Hopi *tsoongo* "pipe for smoking"; Gabrielino (Takic) *$u:ki*, *$u:key* "tobacco" (from the field notes of John Peabody Harrington).

The word has been loaned not only into the NUA languages shown in (5), but into other California languages as well; Timbrook (2007) records Central and Island Chumash "show" "*Nicotiana* spp." (the transcription is imprecise, but clearly resemblant with the Yok-Utian forms).[9] Chumashan, spoken on the coast of California between Ventura and San Luis Obispo, is not a Yok-Utian language. Most scholars consider it to be an isolate, or perhaps a member of the poorly understood "Hokan" phylum.

Within the region where this set of names is found, *N. bigelovii* was the object of semi-cultivation. Among the Kawaiisu and Tübatulabal (Voegelin 1938; Zigmond 1981), women weeded around the plants and pruned the individual plants several times according to a careful schedule, in order to encourage the growth of large healthy leaves. Voegelin (1938:38) points out that these two groups represented the southeasternmost extension in California of the custom of chewing tobacco with lime, practiced by people of both sexes from about the age of 6, often several times a day (Voegelin 1938: 37).

This case is a problem for the Berlin/Brown/Balée tradition of functionalist explanation, which suggests that hunter-gatherer ethnobiological nomenclature is relatively simple because hunter-gatherers simply don't need to know as much about plants as do cultivators. But *N. bigelovii* was the object of very careful attention and expertise. It was carefully distinguished from less desirable species of *Nicotiana* (Zigmond 1981). The case also runs counter to Ellen's (1999) claim about the importance of individual experience over shared encoding in hunter-gatherer communities. The descriptions by Voegelin (1938) and Zigmond (1981) of the semi-cultivation and consumption of tobacco suggest that these were highly social affairs. It seems likely that the popularity and spread of this borrowed lexical item came about not because it added to the store of technical and environmental information about the plant, but because its meaning and function were diversely indexical. The loanword encoded not only the name of a plant, but probably as well its affiliation with a particular set of customs regarding its use, especially the use of the leaves, mixed with ashes or another source of lime, as a "chaw"(although note that the original Yok-Utian words referred to smoking, not chewing). However, the word appears beyond the range of this custom; in Hopi, it means "pipe." The form recorded for several of the languages must have been clearly foreign to speakers, making it a good index for the cosmopolitanism, the "long-distance expertise" and far-flung alliances in a California areal system, and the consequent high status, of those who used the term. Finally, as simple primary lexemes, the words in (5) function as indexical icons, singling out the desirable species of *Nicotiana* which they label as *sui generis*.

The case of *Datura*, the source of a powerful hallucinogen used in California in a widespread ceremonial cult, provides another very interesting system of interlocking loanwords. In southern California among the Takic languages, we see a tight nomenclatural cluster, with a word of unknown origin shown in (6):

(6) Kitanemuk *manich* "Jimson weed, toloache," Serrano *ma:ni-cha* "Jimson weed, toloache, *D. meteloides*"; Gabrielino *ma:ne-t* "*Datura meteloides*, toloache," Luiseño *maani* "elixir usually drunk by boys," Cupeño *mani-t* "*Datura meteloides*."

The word is clearly old in Takic, since, except for the Luiseño word, it has a non-possessed noun suffix from **-ta*. This word also appears in Alliklik, an interior variety of Ventureño Chumash. Alliklik *mah-'neetch* "jimson weed" (cited by Klar [1977] from manuscript notes of C. Hart Merriam) was borrowed from the adjacent Takic language Kitanemuk.

The power of the idea of *Datura* is suggested by the fact that in Luiseño and Cahuilla, the word for the plant itself has been euphemized: Luiseño uses as the everyday name for the plant the word *naqtumush* "drunk," and Cahuilla uses *kikesew-va'al* "agent of craziness, drunkenness" (where the effect of *Datura* is the prototypical form of this state). In Cahuilla, the word from Proto-Takic **mani:-ta* appears only in song language, in a couplet, *tema 'elka maniitu maniitu*, translated as "beautiful (*'elka*) lady *maniitu maniitu*" (*tema* does not appear in the Cahuilla dictionary [Seiler and Hioki 1979]). The word translated as "elixir usually drunk by boys" appears only in Luiseño ceremonial usage, usually in the high-language couplet *maani paa'ish* "elixir, drink." Although Munro (1990) reconstructs Proto-Takic **mani:-ta*, technically this is problematic, since the word is not perfectly cognate among the languages. For instance, the Serrano word should be *ma:n-ch*, instead of the attested form *ma:nicha*. Thus the word probably spread through the Takic languages after their initial dispersal, although at a very early stage. Luiseño *maani* lacks the expected non-possessed noun suffix *-ta*, consistent with the possibility that it was a late loan from some other Takic language. Kroeber believed that the Jimsonweed cult reached the Luiseño quite late, perhaps even during the mission period; he observed that "the Luiseño and Diegueño today sing nearly all their toloache songs in the Gabrielino language without concern at not understanding the words issuing from their mouths" (Kroeber 1976 [1925]:622). The suffixless form of the word in Luiseño, typical of unassimilated loans, is consistent with Kroeber's position.

Another lexical item for *Datura* has spread across language boundaries, as seen in (7).

(7) Tübatulabal *mo:mo:h-t*; Kawaiisu *mo:-py*; Southern Paiute *momo-py*, and probably Tümpisa Shoshone *mui-ppyh* (cf. *mui-yai* "get drunk").

Three of the languages have *mo-* or *mo:-* as the root. The Shoshone element *mui-* seems likely to be part of the same system, although Dayley (1989) labels it as a root that has to do with the mind. These words are not cognate and do not appear in any other UA languages.

Almost certainly part of the same loan system as the word in (7) is Proto-Chumash **mom'oj*, a reduplication of **moj* (Klar 1977:93, also attested in Applegate 1980 and Timbrook 2007) "Datura, moon, a female spirit associated with Datura." The association of *Datura* with a Chumash female spirit reminds us of the Cahuilla couplet linking *Datura* to a "beautiful lady." The source of the Chumash word is probably Luiseño or Gabrielino (Luiseño *moj-la* "moon," Gabrielino *moa:r* "moon"; the loss of /j/ is probably recent in Gabrielino). The word is old in UA, with PNUA **myja/i-* from PUA ***myca/i* "moon." The moon is a female for Takic speakers. However, this UA word cannot be the direct ancestor of the forms in the NUA languages in (7), all of which have regular developments of **myja/i-* "moon" in words meaning "moon," "month," and the like. Instead, the words in (7) are probably borrowed from Takic or from some non-UA language with the Takic loan. In addition to Chumashan, this Takic-origin form appears in Migueleño Salinan *mo:noi'yI* "toloache" (Mason 1918:129) and Chawchila Yokuts *mo:mu'* (Kroeber 1963:211). It may have been borrowed from one of these non-UA languages into Tübatulabal, Tümpisa Shoshone, and Southern Numic, where it exists alongside regular reflexes of the word for "moon."

Words that can be traced to the complex of loanwords for *Datura* also appear in related meanings. The *mo-* element seen in (7) appears in Southern Ute *mamö-pY* "marijuana, bad medicine." Tübatulabal has borrowed the Takic word (or perhaps borrowed the word from the same unidentified source from which the Takic languages borrowed it), as *maneezha'* "deadly nightshade berries."

Western Mono has a completely different loanword, *tanani-by* "Jimsonweed plant," borrowed from Yokuts (Loether 1998:112), where most of the attested forms, such as Tachi *tanai* and Yawdanchi *tanyin*, are related to words meaning "to be drunk." This meaning, of course, is not available to Western Mono speakers unless they are bilingual in Yokuts.

This suite of loanwords for *Datura* in California presents the same problem for established theory as do the loanwords for *Nicotiana*. In order to use *Datura* as a hallucinogen, those who prepared the plant had to know very well which parts contained the concentration of hallucinogenic alkaloids, and in what season, so that visions could be induced without serious poisoning or even death. Moreover, the consumption of *Datura* in the California Jimsonweed Cult as described by Kroeber (1925) was highly social; the plant was administered to young adolescents during initiation rites. However, the distribution of this lexical item does not conform exactly to the distribution of the cult as Kroeber defined it, where a key feature was the use of Jimsonweed in puberty rites, usually for boys, but sometimes for girls as well. Outside the area of the initiation cult, *Datura* was widely used in individual shamanic practice. Kroeber believed that the use of *Datura* in initiations might have originated among the Gabrielino, who themselves traced it to Santa Catalina and San Nicolas Islands, supposedly the homes of great magicians. The range of the cult extends to the Chumash and Yokuts, and to groups in contact with the Yokuts—that is, the Tübatulabal and probably the Western Mono—but does not extend into the Great

Basin. However, the Tübatulabal, who had the cult, have a word for *Datura* that looks more like the Great Basin word (see [7]), and use *maneezha*, the loanword from the same source as Takic **mani:-ta* "*Datura*," as a term for a quite unrelated poisonous plant. The Chumash, who did have the cult, have the *mani:-* word attested only in Alliklik, the interior variety of Ventureño adjacent to Kitanemuk. All other Chumashan languages have words from Proto-Chumash **mom'oj*, a reduplication of **moj* from a Takic word for "moon." The Tübatulabal usage of the loan *maneezha*, a very odd-looking word in that language, for a poisonous berry, is a good example of the projection of undesirable qualities onto outsiders.

In summary, in NUA we see that loanwords, appearing as labels for some of the most important economic plants, constitute a major source for the "simple primary lexemes" that dominate hunter-gatherer ethnobiological nomenclature. I have argued here that the presence of these loanwords within hunter-gatherer ethnobiological lexicons can best be understood in broad semiotic terms. The loans can index the "long-distance expertise" and cosmopolitanism of speakers, enhancing the speaker's status locally. They constitute a valuable symbolic resource, their importance being measurable by the degree to which they become general in the adopting community. This type of social indexicality does not extend to the use of non-borrowed primary lexemes. A second property of these loans is shared with primary lexemes that are indigenous to their languages, and suggests why such items may dominate hunter-gatherer ethnobiological lexicons. The loanwords have no compositional analysis. This permits them to function as indexical icons (Agha 2007) that stand for the primordial—that is, non-derived, non-compositional, and non-partitive—status of the items that they label. This function endures even when the foreign-language source of the lexical item is no longer recognized. The appearance of labels of this type for economic plants of very high salience and importance in the NUA languages suggests that the dominance of simple primary lexemes in hunter-gatherer ethnobiological lexicons is not simply the sign of a lack of need for the detailed distinctions signaled by binomial specific and varietal nomenclature in lexicons collected from cultivators. Nor does it necessarily signal the relative sparseness of collective knowledge as against profound knowledge held by individuals. Instead, simple primary lexemes may have an active and positive semiotic function, clarifying the order of the world and the place of human beings in it, and serving simultaneously to index the structure of knowledge and the social qualities of the human beings who share it.

NOTES

1 The original version of this essay was presented to the session on "The Role of Information in Hunter-Gatherer Band Adaptations," 73rd Annual Meeting of the Society for American Archaeology, Vancouver, BC March 26–29, 2008.

2 The extraordinary proliferation of labels for *Cannabis sativa* in English is a good example of the process at work.

3 The resemblance to Spanish *pipa* "pipe" is a coincidence.

4 Loether (1998:116) considered the word to be a loan from Western Mono into some Yokuts dialects, but he was unaware of Callaghan's findings.

5 Iannucci (1973) reconstructs the form as Proto-Numic **pahmu(h)* "tobacco, to smoke." But the word is absent from the Southern Numic languages and irregular in its resemblances in Western and Central Numic, suggesting that it diffused through these languages after the breakup of Proto-Numic. So Iannucci's reconstruction is unlikely to be valid.

6 The structure of the Numic subfamily of PNUA is as follows. The California languages are listed first.

1. Western Numic: Mono (Eastern and Western), Northern Paiute
2. Central Numic: Tümpisa Shoshone (Panamint), Shoshone, Comanche
3. Southern Numic: Kawaiisu, Colorado River Numic (Chemehuevi-Southern Paiute-Ute)

7 In the Takic languages, non-possessed nouns nearly all end in -t, -ta, -l, -la, -ch or -cha, or -ly. The exceptions are a few sound imitative names for insects, and loanwords. The suffix is seen in the native word for tobacco, for instance Cupeño *piva-t*.

8 Hopi must have borrowed the word after the Hopi vowel shift that took PNUA *o to Hopi /ö/, since otherwise the Hopi word would be *tsööngo*. The Hopi word exhibits symptoms of "foreignness"; it does not exhibit the usual vowel shortening in the combining form, which remains *-tsongo-* in compounds rather than appearing as expected *-tsong-* (Kenneth C. Hill, personal communication, March 22, 2008).

9 Timbrook (2007:126–127) points out that Chumash "show" was the word for the plant. The Chumash word for the tobacco prepared as a chaw was from Spanish *pespibata*, borrowed into Spanish from Gabrielino *pe:spivat* "pounded tobacco," reflecting Proto-Uto-Aztecan ***piivat*.

8 Rite, Ritual, and Materiality of Information in Mesolithic Europe

Marek Zvelebil

Abstract

This paper reviews the material signatures of information exchange among hunter-gatherers in temperate and northern Mesolithic Europe. I focus on the symbolic evidence for such information transmission, covering rock carvings, rock paintings, and other human interventions in the landscape—specifically, burials and mortuary behavior, and carved, sculpted, and decorated artifacts. I conclude by exploring the patterns of transmission of such information, and the social and historical contexts within which such exchanges occurred.

Introduction

Information can be exchanged in several ways in a number of different social contexts: although most commonly transmitted through language, it can also be communicated through symbols as elements of material culture. It can be transmitted intergenerationally, as a set of instructions among individuals or groups of different status, or as communication among peers within the same age and social groups. Its value and role in a learning process are defined by the social rank of human agents involved in the information exchange, by its perceived status as a form of communication between humans and animals, or as communication between human actors, deities, and ancestors. Several key publications address the issues of the social context, adaptive value, and modes of transmission in information exchange among hunter-gatherers (i.e., Barton et al. 1991; Conkey 1985; Wiessner 1983; Whallon 2006; Wobst 1976; see also Shennan 2008 more broadly, and papers in this volume).

In preliterate societies, material culture can be seen as a strategic and important information resource that can be manipulated to negotiate social relations, social status, and access to resources, social power, and social control. It is not fundamentally referential but is embedded in social practice in terms of human agents, structure, practice, and history.

This paper addresses the materiality of information in Mesolithic Europe (ca. 12,000–4000 B.C.), through the use of objects, or features in the landscape, as meaningful symbols that convey information. In this framework, the Mesolithic is perceived as a broad social tradition, shared by postglacial hunter-gatherer communities of northern and temperate Eurasia—that is, as a

> collective of communities sharing broad social traditions and material culture, changing through time within structural conditions defined by their temporal situation within the course of human history. (Zvelebil, unpublished MS, 2008).

Within this understanding of the Mesolithic, information exchange plays a central role because the maintenance of the social tradition is predicated on shared symbolic and cosmological values and on shared stocks of practical knowledge. This can be brought about only through the development of far-reaching, yet structured information networks, utilizing a wide range of information channels. These information channels include material objects, symbols, and signs, ranging from artifacts to enculturated landscapes.

In trying to unravel the structure and meaning of the information exchange through such a wide range of information pathways, we must be aware of a fundamental aspect of information exchange: it comprises a set of relationships that involves the object, the producer of the object's image, the image itself (signifier in the Saussurean structure), and the interpreter who gives the image either the same or another meaning, resulting in the reproduction of the object's meaning (de Saussure 1978). The key and contentious point is that this process of meaning reception and reproduction—often with changes to the original meaning—can be extended indefinitely, thus generating an endless chain of signification (Derrida 1978 [1967]); Foucault 1981; see also Misak 2004 on Pierce's theory of signs). The implication of this argument is that meaning, whether in language or in artifact symbolism, is floating rather than fixed, and so its capacity to transmit unambiguous and concise information is much reduced.

This school of thought has generated widespread debate, encompassing both language and material culture. Even leaving language aside, it is not possible to review in depth the complex relationship between material culture as meaningfully constituted, either in a symbolic and social or evolutionary sense (cf., e.g., Boyd and Richerson 1985; Preucel 2006; Shanks and Tilley 1987; and Shennan 2008).

To accommodate this process of signification without losing inherent meaning in objects of material culture, Barrett (1991) has emphasized the existence of sign-object relationships, where the sign has an inherent meaning, the value for which it stands, as opposed to situations where the sign is separate from the object it represents. This is linked to conditions of co-presence and conditions of distanciation. In referring to ritual, Barrett notes:

> [T]he meaning of a ritual is not to be found simply in the code employed, but in the way that code "spoke" to the participants, with reference to the various horizons of expectation employed in the construction and interpretive "reading" of the ritual event. (1991:1).

In a related but somewhat different way, I attempt to distinguish between rite and ritual as two different pathways of broadcasting information through the use of symbols. The symbols used in these two contexts convey different sorts of information.

Both rite and ritual are embedded in social practice in terms of activity performed by agents (individuals or social groups), referring to cognitive structures within frameworks set by historical contingency. The Mesolithic, as a social tradition, represents such a shared historical contingency.

In this paper, I associate "rite" with routine practice and standardized performance of activities, the meaning of which has been validated through long-term performance of the same patterned activities, or "habitus." The signs produced and reproduced through such activities are symbols marked by inherent meanings, by co-presence, rather than distanciation. In Pierce's definition, they obtain their character "by virtue of some law, usually an association of general ideas," where meaning "is a result of convention" (Preucel 2006:56). The information content of such activities is often generalized and categorical, though vague in detail. In Preucel's words, such symbols are signs "with conventional link between the signifier and signified" (2006:65).

I associate "ritual" with the public domain and specific performance in social negotiations, activities used in the explicit renegotiation and creation of the social order in the collective, in marking rites of passage, and in dealing with liminal situations. This includes cosmological liminality and communication with the non-human world, as well as the resolution of conflict in liminal situations embedded in human society—for example, during a shift from mobile to sedentary hunter-gatherers, in forager–farmer situations, and in conflict resolution between egalitarian ideology and competitive behavior in more complex "transegalitarian" societies. The signs generated through this process add another layer of meaning: they become negotiated symbols, and they involve social agency and active manipulation by human agents. As Miller and Tilley (1982) note, ritual may, in some situations, represent a symbolic resource used by dominant groups or individuals to preserve, in a ritualized form, the ideological image of their own authority (see also Barrett 1991:5–6). Symbols conveyed through ritual may involve distanciation in the reproduction of their meaning, although they do not exclude co-presence of meaning covering both the inherent and renegotiated meaning.

These considerations suggest that performance of rites and rituals is not a mutually exclusive activity: in particular, rituals can involve employment of rites, following their structured understanding, or a symbolic "grammar," which at another level are then manipulated for a specific purpose through social agency. Bloch (1977, 1985), among others, addresses this issue when he makes a distinction between participation in rituals versus in more mundane and daily engagements with the natural world. He suggests that these two regions of social experience create relatively autonomous forms of knowledge—and thus, in my view, of information exchange too. But while the information conveyed may be different, rituals may be symbolically intelligible without the use of rites. Barrett (1991:5) notes that keeping "ritual as a thing in itself with its own logic and its own history" makes it difficult to "explain how social agents operate between political and ritual domains." The solution seems to lie precisely in the incorporation of rites within ritual performances: rituals make the logic of rites explicit. In other words, it is not rituals, but rites that contain within them metaphorical associations, the existence of everyday values, validated often by reference to another world and by traditional practice. The use and manipulation of rites that are widely though vaguely understood and respected within a community, and their interpretation by ritual specialists, give ritual its dominant power and sociopolitical currency.

The materiality of symbolic behavior and the archaeological expressions of such behavior range in scale from entire landscapes to individual artifacts and decorative patterns upon such artifacts. While this paper does not comprehensively cover all these forms of symbolic expression, I discuss, with examples, the symbolic meaning, the social significance, and the information pathways for each of these types of archaeological evidence.

Enculturated Landscapes as Information Pathways: Rock Carving Sites, Burial Grounds, and Natural Features

Within the landscape, ritual activities expressing rites of passage, seasonal rituals, event-marking rituals, communication with ancestors and spirit powers, and burial rituals and liminality can be structured in terms of natural and cultural features, in time and space, and divided in the first instance into practical and ritual landscapes. Ritual landscapes are represented by holy sites, burial sites, exclusively ritual zones, and profane locations of ritual performance (see Table 8.1).

In space and time, the organization of space by a Mesolithic person can be structured along these two major trajectories in the following way. In the time dimension, we move from seasonal time to annual time to life time marked by rites of passage. Beyond, there are more vaguely measured ancestral and cross-generational time and cosmological and mythological time (or timelessness) (Zvelebil 1993; Zvelebil and Jordan 1999). In social space, the geographical dimension can be categorized by the individual self, the kin, and the community; and beyond, by intercommunal regional contact, clearly defined in space, and by space vaguely defined by long-distance, cross-regional contacts. Finally, there are cosmological and mythological contacts, undefined in space. These frameworks have a bearing on the location of ritual sites in the landscape that serve cosmological and social functions and play a role in communicating messages within these domains of the Mesolithic hunter-gatherer society.

While such cognitive landscapes must have existed in every part of Mesolithic Europe, and indeed can be identified among modern hunter-gatherers of Siberia (Jordan 2006), rock carving and rock painting sites of northern Europe represent perhaps the best record of cosmology and ideology of northern hunter-gatherers in Europe (Coles 1991; Hultkrantz 1986, 1989; Lindqvist 1994). At several hundred such locations, we find thousands of painted and/or engraved images representing principally anthropomorphic

Table 8.1. Enculturated Structure of Hunter-Gatherer Landscapes.

(1)	All routine areas are also ritual areas.
(2)	In some locales, ritual has distinct expression: there are some areas dedicated to ritual alone.
(3)	Activities at these locales represent communication and symbolic exchange with the worlds of the dead and the supernatural, some of whom are ancestors.
(4)	Ontologically, these include household, ancestral, cosmological, legendary, and ceremonial locations.
(5)	Ritual areas also include landscapes of the dead: burial locations and cemeteries.
(6)	Activity at all these holy sites involves the creation and deposition of material culture in a structured symbolic context.

Source: Zvelebil and Jordan 1999.

figures, cervids, boats, sea mammals, bears, waterbirds, fishes, reptiles (snakes and lizards), tracks or footprints, weapons and hunting/fishing gear, and abstract designs (Bakka 1975; Baudou 1993; Hallström 1960; Helskog 1985; Lindqvist 1994; Malmer 1981; Nash 2002; Nuñez 1995; Ramqvist et al. 1985; Ravdonikas 1936; Sognnes 2002; Tilley 1991; for a summary of interregional differences, see Ramqvist 2002). The youngest of such rock carvings can be dated on geological grounds to ca. 500 A.D. (Nuñez 1995, with references). In summary, rock carvings and paintings served as palimpsests of ritual discourse and as a record of historical enculturation of a place. While the social role of such ritual sites encompasses the human need for aggregation, communal cohesion, exchange, and resolution of liminal encounters, the information content and the symbolism are almost entirely embedded in cosmology and structured by the world view of the northern Eurasian hunter-gatherers as we understand it. It symbolized within a landscape a structure representing the cosmology of the hunter-gatherer world that was transmitted and shared (see Figure 8.1).

The materiality of information unfolds at several scales, as noted above, from individual and community to interregional, long-distance scales. At the level of rites, performed through routine practice, individuals can "read" the meaning of images by reference to the cosmological elements represented in the carving or painting and widely understood. Indeed, it is remarkable that the same range of images occurs throughout northern and eastern Europe,

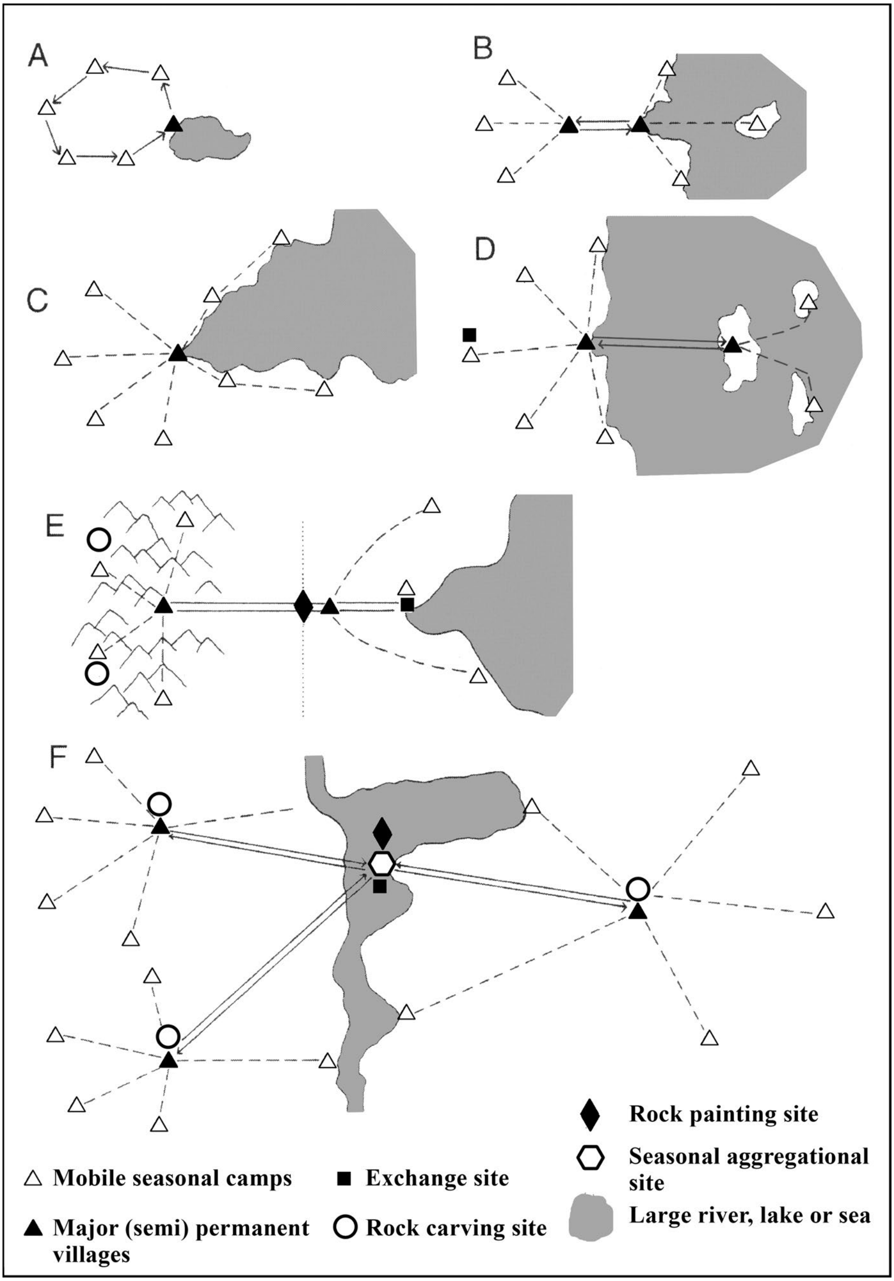

Figure 8.1. Examples of settlement patterns and the locations of rock art sites in liminal zones within Scandinavian landscapes (*redrawn from Zvelebil 2008*).

with minor variations; most are "messenger animals," linking the underworld, the world of the living, and the supernatural world above (Ingold 1986; Mansrud 2009; Pentikäinen 1998; Pentikäinen et al. 1998; Price 2001; Zvelebil 2008; Zvelebil and Jordan 1999). Certain activity routines, when performed at holy places such as rock carving sites, refer to the same set cosmological elements. Judging by ethnographic analogies (e.g., Jordan 2006), such rites often have a specific number of acts that have to be performed in a specific order to maintain validity, and no single act can be left out, although no one knows why. But one person is given the sole role of recording each act by carving a cut into a long bone, or antler, to ensure that correct procedure is maintained. Such engraved antler beams and bones have been found at Late Paleolithic and Mesolithic sites throughout Europe, as well as in more recent ethnographic contexts. In summary, information so broadcast through rites and assembled into ritual performances enclose the sacred sites and the surrounding landscape with cosmological meanings and sacred principles, and so generate a symbolically controlled space for exchange, aggregation, and renewal.

In this way, the location and spatial distribution of holy sites and ritual locales generate a cognitive map of the landscape, furnishing information about its proper use. As Politis put it in an ethnographic context, symbolic enculturation results "in a 'map' of the territory where places are favored or forbidden and where spirits/ancestors/owners integrate the perception and determine access to them" (Politis 2000:199).

In another ethnographic context, Jordan (2006) notes that practical subsistence activities such as hunting or fishing are forbidden within ritual zones around holy sites among the Khanty in Siberia. The distribution of such sites also provides information about territorial ownership and symbolizes that information to outsiders. Through social agency, the use of the landscape and the degree of ownership can be negotiated, however; and access to holy sites such as rock carving/painting locations can be regulated. During seasonal aggregations, several communities may participate in rituals at major carving/painting sites—indeed, one social function of such rituals may be to facilitate friendly encounters among members of different communities. In summary, information broadcast through social agency and ritual is more specific and dedicated to particular goals, such as regulating territorial use, facilitating intracommunal meetings, celebrating rites of passage, marking seasonal or other temporal changes, communicating with ancestors and spirit powers, and reinforcing existing social roles and distinctions.

As an example, we can briefly consider the site of Nämforsen in Swedish Norrland, situated on the river Angerman along the last rapids before the river enters the sea at the junction of the interior uplands and the coastal plain. It is a major rock-carving site, dated very broadly to between 3500 and 1500 B.C. About 1,750 petroglyphs were carved into the smooth rocky surface of three islands in the center of the river (Baudou 1992, 1993; Hallström 1960; Malmer 1975, 1981; Sognnes 2002; Tilley 1991).

The rock carvings at Nämforsen depict elks, boats, people, fish, birds, shoe/foot imprints, and tools, arranged into compositions that are remarkably lacking in hierarchical structure. The meaning of the rock carvings at Nämforsen was interpreted in several ways: as sympathetic magic designed to ensure hunting success, as totemic representations, as a "tribal encyclopedia" (a record of social knowledge), a "visual statement of myths, cosmic categories and associations held to structure both the supernatural world and human existence" (Tilley 1991), as a ritual confrontation between different interest groups within the community, and as a symbol of power and control by male elders over the others. The function of the site was identified as a major ritual center (Baudou 1977), a seasonal aggregation center, and a center for exchange with the farmer traders from the south (Hallström 1960; Malmer 1975; Tilley 1991).

At the same time, there are clear parallels between the cosmological system of northern hunter-gatherers and the landscape and the images of Nämforsen. These include the importance of rivers in the cosmological system, their centrality in territorial identification, and their links with specific clans or communities (Jordan 2001; Martynova 1995; Wiget and Balalaeva 1997; Tilley 1991; Zvelebil 1997). At the same time, the specific location of the Nämforsen carvings on islands within the river by the last rapids before the river enters the sea can be read in terms of the liminality of the location and of the passage of the souls to the "sea of the deceased." Images of boats at Nämforsen have no paddles—possibly an image of death, of groups of people on their last journey to the world beyond the water, the underworld, guided, in some depictions, by a ritual specialist (the shaman) recognizable by the elk-headed terminal, or *turu*, held upright in his/her hand. Carvings themselves, their composition as well as their overall organization, provide additional insights by reference to the same belief system (Tilley 1991; Zvelebil 1997, 2002; Zvelebil and Jordan 1999).

Nämforsen is central to some 600 Stone Age sites within the Angerman River system, and about 60 to 70 km from the next rock carving/

painting site. At the rock-carving site itself, the seasonal occupation during the summer half of the year is suggested by the presence of bones of pike, salmon, seal, waterbirds and beaver—typically a spring/summer prey—while the elk, usually hunted during the winter, is absent (Forsberg 1985; Zvelebil 1981). One of the largest known settlements is located near Nämforsen itself; it was discontinuously occupied from 3000 B.C. to the Iron Age, with the most intensive occupation dating to the late Stone Age (ca. 2500–2000 B.C.), marked by the presence of asbestos-tempered pottery (Malmer 1975, 1981). This settlement, apparently, has not been fully excavated (Broadbent, personal communication 1998).

Ramqvist (2002) noted the differences in location, size, and subject of images between Nämforsen, on one hand, and rock-painting sites in the surrounding landscape of Norrland, on the other: "Large carving sites are much bigger than large sites with paintings" (Ramqvist 2002:148). He suggested that Nämforsen was an intracommunal "tribal" location serving as a major summer aggregation site for the hunter-gatherer communities in central Norrland, each of which, in turn, was based on "larger lake systems occurring within the larger river system" and each of which had a rock-painting location as their central ritual location (Ramqvist 2002:155). This, to my mind, is a plausible description of a settlement hierarchy in the north European inland regions whereby several communities, each with its own territory and a ritual (rock-painting) site, came together during the summer months at Nämforsen and other such locations as their regional ritual and aggregation centers (Figure 8.1).

In summary, such places served as central ritual, aggregation, and exchange sites of hunter-gatherer social groups, each associated with and symbolically relating to a major river system (Forsberg 1985; Ramqvist 2002; Tilley 1991). The symbolism at Nämforsen and other such locations (e.g., Vingen, Norway; Lødøen 2009) can be comprehended by reference to the northern hunter-gatherer cosmology, as can the ritual symbolism of entire prehistoric landscapes (Bergsvick 2009; Lindgren 2009; Zvelebil and Jordan 1999). The landscape analogies to the ethnographic situation of west Siberian groups (such as Kets, Mansi, Khanty) are also clear, and a similar pattern has also been historically documented for north Scandinavian Saami groups (e.g., Bradley 2000; Hvarfner 1965; Manker 1963; Nuñez 1995; Zvelebil and Jordan 1999).

The second set of evidence to consider briefly here relates to cemeteries and burials. These ritual locations are marked by both the rite through routine practice and ritual performance. They serve to communicate cosmology and world view, negotiate liminality and social rank, and inform upon the role and power of buried individuals or the social groups they represent.

The material culture within burials conveying ritual information includes features summarized below. These are specific to the Mesolithic as a social tradition, and differ from either the Upper Paleolithic or the Neolithic:

- *Position of the body*: In the Mesolithic, the position is mostly supine; while other positions are present, they tend to convey special meaning. For example, reclining, vertical, or seated burials have been attributed to ritual specialists or shamans (for further discussion, see Nilsson Stutz 2003, 2009; O'Shea and Zvelebil 1984). In contrast, early Neolithic burials are mostly in a standard flexed position; other forms of burial are present too, but convey special meaning. Later in the Neolithic, cremations predominate in many regions.

- *Use of red ocher* is present in both the Mesolithic and Neolithic. The cemetery at Zvejnieki provides a good example of the widespread use of this practice (Larsson and Zagorska 2006; Zagorskis 1987). The association with blood and regeneration has been noted by many authors (e.g., Zagorskis 1987), and covering the body in red ocher can be interpreted as a widely understood rite through routine practice. Yet in some regions of Europe—for example, the cave and shell midden burials of northern Spain—red ocher is seldom found (Arias et al. 2009).

- *Grave goods:* Mesolithic grave goods include many enculturated natural products; in the Neolithic, there are many artifacts transformed by manufacture (Bradley 1998). Most Mesolithic artifacts relate to the overarching hunter-gatherer cosmology (e.g., Antanaitis 1998; Gurina 1956; Larsson 1990; O'Shea and Zvelebil 1984; Zvelebil 2008), and, as with red ocher, their interment would constitute a rite shaped by widely held understanding and tradition. The exceptions are artifacts symbolizing social status or social group membership—as, for example, with the group of males from Olenii Ostrov who were all uniquely buried with bone projectile points alone (O'Shea and Zvelebil 1984). Other such examples include burials attributed to shamans at several cemeteries in northern and eastern Europe (see Zvelebil 2008 for summary), or artifacts symbolizing and communicating collective identity or "ethnicity" (Larsson 1989).

- *Burial structures* occur both in the Mesolithic and Neolithic—but they are developed in the Neolithic into standardized ritual architecture. In the Mesolithic, burial on antler beams represents a rare but geographically widespread structural element in burial grounds, extending from Teviec and Hoedic in Brittany to Skateholm in southern Sweden and Zvejnieki in Latvia. By reference to ethnographically sourced cosmological information, antler as such represents a process of regeneration, while antler beams represent a link between the three tiers of the universe (the world of the dead, the world of the living, and the heavens), and so their presence in some burials can be understood as a device helping the deceased on his/her journey to another world. In a similar way, placing bird bones or bird parts, particularly of waterbirds, into graves served a similar purpose, because waterbirds were considered messenger animals, capable of living in water (underworld), on the ground (the world of the living), and in the air (heavens), thus linking the three tiers of the universe. Examples of this practice come from Vedbæk in Sweden, where a woman and a child were laid upon a swan wing, and from Zvejnieki, where similar arrangements were recorded (Nielsen and Brinch Petersen 1993; Nilsson Stutz 2003; Zagorska 2009:259; Zagorskis 1987 [2004]; for broader discussion, see Zvelebil 2008; Zvelebil and Jordan 1999). It is tempting to suggest that we are dealing here again with a widely understood rite, informed by cosmology, but the paucity of such rites is thought-provoking: there may be another dimension at play, as yet not revealed, which may be a result of selection and social agency.

- In addition to burial of humans, *dog and bear burials* both occur in the Mesolithic. Both, in my interpretation, constitute rituals informed by social agency and communication of special events. Dog burials at Skateholm have been thoroughly discussed by Larsson (1990, 2004), who interprets them as individuals in their own right, akin to humans in terms of mortuary treatment, but also as sacrificial objects (1990: 159). In addition, dog burials without their human owners, but often formally buried with extensive grave goods, could be interpreted as cenotaphs—that is, dogs being buried in place of the owner who must have perished elsewhere. Burials of bear, the most important animal in northern hunter-gatherer cosmology (Ingold 1986; Pentikäinen 1998; Zvelebil and Jordan 1999), occur rarely and must have been linked to bear hunts and killing of bears—major ritual events in the lives of both prehistoric and modern hunter-gatherers. One example comes from northern Finland, where a barrow, dated to the second millennium B.C., contained a complete skeleton of a bear (Edsman 1965).

In general, then, burial rites and rituals in the Mesolithic refer to hunter-gatherer cosmology: at the routine level of rites, there is widespread similarity across temperate and northern Europe; in terms of agency-driven rituals, they are regionally specific and varied. Within this spatial and symbolic context, the meaning of mortuary sites can be comprehended by reference to this ideology. For example, the ritual distinction between land and water—natural features associated with different worlds (land = living; water = pathway to the underworld)—and the association of waterbirds with the dead find expression in both the rock carvings and burial deposits. In some cases, the burial of the dead "beyond the water" is reflected in the common location of burial grounds on islands or promontories (island locations, for example, are Olenii ostrov, Karelia, Skateholm 1 and 2, in Sweden, and Duokalnis and Spiginas in Lithuania; peninsular locations, for example, are Zveinieki and Abora, Latvia). Waterbirds are commonly found in burials as bone remains, sculpted objects, or carved images; the interment of a woman and child on a swan's wing at Vedbæk (Nielsen and Brinch Petersen 1993) is particularly pregnant with symbolism. All such burial activity could be "read" and understood at the time of the burial, and information thus obtained would be preserved in memory and communicated as oral tradition within the community and from generation to generation.

Portable Artifacts as Information Pathways

Portable artifacts formed another information pathway in the Mesolithic society, both in terms of the practical information they contained and as ritually significant objects. The information content was embedded in the shape, decoration, and raw material of objects.

In terms of shape, sculpted representations of bear, elk/deer, waterbirds, and snakes, or of human figurines or perforated deer "frontlets," can all be taken to represent sacred artifacts used in rites and rituals. In addition, artifacts such as antler beam tools, or bone or antler harpoons, while having a range of practical applications (e.g., Clark 1975; Zvelebil 1994), have been often elaborated beyond their practical use and/or decorated with incised ornaments. Personal ornaments, too, while conveying information about the status and identity of the owner, also referred to broader points of reference, either cosmological or geographical, through shape, decoration, and raw material (e.g., Nash 1998:626).

For example, perforated deer frontlets, consisting of the parietal skull part perforated to form a mask, with deer antlers (usually red deer) attached, have been much discussed as objects of ritual (e.g., Bevan 2003; see Mellars 2009 for a summary of the Star Carr frontlets). The earliest such objects date to the Final Paleolithic site of Stelmoor, northern Germany, and their greatest concentration can be found at Star Carr in England, where the find of 21 frontlets has moved some authors to reconsider Star Carr as principally a ritual site (e.g., Chatterton 2003, 2006; Cobb et al. 2005; Conneller 2000, 2003; but see Mellars 2009). Whether ritual or not, the point requiring emphasis is that the frontlets represent both rite and ritual as defined here, and they both convey different information. The rite element rests in the broader significance of the deer antler as a symbolic *turu*, the link between the three layers of the universe in hunter-gatherer cosmology, which would be implicitly understood by Mesolithic individuals when antler frontlets were handled, curated, and stored using a routine set of practices. The power of the frontlets was activated through ritual performance, through the agency of ritual specialists, and as such was subject to social negotiation and manipulation. The information conveyed here was event-specific, broadcast to a target audience and interpreted differently both in terms of social memberships and spatial distance: the knowledge of deer frontlet rituals taking place at Star Carr was not shared just by the Star Carr community alone, but must have been known to other communities in northern England and beyond (for differing accounts of Star Carr rituals, see Bevan 2003, and sources in Mellars 2009).

Artifact forms can be also used to broadcast claims to territoriality or other forms of social cohesion. Grahame Clark (1975) developed this argument in describing variation in the shape of barbed antler points, which he interpreted as symbolizing discrete social territories across the north European Plain within the broader context of the early Mesolithic Maglemosian tradition. In a similar way, Gendel (1987) argued that specific shapes of microlithic points—with right and left lateralization, specifically—in the late Mesolithic of northwest continental Europe (northern France, Belgium, Rhineland) were code for two discrete hunter-gatherer territories (see also Verhart 2008). The distribution of polished stone axes was also used in a similar way. For example, Bengtsson (2003) has argued that the distribution of Lihult adzes across parts of southern Sweden carried information about a territorial cohesion of those regions, while also marking long-distance exchange patterns. Similar claims can be made about distribution patterns of other stone ax products: for example, the concentration of Olonets green slate axes to the northwest of Lake Onega may symbolize territorial control over that region—and its green slate sources—while the falloff in the distribution of green slate axes denotes long-distance trade in these artifacts (Zvelebil 2008). Bergsvik and Olsen (2003) describe a similar exchange system in stone adzes along the western coast of Norway. In a similar way, Knutsson et al. (2003) suggested that the distribution of handle cores of tuffite, centered on southern Norrland, and of the quartzite handle cores, centered on the northern part of Norrland, may mark two social territories of separate hunter-gatherer groups within the northern part of Sweden. Such strategies of delineation of social territories through emblematic symbolism and social agency might have also included ritual activity, if the deposition of axes, barbed points, and other artifacts in wetlands, lakes, and rivers can be interpreted as acts of ritual (e.g., Bergsvick 2009; Chatterton 2006; Fischer 2003).

Long-distance contacts and circulation of exotic prestige items and of sought-after raw materials were all maintained through trade and exchange throughout Mesolithic Europe. They also served as markers of "informational mobility" (Whallon 2006: 263) and of dispersal of innovations. The use of skis and sledges in winter in northern Europe, and the use of boats throughout Europe, facilitated such contacts (Burov 1989; Clark 1975; Fischer 1995). The ritual dimension of such means of transport is shown by elk-headed carvings tipping the ski runners in northwest Russia and elsewhere (Burov 1989), by carvings of elk placed on sterns of boats (Lindqvist 1994; Nuñez 1995), or by symbolically significant decorations on paddles from Tybrind Vig in Denmark (Andersen 1987).

Examples of interregional and long-distance trade linking vast distances are too numerous to describe here (see Zvelebil 2006 for a summary of north European evidence); they include circulation of flint and ocher within Poland and beyond (Sulgostowska 1990, 2006); green Olonets slate and flint from Karelia across Finland, northwest Russia, and the eastern Baltic; amber from the east Baltic coast; flint from Valdai mountains within northern Russia, the east Baltic, and Finland (Loze 1998; Sulgostowska 2006; Vankina 1970; Zhilin 2003); flint and amber from south Scandinavia traded to peninsular Scandinavia (Carlsson 2003; Fischer 2003; Knutsson et al. 2003); various forms of axes exchanged within Scandinavia (e.g., Bergsvick and Olsen

2003); pumice traded from northern Norway to other regions in Scandinavia; seal oil and other products moved from coastal regions of the Baltic and the central Baltic islands (Saaremaa, Gotland, Oland, Aland) to northern Poland and other parts of northern Europe (Zvelebil 1997, 2008); as well as exchange or trade in polished stone axes, exotic flint, radiolarite, obsidian, and Mediterranean seashells and fossil mollusks in many other parts of Europe (e.g., for Ireland: Kador 2009; Woodman 1978, 1987; for eastern France and southern Germany: Cupillard and Richard 1998; Eriksen 2002; Floss 1994; Jochim 2008; Whallon 2006; for central Europe: Mateiciucová 2004, 2008; for the Mediterranean corridor: Pluciennik 2008).

Such information pathways facilitated interregional and long-distance contact and served to foster the dispersal of technological innovations and the adoption of new stylistic attributes that were then commonly shared and thus united the Mesolithic as a social tradition. For example, Clark (1980) and others (Dolukhanov 1986; Matyushin 1986) have traced the dispersal of geometric microlithic technology across Europe from the Near East along well-established contact corridors across the Mediterranean westward and along the Caspian Sea northward. Such interregional and long-distance contacts were, in my view, often linked to symbolic and ritual activity, although here the distinction between rite and ritual is difficult to make. Elements of rite, as defined here, were embedded in the nature of the raw material and in cosmological references implicit in sculpted or decorated artifacts. For example, Shennan (1993) has emphasized the link between amber and the water from which it came and noted its symbolic connotations, while Bouzek (1993) regarded amber as symbolic of light and sun and linked it to associated rites on the basis of classical evidence.

Ritual acts, on the other hand, are likely to have been linked to locations where raw material was mined or was embedded within the social context of the actual acts of exchange. Sulgostowska (2006) has emphasized the proximity of red ocher mining and the chocolate flint mines in practically the same location in central Poland; red ocher possessed strong symbolic significance as the color of blood and transformation, as a key feature of the burial ritual in the Mesolithic, and its mining may have involved ritual activities that covered flint mining as well. In another context, the mining of Krumlovskyles chert in the Czech Republic involved burying individuals in the mine shafts, although it is not clear at which point in the mining process the individuals were buried. Mines and other locales for raw material extraction, then, served as focal points and liminal places where information was exchanged, often within a ritually controlled context (see also Bradley 2000: 81–96; Tilley 1994:84).

Ethnographic literature records many instances of exchange or trade in hunter-gatherer societies occurring within a ritualized context involving performance of ritual acts. This was especially the case when the exchange was not generalized and intracommunal, but involved balanced or negative reciprocity and intercommunity relations (e.g., Bruggmann and Gerber 1987; Fischer 2003, with references; Hayden 2003; Sahlins 1972). While this kind of activity is very difficult to identify in the archaeological record, it seems reasonable to assume that the same pattern of behavior, designed to provide safety and reassurance through enacting a shared system of values in potentially risky and confrontational exchange situations, would have occurred among the hunter-gatherers of the Mesolithic.

Motifs, Signs, and Symbols: Decorative Elements as Information Pathways

The fourth set of evidence meriting discussion as an information resource concerns motifs and decorative elements on sculpted artifacts, status tools, and ceramics. In this context, Mesolithic symbolic elements can be regarded as a grammar of communication, cosmology, and the expression of identities, operating at different social and symbolic levels (Figure 8.2; Table 8.2).

A range of symbols used by the Mesolithic communities can be identified on bone and antler artifacts, and on ceramics used by the hunter-gatherer communities of northern and eastern Europe (e.g., Ahlbäck 2003; Clark 1975; Hernek 2009; Jordan and Zvelebil 2010; Lødøen 2009; Nash 2001; Terberger 2003), and less commonly in other regions of Europe. The standard range of Mesolithic motifs includes tree-ornaments (vertically or horizontally applied herringbone impressions); less formalized or patterned zigzag patterns, angular wave patterns, triangles, rows of triangles fixed to a line, and filled-in triangular ornaments; rows of strokes, lines, or dots; oval or circular "pit" impressions, and circular incision ornaments resembling whirlpools; antler symbols and other "corniform" symbols; and various arrangements of single or double parallel lines crossed with line ornaments to form "ladder" patterns, or crossed line symbols (Figure 8.2; Table 8.2; Ahlbäck 2003; Clark 1975; Terberger 2003; etc.). They also include fingertip and nail impressions. The meaning of such symbols has been explained in a number of ways—for example, in terms of hunter-gatherer cosmology and

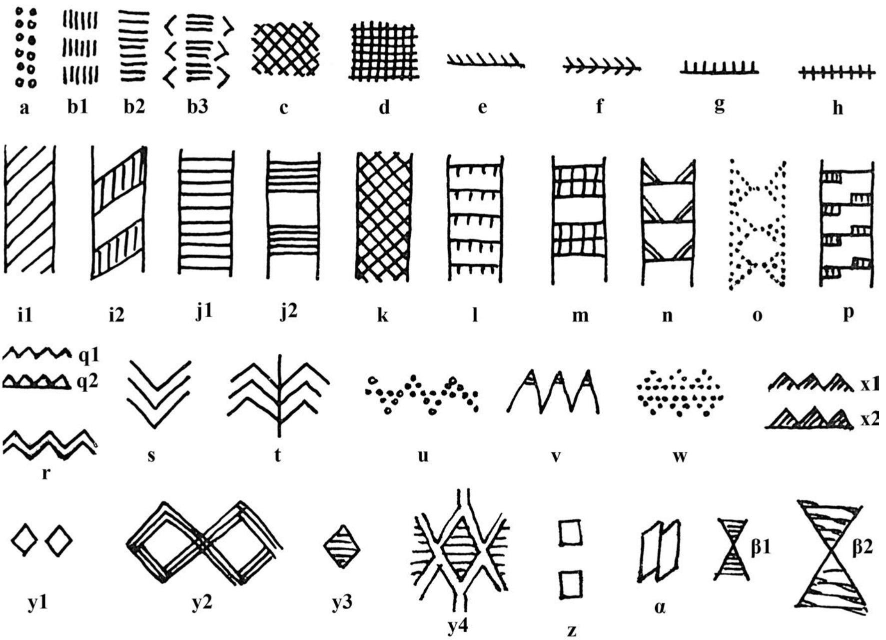

Figure 8.2. Geometric designs on artifacts of the earlier Mesolithic, later reproduced on ceramics *(redrawn from Clark 1975)*. Author's interpretation: (*a–b*): funerary and liminal symbolism; (*c–d*): net motifs; (*e–h*): tree of life, *turu*; (*i–p*): cosmic river; (*q*, *r*, *u–x*): linked triangle symbolism, water, river, liminality, birth, female; (*s–t*): male elements; (*y*, *z*, *α*, *ß*): female elements.

shamanism, linking the tree and herringbone patterns to *turu*, or the "tree of life" that links the three tiers of the universe, or linking the whirlpool patterns and other circular features to represent entrances to other worlds, "made to help shamanistic journeys and activities in the mental space" (Ahlbäck 2003:475; see also Hernek 2009). Nash (2001) and Schmidt (2000) attempted to explain many of the symbols in terms of sexuality, gender identity, fertility and reproduction (see Pugsley 2005 for a critique). It is notable that such abstract symbols differ markedly from rock-art engravings which are in general far more realistic, depicting ritually significant animals such as elk or waterbirds, boats, people, people in boats or on skis, and ritual and hunting scenes involving humans dancing or hunting. The only two recurrent abstract symbols are so-called shoe or foot imprints, and sun-symbols (Goldhahn 1999, 2002; Hallström 1960; Lindqvist 1994; Malmer 1981, with references; Sognnes 1998).

In general, it can be assumed that symbolism used in the Mesolithic had a certain "grammar"—a structure evident from patterned and formalized arrangements of symbols engraved on bone and antler artifacts, or from the patterned symbolism of ceramic decoration. In my opinion, the structure and meaning of these symbolic patterns referred to four subjects and carried four broad categories of meanings: (1) cosmology of hunter-gatherer communities, carrying cosmic meanings; (2) gender identity of living beings, things, and events, carrying engendered meanings; (3) status or functional identity of roles within community, carrying social status meanings; and (4) life-passage stages, such as ancestry, birth, death, and rebirth, carrying transcendental meanings associated with time and intergenerational passage of human existence (for broader discussion, see, e.g., Boas 1927 [1955]; Hayden 2003; Levi-Strauss 1966; Zvelebil 2003). The actual message conveyed by such symbols

Table 8.2. Symbols as Information Operating at Different Social and Cosmological Levels

	Barbed line pattern	Circular disk, pits, whirlpool	Antler symbols	Triangles, vertical or horizontal; zigzag	Herringbone or fir tree
Cosmic meanings		Entrances to other worlds	Links to upper world	Water, river, liminality	Tree of life, link worlds; *turu*
Engendered meaning		Female	Male	Female	Male
Life passage	Record of ritual performance	Rebirth + regeneration	Rebirth + regeneration	Birth	Ancestry, death, transcendental
Social role	Ritual agent	Ritual power	Social power, ritual agent	Ritual power	Ritual power, shamanism
Other	Mnemonic device			Linking of liminal places, events	Communication between worlds

was situationally contingent and specific to particular events or locations, and can only be understood using the associated contextual information.

DISCUSSION AND CONCLUSION

My aim in this paper has been to link rite and routine practice and discuss its meaning and information load, on one hand, and to link ritual and public display symbolism manipulated by agency, with its inherently different audience and symbolic information load, on the other. Both these information channels are realized and broadcast through material culture. Through different manifestations of material culture, they form several information pathways that come together as a structured information network, operating at different spatial scales: regional, interregional, and long-distance. Signatures for such networks can be found within enculturated landscapes, site locations, portable artifacts, and the patterning of their exchange, distribution of exotic raw materials, and decorative patterns used during the Mesolithic.

Operation of such information networks, embedded within rite and ritual, promoted exchange of knowledge, dispersal of technological innovations, and exchange of partners among hunter-gatherer communities. Rite and ritual provided an important force for the initiation of interregional movement and contact. As Whallon emphasized:

> In fact, ritual and ceremonial values, duties, or obligations are all cultural ways of "making" people travel, visit special locations or other groups, aggregate, etc. in directions or at times that would not be normal in routine foraging and material procurement. (Whallon 2006:263)

One of the key questions that requires further consideration is how specific was the nature of symbolic information among the hunter-gatherers of the Mesolithic? The focus of the discussion here is that while the symbolic meaning of an object—whether a landscape feature such as rock art, or a decorated artifact—can convey several meanings, they are intelligible and complementary, rather than obscure and contradictory. So, for example, a rock carving will have a broad cosmological meaning, but at the same time can have specific social and/or ritual information, tell a story, and alert a knowledgeable reader to long-distance links and contacts. The same can apply to artifacts.

Information exchange played a central role in a historical process of change and development among prehistoric hunter-gatherers. It maintained the Mesolithic as a social tradition shared by hunter-gatherer communities in Europe and, arguably, adjacent areas of northern and temperate Asia. This social tradition was predicated on shared symbolic and cosmological values and beliefs and shared stocks of practical knowledge. The coherence of this tradition, as well as its historical development, was only possible though maintenance of far-reaching yet structured information networks, utilizing a wide range of information channels. Material culture, addressed here in the broadest possible sense and ranging from artifacts to landscapes, provided symbolic signatures of this process of information exchange and specified its content to the human actors through enculturated interpretation that began with a sign encoding a symbol, and involved the transmission of the symbol, its reception, and interpretation (de Saussure 1978). This process was through an activity which I have here associated with rites—a routine practice of "reading" the symbols and acting upon its meaning in a habitual way, without social negotiation or deliberate manipulation. Or it may have involved ritual, a form of human action that involved active manipulation of symbols and rites for reasons of prestige acquisition, resolution of liminal situations, or acquisition of other social or ideological goals. Tentatively, I have tried to show that information passed along these two channels was of a different nature, though perhaps not in every case. In the aggregate, however, such communication played a key role in the economic, social, and cosmological life of hunter-gatherer communities of the period and helped to maintain Mesolithic society as a social tradition by a broad-ranging network of contacts through which technical innovation, practical and ritual knowledge, kin and partner relationships, and social changes were negotiated and distributed.

ACKNOWLEDGMENTS

I would like to thank Robert Whallon as lead editor of the volume for his patience in waiting for my late contribution, to John Barrett for reading and helpfully commenting on the earlier text of this paper, and to Jenny Moore for her expert help in proofreading and the preparation of the bibliography for this paper.

9 The Role of Information Exchange in the Colonization of Sahul

Peter Veth, Nicola Stern, Jo McDonald,
Jane Balme, and Iain Davidson

Abstract

The earliest populations of modern humans to successfully expand their range beyond the tropical savannahs of Africa dispersed rapidly southward through South Asia and on to Australia circa 70,000–50,000 years ago. Colonization of the previously uninhabited Australian continent was contingent on the use of watercraft, and it has been argued previously that this involved planning depth for which symbolic communication was a fundamental prerequisite. Symbolic communication also accounts for the flexible social and economic strategies that are indicated by the rapid settlement of diverse and unfamiliar habitats. Despite this, it has been argued that there is an apparent dearth of material symbols in the Australian Pleistocene record. Material remains that arguably served as identity markers or played a role in information exchange or that represent complex technologies involving planning depth are identified. This provides a basis for evaluating the abundance and significance of material symbols in the Australian record. These types of material traces are, in fact, a conspicuous, if poorly dated, component of the early Australian record, even though population densities were low and migratory events rare. This suggests that extensive information exchange between groups, and marking of identity within them, was critical in fostering their accumulation.

INTRODUCTION

During the past decade, a number of attempts have been made to reevaluate the supposed distinctiveness of the archaeological traces of anatomically modern humans in an effort to resolve the apparent mismatch that exists between the fossil and archaeological records of modern human origins. These reviews have shown that the items of material culture under consideration appear intermittently in the archaeological records associated with the earliest populations of modern humans (e.g., McBrearty and Brooks 2000) as well as having quite variable expression in late Pleistocene records associated with populations whose morphology, genes, and behavior were unquestionably modern (O'Connell and Allen 2007). This outcome is not surprising, given that only a few of the traits under discussion have actually been linked to specific cognitive or behavioral capacities and in view of the limitations of our current understandings of the links among anatomy, cognition, and behavior.

In this paper, we review the material evidence for symbolic behavior in Sahul (the Pleistocene landmass comprising Australia, New Guinea, and Tasmania) and discuss the behavioral inferences that can be drawn from these material traces. The implications for current understanding of the circumstances in which symbols are likely to have been manifest in the material record are also considered. Recent reviews of the early record of Sahul differ in their assessments of the abundance and import of material symbols and their bearing on discussions of modern human origins (e.g., Balme et al. 2009; Habgood and Franklin 2008; O'Connell and Allen 2007; Stern 2009). As Sahul was colonized after modern anatomy and symbolic behavior were already established, its archaeological traces present a yardstick against which other records can be compared (cf. Davidson 2010a; Stern 2009). The way in which this record is interpreted and presented therefore is critical.

THE COLONIZATION OF SAHUL

The colonization of Sahul appears to have been one end point of a rapid dispersal of modern humans from Africa through the "southern arc": from Africa to Arabia, through South Asia and into island Southeast Asia (Balme et al. 2009). Although there is some debate about the age of the oldest archaeological traces in Sahul, current consensus indicates the continent was colonized before 45,000 B.P. (Bowler et al. 2003), perhaps between 54,000 and 47,000 years ago (Allen and O'Connell 2003; Gillespie 2002; O'Connell and Allen 2004; Roberts et al. 1994; Veth et al. 2009). The continent settled by these dispersing populations is now the world's most arid landmass and, though conditions were somewhat more benign 45,000 years ago, 40% of the habitats encountered by the colonizing populations were arid or semi-arid. By 35,000 B.P., a substantial trend toward cooler and more arid conditions had been initiated, and at the height of the Last Glacial Maximum (LGM), 70% of the continent was cool, arid, sparsely vegetated, and windswept (Hope 2009; Williams et al. 2009). In these circumstances, the exchange of information between colonizers of new habitats and their parent populations, and among small, dispersed populations, must have provided a crucial social and economic buffer. Thus, it is not surprising that, despite the relatively small sample of sites in Sahul dated earlier than the Last Glacial Maximum, a significant proportion have yielded evidence for the use of identity markers and/or exchange networks (Balme et al. 2009).

We note that the concept of the band as a proxy for residence groups, as deployed in other case studies in this volume, does not resonate in the Australian context (*sensu* Keen 2004: 307–308; *contra* Gould 1977; Tonkinson 2002: 9). Australian archaeology has not generally joined the characterization of any part of its archaeology as corresponding to a "band-level" of organization. Across much of this arid continent, it has been noted that residence groups do not always have an enduring identity related to particular places (after Myers 1986:71–91). As Keen (2004:308) notes, "Extended families tended to live together but individuals were very mobile, while families and aggregations of family groups had a transient existence."

The colonization of Sahul appears to have involved small numbers of people and no more than a handful of sea crossings, and this probably changed the social makeup at each crossing. This makes it extremely likely that most of the diverse social structures and patterns of interaction exhibited by groups in different parts of Australia were invented or discovered on this continent. The archaeology of Australia is therefore a story of how these small groups became Australians (Davidson 1999a; Pardoe 2006).

The focus of the following discussion is the variable representation of material symbols in Sahul, and the problem of determining the extent to which this can be attributed to survival in the record and/or to changes in the circumstances in which symbols solved crucial socio-ecological problems. In contrast to some arguments made for the Northern Hemisphere (e.g., Kuhn et al. 2001; Shennan 2001), the contexts in which symbols occur in Sahul suggest that high population densities may not have been the only trigger for the manifestation of symbolic markers or complex technologies.

MATERIAL SYMBOLS IN THE PLEISTOCENE RECORD OF SAHUL

The apparent rarity of highly visible, durable material symbols in the Pleistocene record of Sahul, compared with their abundance during the Holocene, has led some researchers to argue that they only became important in response to an increase in population size and density (e.g., Brumm and Moore 2005; Haberle and David 2004; O'Connell and Allen 2007; Rosenfeld 1993). The link between population increase and material symbols is based either on long-standing speculation about a mid-Holocene population increase that resulted in a reorganization of socioeconomic relationships (e.g., Haberle and David 2004; Lourandos 1983) or on the argument made by Shennan (2001) and others (e.g., Powell et al. 2009) that the manifestation of culturally complex traits is linked to demographic factors. The apparent rarity of material symbols in Pleistocene Sahul has led some to question their usefulness as a marker of modern human cognition and behavior (e.g., Brumm and Moore 2005; O'Connell and Allen 2007).

There are two reasons for being wary about this suggestion. First, identifiable material symbols are not the only evidence for these abilities that can be found in the Australian archaeological record. As Davidson and Noble (1992; Noble and Davidson 1996) argue, the very act of building the watercraft that was required to colonize the continent implies these abilities. Second, it is the presence, not the abundance, of material symbols that establishes whether or not the cognitive abilities associated with their use were in place (e.g., Wadley 2001). Material symbols appear intermittently and in varying form and abundance in the archaeological traces left by populations of modern humans over the past 150,000 years (e.g., Bar-Yosef 2002; James and Petraglia 2005; McBrearty and Brooks 2000; Zilhão 2007). This suggests that highly visible, durable material symbols were more likely to have been produced in some circumstances than in others (e.g., Powell et al. 2009). However, their abundance in the records of different places and time periods also needs to be considered in the context of their potential for surviving in a recognizable form in that particular record. This depends not only on the types of durable markers that were employed and their likelihood of being discarded and/or covered over by sediment, but also on the potential for establishing their age. At the same time, the use of material symbols will have depended on the socioeconomic circumstances that prevailed in different places and at different times.

Here we use the concept of the symbol in the semiotic sense of a sign that stands for some other thing by convention and where the relationship between the sign and the thing is often arbitrary (Peirce 1986). In this sense, symbols differ from, but are closely related to, two other classes of signs: iconic signs and indexical signs. An iconic sign stands for another thing by having some resemblance to it. In practice, there is some selectivity in the choices that are made about resemblance, and these generally are made in a socially prescribed, conventional manner (in most Australian Aboriginal rock art, humans are represented as if from in front, lizards are represented as if from above, and kangaroos are represented as if from the side), and such choices often constitute the stylistic conventions—the isochrestic choices of representation that groups make in their signaling behavior (e.g., McDonald 1999; Sackett 1990). Indexical signs signify other things by their invariant occurrence with them. Examples include the presence of smoke as an indexical sign of fire, and the footprints that signal the passing of an animal. In general, flaked stone artifacts—and especially knapping debris (Isaac 1981)—are an indexical, not symbolic, sign of the past presence of hominins or people (e.g., Davidson and McGrew 2005).

It has been argued that some artifacts imply a symbolic representation of functions because they cannot have been made as a response to immediate contingencies or habits of behavior. Thus, it was argued by Davidson and Noble (1992) that the construction of a watercraft that brought people from island to island across Wallacea to Australia involved the representation of either the juxtaposition of materials from different habitats to build rafts or the conceptualization that a boat could be hollowed from a solid object; both imply symbol use in cognitive operations. Davidson and Noble (1992) also argued that objects such as beads could have been fashioned for no particular purpose, but, insofar as they may have represented the relations between people—signifying that "we" are bead-makers and "they" are not—they too had a conventional quality that made them symbolic. The marking of places through rock art created indexical signs of the presence of people; but to a much greater extent than any with flaked stones, the conventions of rock art are symbolical signifiers of the nature of the people who made the art, whether or not it involved the use of iconic signs. It can be argued that in these three important ways, the use of material symbols was fundamental to solving the social and ecological problems encountered in colonizing Australia. In the case of beads and rock art, those solutions involved particular ways of using information that is not just a product of population density. Rather, once the cognitive requirements for symbol production and use emerged, they may be an important part of the ways in which human societies deal(t) with increasing the frequency and complexity of interactions with others (*sensu* Wiessner 1989, 1990).

Whatever routes were taken from Sunda to Sahul, dispersing populations would have had to make numerous water crossings to move between the islands of Wallacea (Figure 9.1). The lengths and depths of those water crossings indicate that both planning and watercraft would have been required. The recovery of pelagic fish from deposits at Jerimali in East Timor that are dated to ca. 40,000 B.P. (O'Connor 2007) suggests the existence of well-established maritime skills and raises the possibility that two-way voyages between the islands of Wallacea were undertaken from the time modern human populations first moved into the area (cf. O'Connor and Veth 2000). Certainly, once populations were well established in Sahul, there is evidence for the repeated movement of obsidian and live animals between mainland Sahul and the islands lying to the northeast (Allen and Gosden 1991; Davidson 1999a; Torrence et al. 2004).

The rapid dispersal of the colonizing populations into an array of different habitats points to the existence of complex information exchange systems that enabled parent and daughter populations to maintain existing social networks and small colonizing populations to establish new networks as well as pass on information about the location and distribution of resources (Balme et al. 2009). The establishment and maintenance of social networks would have been particularly important for the long-term survival of small, dispersed and highly mobile populations in semiarid and arid habitats characterized by spatially and temporally patchy resources (cf. Smith and Hesse 2005; Veth et al. 2005).

Material symbols will only survive if they are buried by sediments conducive to their preservation and will only be found if those sediments are exposed on the modern land surface. Part of Pleistocene Sahul now lies beneath the ocean, but perhaps of greater consequence in constraining the recovery of evidence for past information exchange systems is the fact that skeletal soils and sand sheets cover much of the continent's surface. Fragile organic remains are most likely to have been preserved in geomorphic settings in which the accumulation of sediment was low energy and quasi-continuous and the accumulating deposits were not subject to dramatic variations in temperature and moisture. Such sediment traps also had to be one of the foci of people's social lives if they were to capture for posterity frag-

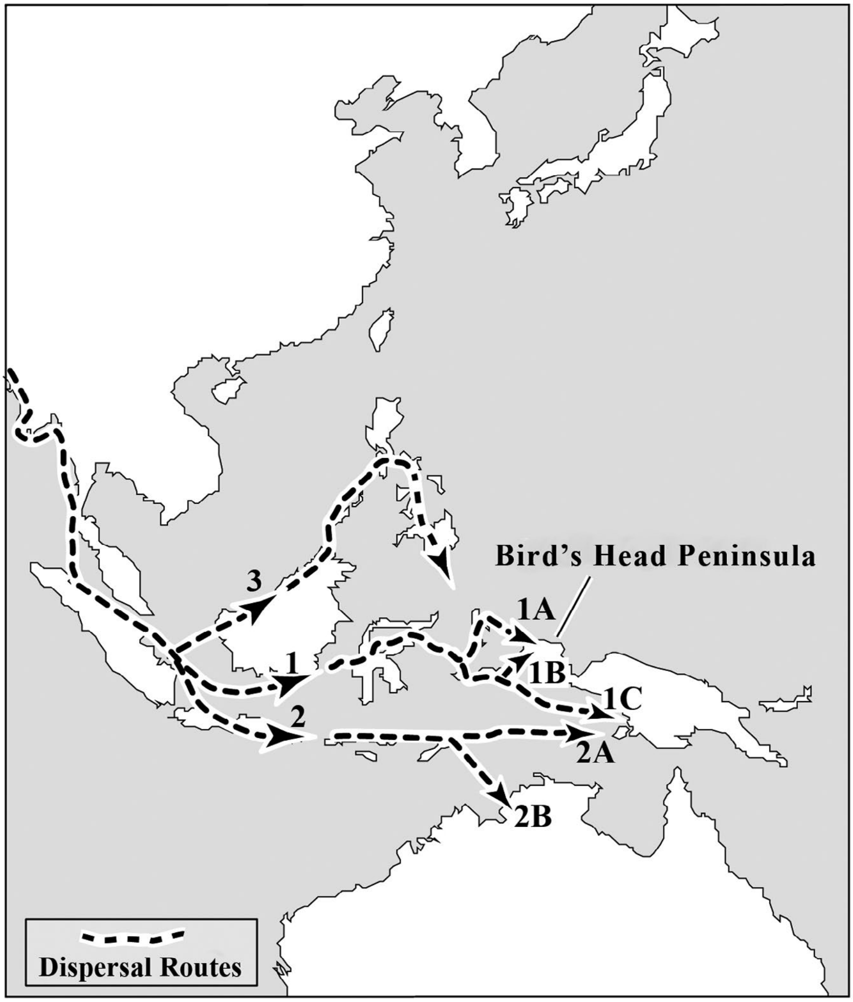

Figure 9.1. Alternative routes from Sunda to Sahul. Routes 1 and 2 were identified by Birdsell (1977), and Route 3 was identified by Morwood and van Oosterzee (2007).

ile symbols that were lost or discarded infrequently. In Sahul, engravings and paintings tend to occur on surfaces that are open to the elements and thus where long-term preservation is less likely.

The types of material markers employed, and the contexts in which they were used, would have had an obvious influence on the probability of their entering the sedimentary record. Ornaments and complex tools imbued with high social value were undoubtedly looked after, passed on, and/or recycled and consequently entered the archaeological record infrequently. Judging from the frequency with which broken slabs of engraved or painted rock are recovered from dated stratigraphic contexts, they too had a low probability of entering the sedimentary record, albeit for different reasons. Direct dating of the mineral skins that cover rock paintings and engravings has been attempted in Australia, but the number of reliable age determinations is still limited (e.g., Cole and Watchman 2005; Watchman 2001), and few paintings contain organic materials that could be dated using radiocarbon. This sets constraints on the extent to which regional and temporal variation in symbolic systems can be assessed.

Despite the factors affecting the survival and visibility of past information exchange systems, the early Pleistocene records of Australia and New Guinea preserve a variety of such evidence. The relevant data are reviewed here, with the aim of demonstrating that it is a much more substantial body of evidence than some recent reviews have suggested, and we include a detailed discussion of evidence for the Upper Paleolithic trait list presented by Habgood and Franklin (2008). Sites mentioned in the text are shown in Figures 9.2 and 9.3.

Identity Markers

Items of personal adornment that arguably functioned as identity markers and helped to mediate intragroup and/or intergroup interactions have been recovered from widely dispersed pre–Last Glacial Maximum sites. Two of these sites, Mandu Mandu Creek Rockshelter and Riwi, are in the semiarid zone northwest of Sahul (Balme and Morse 2006). At Mandu Mandu Creek, a collection of 22 cone shell (*Conus* sp.) beads that are older than 32,000 B.P. were recovered, while at Riwi, in the Kimberley, 10 tusk shell (*Scaphopoda*) beads were recovered from deposits that date to approximately 30,000 B.P. (Balme and Morse 2006). The beads from Mandu Mandu have perforations and edge damage consistent with their having been suspended. Those from Riwi also preserve evidence of edge damage consistent with suspension as well as the remains of fiber, and ocher coloring.

On New Ireland, a perforated shark's tooth from Buang Merabak (Leavesley 2007), dated between 40,000 and 28,000 B.P., shows the wide geographic distribution of personal ornaments in the region at this early stage. Bone beads from Devil's Lair, in southwest Australia and dating to 19,000–17,000 B.P., are younger than the other ornaments but demonstrate the range of materials from which they were made (Dortch 1984).

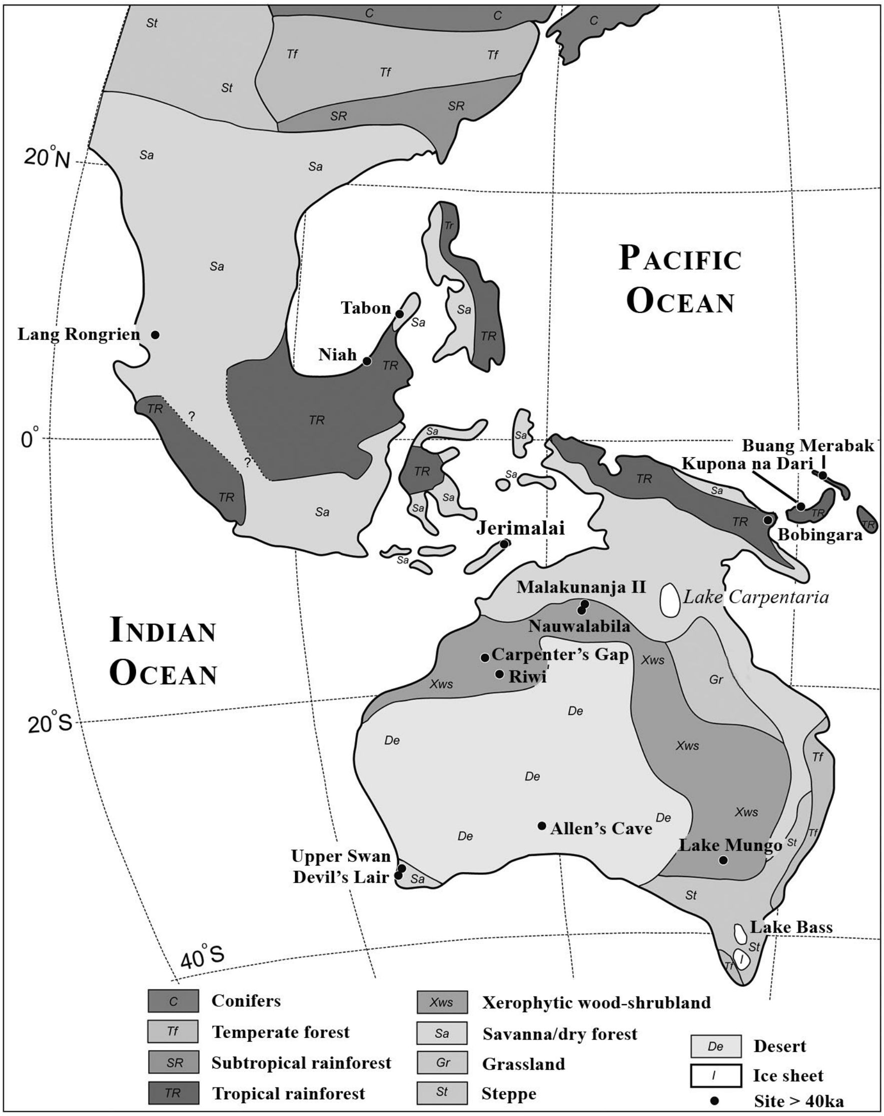

Figure 9.2. Locations of sites in Sahul that contain early evidence for symbolic behavior and are referred to in the text. *(Source for the base map: Hope et al. 2004.)*

Burials

The largest known sample of Pleistocene burials in Sahul comes from the Willandra Lakes on the edge of the semiarid zone in the continent's southeast, and two of these are both well described and well dated: Mungo I and Mungo III (WLH 1 and 3, respectively). Both are ritual burials and both are bracketed by OSL age determinations that place them between 42,000 and 38,000 years B.P. (Bowler et al. 2003). Mungo I is the world's oldest known cremation, while Mungo III is the world's oldest known ocher burial. Another 150 burials have been recorded in the Willandra Lakes area, and, though most are undated, stratigraphic contexts indicate that the majority are Pleistocene and that cremation and smearing of the body with ocher were among the burial rituals practiced (Webb 1989). In the absence of comparable samples from other parts of the continent, and in the absence of more precise age determinations, it is not feasible to assess whether these were regionally and temporally distinct burial practices.

Ocher Processing

Ocher is preserved at many pre-LGM sites in Sahul, but inferences about the use of ocher in symbolic contexts are best restricted to those sites that contain lumps of faceted ocher, grindstones that were used to process ocher, or slabs smeared with pigment. A painted rock fragment recovered from Carpenter's Gap in the Kimberley has been dated to 42,000 b.p. (O'Connor and Fankhauser 2001), and evidence for the grinding of ocher has been recovered from Malakunanja 2 and Nauwalabila 1 in Arnhem Land, the lower levels of which are dated by OSL to 53,000 and 59,000–53,000 B.P., respectively (Roberts et al. 1994). Allen and O'Connell (2003) provide good grounds for questioning these dates, and although they subsequently argue that there may be artifacts that are reliably dated to 45,000 B.P. uncalibrated (O'Connell and Allen 2004), the age of the lowermost deposits at these sites needs further investigation. Somewhat younger sites with evidence for the processing of ocher are scattered across the continent (Figure 9.3).

LONG-DISTANCE MOVEMENT OF MATERIAL

Evidence for long-distance movement of materials that might provide an estimate for the extent of people's social networks is documented at a number of pre-LGM sites (Figure 9.3). Although ocher has been recovered from many Pleistocene sites, only a few of these occurrences have been sourced. The oldest evidence for long-distance movement of ocher used in a ritual context is the ocher that was smeared over the burial of Mungo III, which is between 42,000 and 38,000 B.P. The nearest source of ocher is in the Bar-

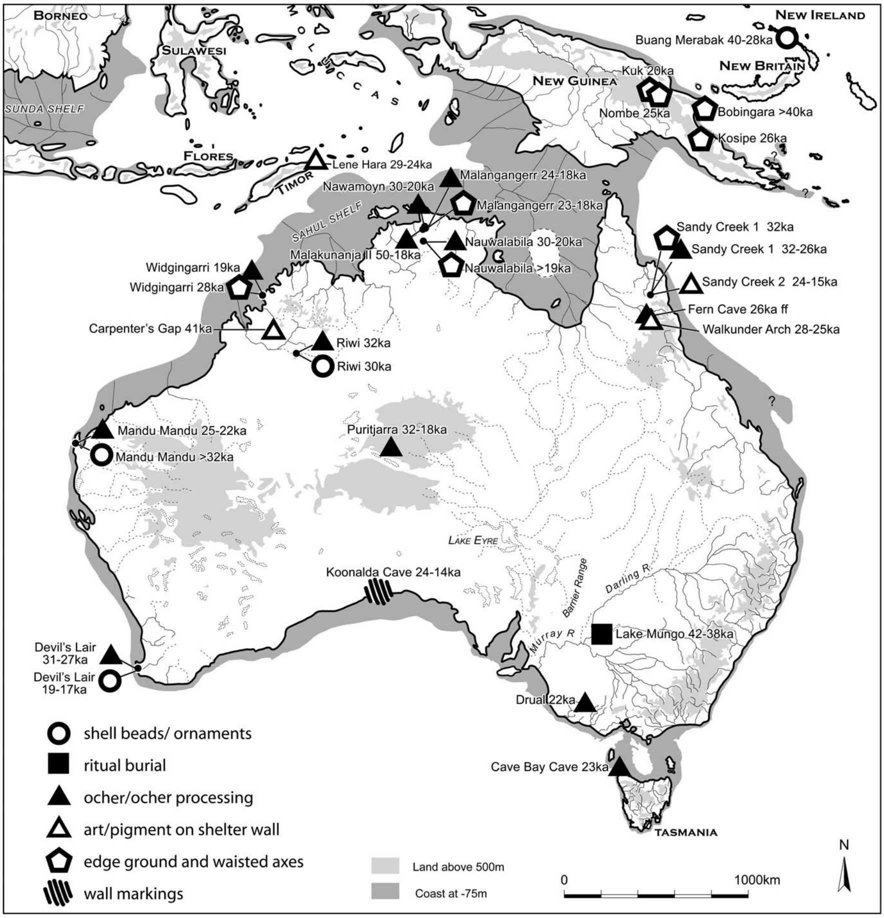

Figure 9.3: Map of Sahul showing the evidence for long-distance movement of material imbued with high social value dated to > 25,000 years *(Balme and Morse 2006; Cosgrove 1989; Johnston and Clark 1998; Morse 1999; O'Connor 1999, 1995; Smith et al. 1998)*.

rier Range, 250 km away (Johnston and Clark 1998). In central Australia, ocher was moved 125 km from a source at Karkurr to Puritjarra between 32,000 and 18,000 B.P. (Smith et al. 1997, 1998), while the closest source for the ocher recovered from the 25,000- to 22,000-year-old levels at Mandu Mandu was 300 km away (Morse 1999).

Unworked pearl and baler shell also moved long distances in the Kimberley. Both are present in the 28,000–19,000 B.P. levels at Widgingarri when the coast was 200 km away, and baler shell is present in the 30,000- to

19,000-year-old levels at Carpenter's Gap, when the coast was more than 100 km away (O'Connor 1999). The nearest coastline was about 500 km away from Riwi 30,000 years ago when *Scaphopod* shells were collected or transported to the site as finished beads.

With the exception of the shell beads at Riwi, none of the documented movements of symbolic and/or socially significant materials during the Pleistocene rivals the distances over which some materials moved during the historical era (Davidson et al. 2005; McBryde 1987; Mulvaney 1975: 110–115). This could reflect the small number of Pleistocene sites that preserve relevant evidence or the qualitative difference between data based on behavioral observations and those based on the material record, or it might hint at differences in the extent of people's social networks at different times in the past.

COMPLEX TOOLS

Tools whose manufacture required the use of other tools and/or involved multiple steps indicate an ability to conceptualize form and to plan a series of actions (Davidson 2010b). Complex tools of this type are present in the earliest artifact assemblages in Sahul (see Figure 9.4). Most notable are the edge-ground and/or grooved axes that have been recovered from sites on the Huon Peninsula and in the Highlands of New Guinea (Groube et al. 1986; White et al. 1970), Cape York (Morwood and Tresize 1989), Arnhem Land (Schrire 1982), and the Kimberley (O'Connor 1995. Such axes seem to have been confined to the tropical north of the continent until at least 45,000 years ago. Manufacture of the axes involved pecking and/or abrasion and the preparation of grooves and/or notches to facilitate hafting. They are interpreted as multipurpose tools used in a variety of activities, which may have included clearing paths through the forest, the acquisition of some food sources, and craft activities (Groube 1989).

In northwest Australia, complex tools, including boomerangs, appear in the earliest Kimberley pigment paintings and stencils (the Irregular Infill Animal period) with subsequent phases of Bradshaw figures (or Gwion Gwion: Doring 2000) demonstrating increasingly complex weaponry (Walsh and Morwood 1999). Complex tools are also recorded among dynamic figure pigment art in northern Australia (Chaloupka 1984, 1993). Although dating of these art styles is not conclusive, an OSL date suggesting a minimum age of 17,000 B.P. for one Bradshaw/Gwion Gwion painting (Roberts et al. 1997) and studies of style, motif, and environment (e.g., Chaloupka 1993; Chippendale and Taçon 1998; Lewis 1988) suggest that these could reasonably be expected to be Pleistocene (see below).

In those same paintings, dilly bags are also depicted, showing the presence of a fiber technology. Fiber is rarely preserved in early archaeological deposits, but other evidence from the region suggests its critical importance in the development of complex technology. Fiber was almost certainly used as a fastening component in the colonization watercraft that had to cover long distances

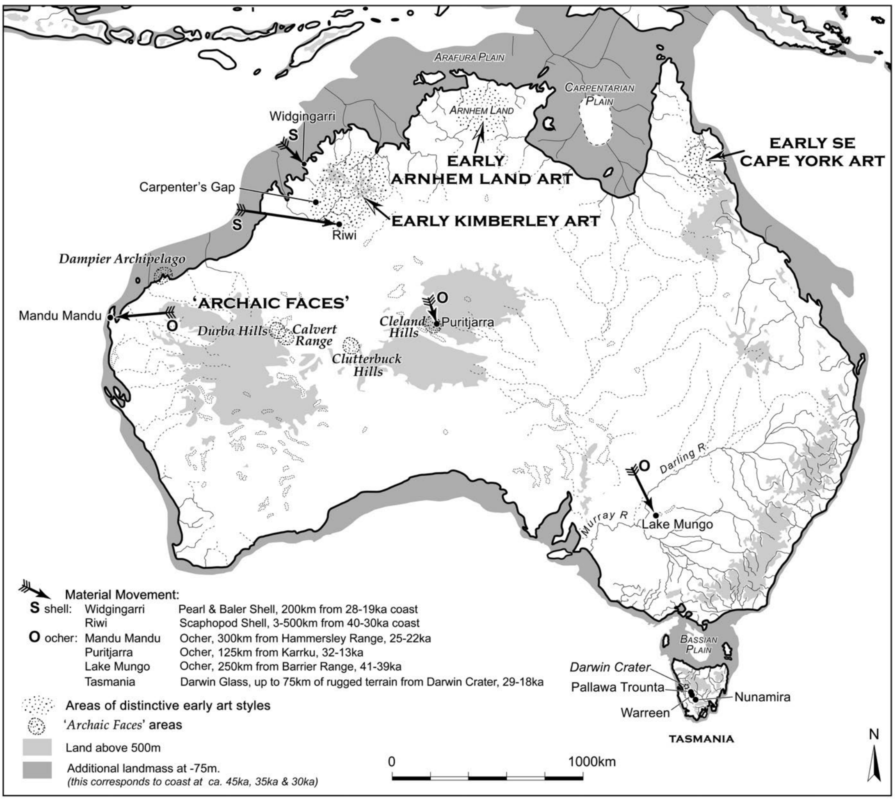

Figure 9.4: Map of Sahul showing the areas in which Pleistocene art is found. As discussed in the text, the art in each of these areas is distinctive, suggesting regional differentiation of symbolic behavior before the last glacial maximum. However, these are not formal definitions of "art traditions," and the labels either refer to geographic location or are derived from well-known studies of the art but do not necessarily describe all of the characteristics of that art (e.g., Archaic Faces [Dix 1977]); Arnhem Land [Chaloupka 1993]; Cape York [Rosenfeld et al. 1981]; Kimberley [Walsh 1994]). *Sources for the base map: Duncan 1982; Kilgour and Hatch 2002; Lampert 1981; and Voris 2000.*

and strong currents. The presence of large, deep-water fish in Timor at the site of Jerimalai and from the New Ireland site of Buang Merabak, both dating to about 40,000 B.P., implies deep-sea fishing techniques. This could have involved the use of either hook and lines or nets, but no hooks have been found yet in Pleistocene deposits. The use of nets has been invoked to explain the abundance of fish of uniform size within single-use middens preserved in Pleistocene sand dunes bounding an inland lake in western New South Wales (Balme 1995). The beads with evidence for stringing discussed above are further confirmation of the role of fiber in complex artifact design. Fibers would, therefore, have been available to haft the hatchet heads from northern Sahul.

REGIONAL ART TRADITIONS

Much of the extant body of painted and engraved art in Sahul is of unknown age, and much of it is undoubtedly recent. However, the art from at least four areas includes likely Pleistocene components: the early paintings from Arnhem Land (Chaloupka 1993; Chippendale and Taçon 1998; Lewis 1988), the Kimberley, discussed above (Roberts 2000; Roberts et al. 1997), the early paintings from southeast Cape York Peninsula (Cole and Watchman 2005; Watchman 1993), and engraved assemblages which include "Archaic Faces" from the arid zone (Figure 9.4). The art from each of these areas is quite distinct and indicates that symbolic differentiation of populations from different regions took place before the LGM (McDonald 2005; see also Franklin 2004).

Age determinations for minerals contained in the oxalate crusts formed between layers of pigment at sites in the southeast of Cape York Peninsula show that paintings were being produced in this region between 32,600 and 29,000 years ago (Watchman 2001). There is no way of knowing whether the pigments were part of a stencil or painting, and if the latter, what motifs were depicted (David 2002). However, given that there is pigment art of comparable antiquity from other regions, this evidence is quite widely accepted.

On the Arnhem Land plateau, four phases of painting have been distinguished on the basis of content and stylistic conventions, and three of these predate the postglacial rise in sea level, an inference based on the depiction of extinct animals in the earliest paintings and the fact that contemporary marine and swamp fauna are depicted only in the most recent paintings (Chaloupka 1994; Chippendale and Taçon 1998; Lewis 1988). There are marked discontinuities between the different phases of painting, reflecting changes in the environment as the sea flooded the Arafura Plain. Some have claimed that the art records evidence for shifts in belief systems (Chippendale et al. 2000; Davidson 1999b; Taçon et al. 1996) and changes in the intergroup warfare (Taçon and Chippendale 1994 and comments therein).

In the Kimberley region, an OSL age determination of 17,500 B.P. on a mud wasp nest that overlay a pigment figure (Roberts 2000; Roberts et al. 1997; Walsh 2000) suggests that this art tradition was well established (at a minimum) a few thousand years after the LGM. Several paintings in the Kimberley have now been interpreted as depicting the extinct carnivore *Thylacoleo carnifex* (Akerman 2009; Akerman and Willing 2009). One of these would be consistent with the early Large Naturalistic phase (Akerman and Willing 2009), while the other is associated with an early Bradshaw figure, with the human and striped marsupial separated by a multi-barbed spear (Akerman 2009). If this depiction has been interpreted correctly as *Thylacoleo carnifex*, then it suggests considerable antiquity for this art, as there is no available evidence for *Thylacoleo* more recent than 44,000 and 42,000 years ago (Johnson 2005; Turney et al. 2001).

In many parts of the arid zone, a distinctive suite of engravings (or petroglyphs) has been documented. While being a broadly homogeneous style (Edwards 1971; Maynard 1979), variation in the proportions of motifs depicted suggests regional differentiation within this widespread graphic tradition (Franklin 2004; McDonald 2005). These engravings are undated, but most of them are heavily weathered, patinated, and otherwise altered by geological processes, irrespective of the dip, strike, and petrology of the rock surfaces on which they are found. Thus, they are widely regarded as old (Dix 1977; Edwards 1968; McDonald 2005; Walsh 1988:68–74), although none of the weathered images has been dated directly (Watchman 1992). "Archaic Faces" found among this art tradition have been interpreted as demonstrating the extent of a regional network in this distinct graphic tradition (McDonald 2005).

This differentiation of art styles relatively early in the northern part of the continent makes the point that symbolism was used to mark some aspect of identity over areas much wider than the sporadic occurrences of sites that have produced personal ornaments or fragments of ocher. The shell ornaments seem likely to have marked something about personal relationships, possibly at the level of roles within social groups. On the other hand, the marking of places through painting and/or engraving probably indicated, both to members of the society and to outsiders, what the relationship of the artists was to their country. In both respects, symbols seem likely to have conveyed information important to the successful colonization of the arid and semiarid regions.

THE ROLE OF INFORMATION EXCHANGE IN THE COLONIZATION OF SAHUL

Elsewhere in this volume, McDonald and Veth (Chapter 10) propose a model for the use of art in information exchange systems deployed by colonizers of the arid interior. A detailed archaeological test of this model is not yet possible because the dating of all phases of the art sequence has not yet been achieved. However, there is good evidence for regional diversification in the use of material symbols in the pre-LGM record in Sahul. The implied role of information exchange in this process, and in the successful colonization of the arid and semiarid core of Sahul, has broader implications that are worth elaboration.

When people moved into the semiarid and arid interior of Sahul circa 45,000 years ago, surface water was abundant and conditions were considerably more benign than they are now (Johnson 2005; Hiscock and Wallis 2005). Current evidence relating to the economic, technological, and social strategies employed by these colonizing populations is limited, but has been interpreted as indicating highly flexible territorial arrangements and subsistence activities (Veth 2005a). It also suggests that one focus of people's activities was around large, freshwater lake systems, as these areas provided an array of predictable aquatic resources. It remains to be established whether these were fallback foods or the focus of people's economic activities.

The archaeological traces in the landforms bounding these lakes consist primarily of individual hearths, clusters of lacustrine and/or terrestrial food remains, or stone artifact scatters, many of which arguably represent the material remains of individual meals or tool-making activities (e.g., Balme 1995; Veth et al. 2009). These are widely scattered across the landforms and through the stratigraphic sequences in which they are found, and the quantities of archaeological debris they contain have led many commentators to argue that populations were small, dispersed, and highly mobile (e.g., O'Connor and Veth 2006). Nevertheless, these records include some of the earliest evidence on the continent for symbolic behavior and social networks, including long-distance movement of materials and identity markers (Figures 9.3–9.4).

It has been argued that communication between groups increases as population density increases because there is greater probability of meeting unfamiliar people for whom information might be useful (e.g., Kuhn et al. 2001; Stiner 2002). Such signaling overcomes the problems that arise from ambiguities of group identity in a context in which communication involves both arbitrariness and convention through the use of symbols (Nettle and Dunbar 1997; Davidson and Noble 1992). However, in a situation in which social groups are small, dispersed, highly mobile, and not especially territorial, there is a high probability that any encounter will be with an unfamiliar person. Identity markers may have reduced the risk of those encounters being antagonistic and facilitated the exchange of critical information about the location of resources and people.

Recent simulation studies confirm the role of population density in the manifestation of material symbols and identify two other factors as exerting a major influence on the occurrence of culturally complex traits: migratory activity and the number of other populations with which a population interacts (Powell et al. 2009). One, but not both, of these conditions may have been met in late glacial Sahul. Genetic studies suggest that the founding population was small and diverse, and relatively isolated once established (Hudjashova et al. 2007; Merriwether et al. 2005). This does not mean that there were no subsequent migrations to the continent, simply that smaller numbers of later arrivals had limited impact on the existing genetic diversity (Pardoe 2006). That genetic diversity is interpreted as the outcome of a lengthy occupation and a long period of genetic isolation (Huoponen et al. 2001). Thus, it can be inferred that migrations to the continent that might have increased the variance in skill levels and enhanced the transmission of cultural traits were limited.

Genetic studies also indicate that some populations have lived in the same region since the continent was first settled (van Holst Pellekaan et al. 2006). Thus, migratory activity within the continent probably was not significant once all the major biogeographic zones had been settled, despite the apparent replacement of all languages in southern Sahul by the Pama-Nyungan languages (Evans 1988) relatively late in the Holocene (Evans and Jones 1997). Within each biogeographic zone, subsequent expansion of settlement into previously unoccupied landforms, or resettlement following abandonment or local extinction, is likely to have taken place from surrounding areas (e.g., Veth 1989).

The number of other social groups with which any particular late glacial social group interacted is difficult to gauge on the basis of current data and is likely to have fluctuated as new economic and social strategies were devised to cope with the environmental changes that took place in the lead-up to the LGM. However, Pardoe's (1994, 2006) study of the relationship between territorial size and environmental productivity in the Murray River Valley, and his efforts to model the impact of this on marriage partners and gene flow, establishes some useful general principles (see also Birdsell 1953). Social groups that inhabited larger territories in less productive environments would have had more neighbors and geographically more extensive social networks and so interacted with a larger number of other social groups, while those in highly productive environments would have had smaller territories and interacted with fewer other groups.

Although surface water was more extensive when people first moved into the interior of the continent (Hiscock and Wallis 2005), much of the surrounding areas was clothed in a relatively unproductive xerophytic shrubland; and if the inference that it was inhabited by small, dispersed, and not especially territorial groups is correct, this situation would have fostered intergroup interactions. After 35,000 B.P., when there was a marked trend toward cooler and more arid conditions and a marked reduction in atmospheric CO_2 resulting in reduced biological productivity, reciprocal relationships between groups may have been enhanced. Archaeological tests of these generalizations, however, require much more detailed regional records of economic, technological, and social activities than are currently available.

CONCLUSION

The early archaeological record from Sahul indicates that identity markers, exchange networks, and complex technologies do occur in situations where population densities are low and migratory events are rare and of limited impact. Thus, extensive intergroup interactions may have been sufficient to foster the accumulation of culturally complex traits. This suggests that further consideration needs to be given to the socio-ecological circumstances in which networks of reciprocal relationships are maximized. Complex information exchange is clearly implicated in the colonization of Sahul, given the plethora of modern cognitive and symbolic capacities we have summarized in this paper.

10 Information Exchange among Hunter-Gatherers of the Western Desert of Australia

Jo McDonald and Peter Veth

Abstract

Australian Western Desert Aboriginal groups display some of the highest levels of residential mobility and the lowest population densities recorded globally. Nevertheless, aggregations of many hundreds of people occurred regularly with the exchange of information, material culture, and genes. Widespread connections in kinship, language, ritual, and material cultural over vast distances are documented. The engraved and painted art corpus of the Western Desert is tangible symbolic behavior aimed at transmission of information, both maintaining long-distance networks and establishing group identity. We report on recent dating of pigment art and stratified sites and outline the information exchange model that we are developing for the Western Desert.

Recent excavation of ancient lakeshore deposits in the Great Sandy Desert has revealed arid zone occupation from before 37,000 B.P. and most probably in the range of circa 50,000–45,000 B.P. (Veth et al. 2009). The deep stratigraphic section at Parnkupirti provides a long record of the Quaternary history of Lake Gregory, which remained a freshwater system during the Late Quaternary. Archaeological rockshelter excavations throughout the Western Desert have confirmed a Pleistocene signal from circa 24,000 years ago while fleshing out the Holocene sequence (O'Connor et al. 1998; Veth et al. 2001, 2008). Stone tool assemblages reveal occupation through the

Holocene, and there is a notable shift in both raw materials procured and the technological manufacture of artifacts in the last 1,000 years. Engraved and pigment art has also been produced episodically throughout the occupation of the arid zone. Some of the engraved art appears to be extremely old. Much of the pigment art is more recent. We have been using occupation indices and information exchange theory to view rock art as a form of negotiated identity throughout the entire human occupation of the arid zone.

It has generally been assumed (Gamble 1982; Jochim 1983; McDonald 2008; McDonald and Veth 2006a; C. Smith 1989) that art in more fertile regions—where population sizes are high, social networks closed, and distinct languages spoken—the pressures of interaction among these groups will be greater and demonstrate a high degree of social information, with distinctive group-identifying and bounding behavior (following Wobst 1977). In the arid zone, on the other hand—with its widely ramified open social networks, very low population densities, and dialects of the same language being spoken—symbolic behavior has been thought to function to reinforce broad-scale intergroup cohesion, with stylistically homogeneous art being the expected outcome. Against expectations, we have repeatedly found surprisingly high levels of stylistic heterogeneity across the arid zone, particularly in the art of the recent past. We have argued previously that the "aggregation locale" concept (Conkey 1980) is optimal for explaining art sites/provinces where groups from many disparate social groupings coalesce (McDonald and Veth 2006a). Aggregation behavior constitutes part of the normal ebb and flow of social contact within the arid zone, and explains at least some of these high levels of stylistic variability. Aggregation phases were important for ritual production and facilitated the exchange of language, material items, and marriage partners (Gibbs and Veth 2002). Aggregation behavior, with its opportunities for contested space, identity signaling, and highly public messaging, particularly at resource nodes around the Western Desert, would have presented the opportunities for the dissemination of social information, with both personal and distinctive group-identifying and bounding behavior being the result (after Wiessner 1989, 1990). We posit that the accelerated ritual and ceremonial cycles in the recent past, combined with increased long-distance exchange and the evolution and movement of Western Desert languages, would have resulted in the development of distinctive localized-style graphics across the arid zone. We believe we are beginning to track these local style markers.

The Pilbara-style provinces in the arid uplands adjacent to the Western Desert provide a proximal data set with even higher levels of stylistic heterogeneity. Differences in population density and territory sizes between these two parts of the arid zone are marked. The highly structured and distinct language groupings of the Pilbara, with their higher population densities provide an easy explanation for these stylistic differences in terms of information exchange (Table 10.1; Plate 10.1). There is broad congruence between many of the documented Pilbara-style provinces and sociolinguistic boundaries (after Tindale 1974). But there are also several notable exceptions to this neat fit. The distribution of the extraordinary Woodstock Abydos style of petroglyphs (Worms 1954; Wright 1968, 1977) transcends the current language boundaries of three neighboring language groups (Njamal, Indjabandi, and Pandjima [orthography after Tindale 1974]). The Cooya Pooya style similarly can be found in both the Ngarluma and Indjabandi territories. And the extraordinary style province of the Dampier Archipelago—or Muruguja—similarly contains stylistic elements of many of the Pilbara styles, while also exhibiting its own unique style of graphics (McDonald and Veth 2006b, 2008, 2009). Preliminary analysis of these styles and their boundaries suggests that some of these rock art provinces likely predate the current linguistic and territorial arrangements. Given that linguistic stratigraphy (McConvell 1996; Veth 2000) suggests that the Pilbara language subgroups could date up to before the late Holocene, those styles that cross the contact language boundaries could predate the introduction of these language groups.

It is the changing use of rock art throughout the occupation of the arid zone—and rock art's role in social mediation through these time slices—that we are interested in exploring. Over the last 10 years, we have been developing a model that contextualizes art within a consideration of

Table 10.1. Arid Zone Population Densities

Language Group Territory	Arid Zone	Density (person/km^2)
Ngarluma	Coastal Pilbara	1/29
Pandjima	Pilbara uplands	1/57
Wardal	Western Desert	1/135

SOURCE: Based on Tindale 1974.

broader occupation indices (McDonald 2005; McDonald and Veth 2006a). In this paper, we focus on the most recent manifestations of that relationship, but it is worth reiterating how we see rock art functioning throughout the arid zone's occupational history (Table 10.2).

Initial settlement of the arid zone was in the Pleistocene (M. A. Smith 1989, 2006; Veth 2005a, 2005b, 2006; Veth et al. 2009), and our model sees art as an integral part of that colonizing social repertoire (and see Balme et al. 2009; Veth et al., this volume, Chapter 9). Ancient Panaramitee-style petroglyphs (Plate 10.2) across the arid zone reveal long-distance connections, while the addition of archaic faces and the development of more complex motifs demonstrate shared graphics across thousands of kilometers (McDonald 2005). A tightening of social and territorial organization occurred before the Last Glacial Maximum (LGM) following a long phase of high group mobility and multivalent art.

During peak aridity, we suggest that large tracts of plains and interdunal corridors dropped from peoples' normally frequented ranges. It is possible that rock art was not produced in some areas during this period—either because of the absence of people or because of the isolation of social groups—negating the need for signaling behavior. Between circa 3000 and 6000 B.P. there was climatic amelioration, and we posit that rock art was again used to establish territoriality, with an increased demonstration of identifying behavior in core territories.

Between 6000 and 3000 years ago, we see the emergence of social networks that continued into the recent period. Art at this time was likely used to negotiate broad-scale *and* local group identity. Demographic packing occurred, and it is likely there was increasing social pressures as a result of expansion of old territories and the occupation of new ones. Signaling of territoriality by Pilbara language groups is likely to have become intense during this period, and it seems likely that many of the identifiable style provinces emerged in this time frame.

In the Western Desert from ca. 1,500 years ago, there appears to be a major increase in site numbers and artifact densities, coinciding with the likely spread of the Western Desert languages out of the Pilbara region (McConvell 1996; Veth 2000, 2006). We assume that the ramified social networks described by anthropological research have functioned for some 1,500 years (and see Smith and Ross 2008a, 2008b). In the last 500 years, there appears to be increased interaction, with social networks moving from the Western Desert into central Australia. Western Desert cults moved into

Table 10.2. Western Desert Occupation Phases and Art Correlates

Occupation Phases	Occupation Model	Likely Art Correlate
Phase 1 50,000–22,000 BP	Initial colonization leading to all land systems in use A broadly based economy	Sporadic art production reflecting small population groups at occupation nodes Widespread group cohesion with homogeneous art styles across arid zone
Phase 2 22,000–13,000 BP	Shifts in demography during LGM Changes in residential patterns; groups persist in refugia Lowlands used more opportunistically	Broad-scale social cohesion with perhaps increased localized identifying behavior in refugia – territorial tethering
Phase 3 13,000–6000 BP	Climatic amelioration Marginal lands used more systematically	Art used to express open social networks
Phase 4 6000–1500 BP	Occupation of all desert ecosystems Re-establishment of regional exchange/ information networks with Pama Nyungan occupation of WD	Art used to negotiate broad-scale and local group identity with increasing territoriality
Phase 5 1500–500 BP	Spread of WD languages leads to increased intensity of site occupation Accelerated ritual and ceremonial cycle with evidence of linguistic contact between north and central deserts Increase in long-distance exchange	Increased use of art to negotiate local group identity Distinctive localized style regions develop Aggregation locales demonstrate product of accelerated ceremonial activity
Phase 6 500 BP–contact	Increased interaction with social networks in central Australia A late spread of WD into central Australia	Art influences appear from the east and farther afield Increased distinctive local group identity is displayed Aggregation locales continue to be used

the Pilbara uplands, as did Western Desert graphics, while central desert graphic influences are also seen in the Western Desert during this period.

We believe that the changes over time in occupation indices and art production reflect shifts in exchange networks, increasing artistic activity, and changing residential mobility patterns. Dating the regional rock art assemblage, with its complex graphic vocabulary in the recent past, adds to this picture of increased dynamism.

It is this most recent period that our rock art dating program has targeted, as we attempt to come to grips with stylistic variability within a single art phase. Given that many Western Desert people are but a few generations from first contact, there are also good ethnographic reasons for targeting this phase. We are also trying to disentangle the rock art imagery that has relevance to specific mythological narratives. In the process, we are learning how specific mythologies can be traced across the landscape in dreaming tracks, creating connections that are sometimes clear, but at other times are archaeologically ambiguous (Gould 1969; McDonald and Veth in prep.).

So far we have dated pictographs in the Calvert and Carnarvon Ranges—two isolated ranges set among the dunefields of the Little Sandy Desert (Figure 10.1; Table 10.3). In both of these ranges, we have also excavated rockshelters that provide long-term occupation patterns which contextualize rock art production. These ranges provide punctuated resource foci for groups of people in the Little Sandy Desert. The Carnarvon Ranges are located about 400 km southwest of the Calvert Ranges, and both of these features provide shelter, semipermanent water, and suitable media for rock art production—separated by significant distances where there are no such resources.

Serpent's Glen Rockshelter (Katjarra), on the southern edge of the dunefields, provides evidence for sparse occupation of the Western Desert circa 24,000 B.P. (O'Connor et al. 1998). The site has no artifacts from LGM, with occupation commencing again by the mid-Holocene. But nearly 97% of the artifacts deposited in this rockshelter date to the last several hundred years (O'Connor et al. 1998). The plotted excavation data show that the trend in deposited artifacts does not match that of the excavated pigments (Figure 10.2): the (mostly red) ocher distribution curve indicates a slightly earlier peak in ocher than is observed with the stone artifacts. This suggests changing site function through the Holocene—and indeed an inverse relationship between the deposition of ocher and stone

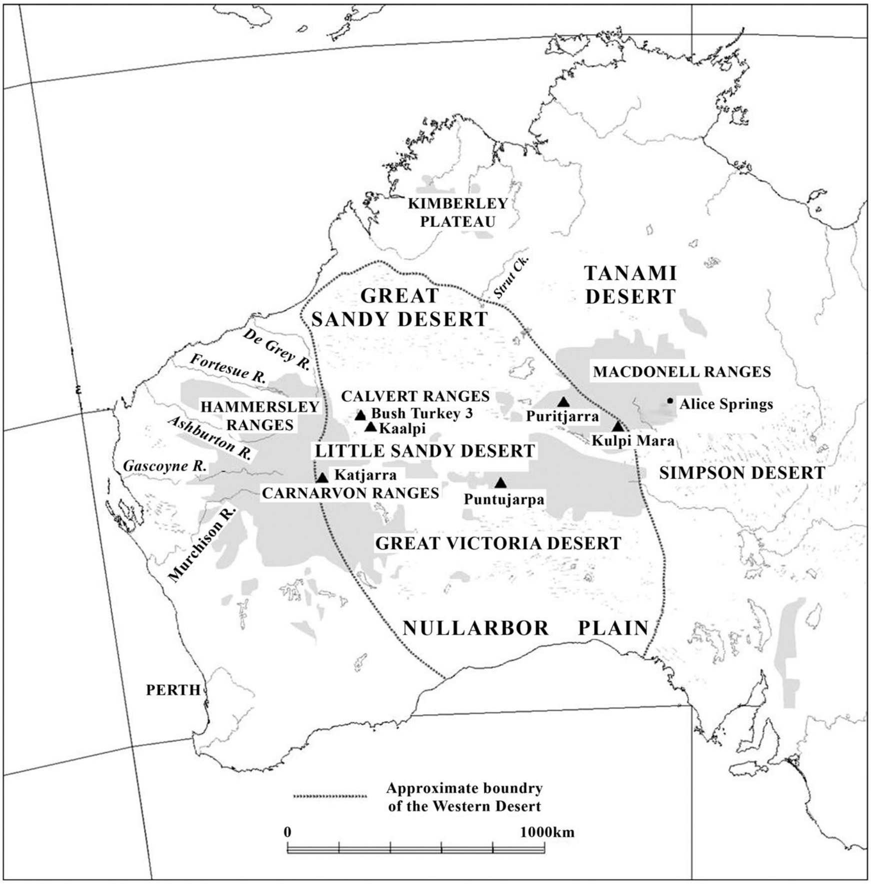

Figure 10.1. The Western Desert showing the location of Calvert Ranges (Kaalpi) and Carnarvon Ranges (Katjarra).

tools in the recent past. Interestingly, the art dates (collected from sampled motifs on the wall, not made on excavated materials) all fall between circa 720–150 calibrated years ago—these clearly being premodern. The dating of the art motifs suggests that a reinvestigation of this site's most recent usage is warranted. Our dating work targeted the shelter's most recent art phase—predominantly black-and-white paintings (Plate 10.3). This dated art is superimposed over the main phase of art production in this shelter—the phase where the red-and-white paintings were produced in the main panel. It is assumed that the pigment in the deposit relates to this earlier art production. There has obviously been episodic art production within this

Table 10.3. Radiocarbon Age Determinations from the Kaalpi and Katjarra Motifs

Motif	Sample No.	CAMS ID	μg C	Radiocarbon Age (Years BP)	Calibrated Age (cal BP)
Kaalpi					
Black outline of SNF	10	134001	300	260 ± 40	445–250
Black outline of CXNF	17	134000	260	285 ± 35	445–270
Katjarra					
Gray *mamu*	18	134002	300	285 ± 35	445–270
Gray *mamu*	19	133998	160	460 ± 40	535–390
Phytomorph	24	130499	100	745 ± 45	725–560
Phytomorph	25	133999	69	540 ± 80	660–390

SOURCE: McDonald and Steelman 2008.

shelter over the last millennium, and our dating work has so far specifically refined an understanding of the most recent production phase. Dating of components from earlier art phases continues to be explored.

The Kaalpi rockshelter in the Calvert Ranges represents a very different type of occupation site. It has an equally impressive—if quite different—rock art gallery. As with the Serpent's Glen site, there is a large assemblage of pictographs. In the Kaalpi rockshelter, there was a notable increase in ocher discard and formal grindstones and mullers in the deposit after 1300 B.P. (Plate 10.4). By contrast, the flaked stone artifact discard rate halved during the last 1,000 years (Veth et al. 2001:13). Again, the signal of ocher deposition does not match that of flaked stone artifacts—suggesting, perhaps, that the use of rockshelters for domestic habitation and rock art production is not clearly correlated. We have dated two motifs in this rockshelter so far, both of which were considered to be representative of the most recent phase of art production. Both of the dated motifs were painted less than 300 years ago (McDonald and Veth 2008; McDonald and Steelman 2008; Steelman et al. 2008, using techniques described in Rowe 2001). We expect that red paint motifs (should these contain organics) would extend the dated art range in this site; from the distribution of excavated ochers, this age range might be circa 1300 B.P.

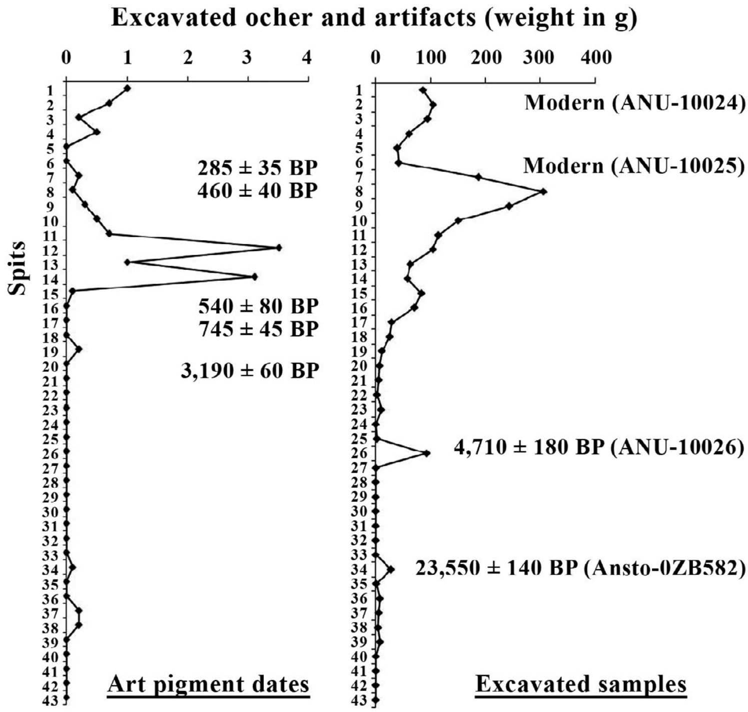

Figure 10.2. Serpent's Glen (Katjarra). Correlation of excavated ocher (mostly red, some yellow) distribution and artifact weights by spit (excavation data from O'Connor et al. 1998). Dates from excavated charcoal are shown on the right; the pigment dates (*left*) received from motifs are positioned chronologically relative to the excavated dates.

The age ranges for three of our dated samples—two from Kaalpi and one from Katjarra—overlap at 95.4% probability, indicating that these images were created contemporaneously (Table 10.3). At Katjarra, two *mamu* figures and two phytomorphs dated by the current analyses showed some variability in their ages, although two samples overlap at 95.4% probability (Plate 10.5). The radiocarbon date for the second phytomorph overlaps with the first phytomorph at 2σ at 45 radiocarbon years B.P. These slight variations in age ranges could be due to a number of expected technical factors (e.g., variations in ages of charcoal collected to produce the art). In an archaeological sense, the age ranges obtained clearly fit within a single cultural period. Archaeologically we would not expect to get a more precise indication of age—and the ranges we have obtained are an acceptable range of variation for a single artistic episode, if not a single painting episode.

It is clear that art was being produced in both the Carnarvon and Calvert Ranges at the same time and that the types of art being produced in this time period were similar. There is clearly regional variation in stylistic schema in the recent past across the Western Desert—and clear connections between categories of art and specific motifs over large distances. These two art provinces are linked by contemporary mythological sagas, which is an area of current research focus (McDonald and Veth in prep.).

The dating suggests that certain motifs and styles occurred throughout this particular period, over significant distances and across dialect boundaries. So what are the stylistic and mythological connections between these two art provinces? And does the art reveal how people demonstrated their cultural connectedness in the last millennium?

Differences in headdress depiction have already been identified as an extremely sensitive indicator of local group signifying behavior (McDonald 2005). Snakes and headdress figures occur in both locations, and these do appear to demonstrate localized variability in pigment production (compare Plates 10.3 and 10.6). In the Katjarra site, both motifs occur in considerable numbers, and there is a distinct graphic vocabulary being used in their production. The same can be observed within the Kaalpi rockshelter and Calvert Ranges more widely.

Mamu figures occur in both art provinces, although they are documented more widely across the Western Desert (Berndt and Berndt 1964; Gould 1969; Meggitt 1955). Gould describes these as "ghosts" which are sometimes regarded as cannibalistic. They were often used by adults as a way to stop children from straying from camp at night or to scare them away from sacred places (Gould 1969:129). The Berndts described *mamu* as that part of a deceased's spirit that remains to haunt the living, while other parts of the spirit return to a totemic spirit-center (Berndt and Berndt 1964:183). The Martu have a situational mythological narrative (Tonkinson 1974) relevant to these malevolent beings. We were told by Martu traditional owners that the *mamu* live in Lake Aerodrome, a large salt lake situated roughly midway between the Carnarvon and Calvert Ranges (southwest of Well 12 on the Stock Route). The *mamu* from different parts of the salt lake are of slightly different colors, reflecting geological and geomorphic conditions around the lake. Martu must be very careful that they camp in "the right place" around this lake—in terms of their social relations and position relative to country—or they will upset the *mamu*, invoking their disapproval, to the detriment of the people concerned. We have had *mamu* depictions interpreted as such in both of these art provinces, and in terms of graphic vocabulary they can be seen as being similar but subtly also different. They vary in color and morphology, and informants have said on various occasions that the colors used in such depictions are important—in telling which part of the lake the *mamu* have come from.

At Katjarra, there are three *mamu* motifs (Plate 10.7). They are all solid infilled forms, and all appear to have been made with white pigment mixed with gray (an ashy component). Two of these motifs have been dated, as has the phytomorph associated with the third *mamu* (sample 24, Table 10.3). The dates for these motifs range over circa 500 years, and it seems likely that their production was episodic. This may well account for the fact that, as a graphic, they are not an internally coherent form, although the mode of their production (painted solid gray) is consistent. All of these motifs are anthropomorphic in nature, although their body postures and associated features (headdresses and/or hair, genitalia) are not the same.

In the Kaalpi site, there are six *mamu* figures which are internally coherent as a graphic while not looking exactly identical (Plate 10.8). They appear to have been produced during a single painting episode using the same white pigment. They are all outline motifs but have varying numbers of limbs (two have six limbs, one has five limbs) and varying numbers of digits and are of different genders. Three have heads that also apparently have digits. They are all positioned on a single panel of this rockshelter's ceiling. Three other shelters nearby in the same valley have a similar motif (again with slightly different numbers of limbs and postures). Unfortunately, there appears to have been no organic component added to the kaolinite (pipe clay) in these motifs: samples collected for potential dating produced insufficient carbon for radiocarbon determinations (Steelman et al. 2008). The white pigment used for the production of these motifs, however, is similar in consistency and color to the two nonfigurative bichrome motifs (made using black and white pigments) that were dated at this rockshelter (to ca. 400 years ago) and which, from the similarity of the age determinations, could have been created in a single artistic episode. While these motifs appear to have been created in a single art production episode, the morphological differences between the individual motifs are considerable. These differences, given the apparent single painting episode, suggest that the range of variation is culturally acceptable in the depiction of a particular schema within a single art phase (Morwood 1984) at a particular point of time (and see Smith and Ross 2008b). Conversely, the differences between the depictions of *mamu*s in the Calvert and Carnarvon Ranges appear to represent differences in both time and space—with distance, dialect, and possibly time accounting for variation in the ways that these motifs have been portrayed. Our dating work places them all within the same cultural phase (of the last 500 years). The classification (by our current analysis) places these motifs (which are not visually identical and which would not necessarily be placed archaeologically into the same motif class) in the same taxa, based on the interpretation of these forms by contemporary informants. The complexities of interpreting rock art are thus fully exposed.

By these processes we are beginning to tease out how mythological narratives cross the arid zone landscapes and how the rock art "tracks" these dreaming stories.

One of the recognized pitfalls of analyzing rock art variability arises from comparing assemblages that may not be contemporaneous. Our dating work so far has been aimed at identifying and analyzing the most recent phase of rock art production in the Western Desert, which has ethnographic valency and for which interpretation can be sought from our informants (many of whom had first contact with Europeans between 1963 and 1976). By seeing how this rock art system varies spatially and how it functions within contemporary mythological frameworks, we are investigating the social construction of rock art production in the Australian arid zone. By dating the rock art, comparing art of a similarly recent time period, and combining this with a detailed trait analysis and culturally relevant interpretation, we are beginning to disentangle the social expression and functions of rock art across the space of this huge arid canvas.

By investigating the most recent phase of art production and exploring its stylistic variation in terms of language and social structure, and in the context of the dispersed territories and punctuated aggregation locales of the Australian arid zone, we hope to further develop a model for rock art as symbolic behavior aimed at the transmission of social information. In a variety of social contexts, rock art can establish local and/or group identity and be used to maintain proximal and long-distance networks. By establishing the connections between graphic systems that are related in time and within certain mythological narratives, we are developing a socially constructed view of arid landscapes.

People of the arid zone signal their social individuality and depict their mythological narratives in distinctive ways. Rock art production has occurred in a variety of social contexts, affected by both day-to-day territorial configurations and also calibrated by ceremonial and ritual cycles. We are attempting to disentangle the *messaging* potential of rock art in this range of social contexts. Aggregation behavior inferred from art galleries at resource nodes around the Western Desert have presented the opportunities for the dissemination of social information (Wiessner 1989, 1990). Detailed occupation indices demonstrate changes in occupation patterns over time. By contextualizing rock art within a range of domestic and nondomestic contexts, we hope to develop a more sophisticated view of style as social strategy in the Australian arid zone.

11 Rock Art Information among Hunter-Gatherers in Northwest Patagonia: An Assessment of Broad-Scale and Territorial Models

Vivian Scheinsohn

Abstract

Different kinds of transmitted information can potentially be recorded in rock art. A research project developed in Northwest Andean Patagonia is presented as a means of evaluating the types of information that might be transmitted by rock art in this region. For the study area, some authors have argued that Late Holocene Patagonian rock art reflects the rise of territorial circumscription and the demarcation of ethnicity. Others, on the contrary, sustain a model in which this rock art represents a macroregional system sharing a similar communication or symbolic code. In this paper, I will discuss and evaluate these alternative models.

Introduction

Jablonka and Lamb (2006) state that the transmission of information requires that a receiver interpret an informational input from a sender who was previously a receiver. When variations in the sender's state lead to similar variations in the receiver, we can talk about the transmission of information. In biological terms, this typically occurs through reproduction, but it can also occur by communication. Jablonka and Lamb (2006) refer to these concepts from a biological point of view, but they consider human communication to be a special case of transmission of information.

Rock art certainly has a role as a human communication device. Numerous researchers have delineated an "information storage model" (Barton et al. 1994; Conkey 1978; Gamble 1991; Mithen 1988; among others) in which the production of rock art is assumed to be an adaptive process facilitating the storage and communication of vital information. As Whallon has argued (this volume, Chapter 1), this system functions only as long as the knowledge of how to retrieve that information is present in a social group. When that knowledge is lost, it becomes impossible to access the stored information. So, in Whallon's terms, this is not storage, properly speaking. But the information is still there. Can it be accessed at some level?

In this chapter, I focus on what sort of information rock art could offer. It is argued that different kinds of transmitted information can be recorded in rock art. Certain authors claim that rock art primarily reflects social interaction or network information (Conkey 1978; Gamble 1980, 1982; among many others), while others consider that it reflects information about potential resources (e.g., Mithen 1988, 1991). Other interpretations have also been offered, such as the relationship between rock art and altered states of consciousness, known as a "shamanic approach" (Dowson 1998; Lewis Williams and Dowson 1988). In spite of critiques directed at the information storage model (Dowson 1998), the shamanic approach can also be integrated with it, since, in this view, rock art is still recording (and preserving) the images perceived in altered states. Different kinds of transmitted information, then, either real or imaginary, can be recorded in rock art.

In this paper, I present a research project being developed in Northwest Andean Patagonia in order to test what sorts of information are recorded in rock art. The conspicuous presence of rock art in a region where archaeological visibility is severely constrained has led us to reconsider how to recover information from it. For the study area, some authors have argued that rock art actually reflects the rise of territorial circumscription and ethnic demarcation (see below). Both this and alternative models are discussed and evaluated below.

Study Area

Patagonia is the only landmass projecting southward into the Southern Hemisphere from 46° south latitude. Patagonia thereby acts as a physical barrier, cutting east–west atmospheric and oceanic circulation. The region is characterized by strong winds from the west (westerlies), short days and prolonged nights in winter (and the opposite in summer), and an oceanic influence which creates a lack of tundra and permafrost in spite of its high southern latitude (Morello 1984). Due to the rain shadow effect provoked by the Cordillera de Los Andes, Patagonia is divided into two contrasting environments: a forested and rugged area present on both sides of the Cordillera, and a steppe, which covers most of its surface. The Cordillera also divides Patagonia politically, between Argentina and Chile.

The role of forested environments for hunter-gatherers has been one of the most debated issues in recent Patagonian archaeology (for details on this debate, see Bellelli et al. 2003; Bellelli, Pereyra, et al. 2000; Bellelli, Scheinsohn, et al. 2000). Historically, in Argentinean Patagonia, archaeological research has focused on the steppe, while forests, located near the Cordillera de los Andes, have received little attention. This situation could be explained merely as a sampling problem, since most of the Argentinean Patagonian land surface is covered by steppe. But actually this pattern is also related to the traditional model of Patagonian peopling, delineated in the 1960s and 1970s. This model posited a gradual peopling, highly effective and temporally continuous, over a homogeneous territory. In this view, people populated the territory as water pours out of the tap, filling a glass. Thus, archaeological concern was directed toward determining and studying the oldest human occupation in Patagonia. Since Pleistocene/Holocene transition sites were located on the steppe, forest environments occupied during Late Holocene times were considered unimportant (Scheinsohn 2006; Scheinsohn and Matteucci in press).

In the 1980s, things changed. First, discovery of the site of Monteverde (Dillehay 1989) settled the possibility of a Pleistocene/Holocene transition occupation of the Patagonian forests. Second, Borrero (1989–1990, 1994–1995, 2001a, 2001b) posited a new model for the peopling of Patagonia. Synthetically, the new model considers a discontinuous and punctuated rhythm of peopling, with failures, over a heterogeneous territory. Hence, environmental heterogeneity, posited in terms of differences in a semiarid region, began to be recognized in the Patagonian steppe. Also, scholars began to see the importance of evaluating the challenges and opportunities offered by the steppe, the forest, and their ecotone. These new research programs led to the discovery of new Pleistocene/Holocene transition sites in Patagonia (see Miotti and Salemme 2004 for a summary) even in forested environments (i.e., Laguna El Trébol: Hajduk et al. 2004). Nevertheless, the Andean forest showed occupational discontinuities until approximately

3000 B.P., when the archaeological signal strengthened and became continuous.

Information and Rock Art in Late Holocene Patagonia

Late Holocene times in Patagonia are supposed to be related to increased population density and demographic expansion (see Barrientos and Perez 2004). This process should be correlated with restricted residential mobility and wide exchange networks, as demonstrated by obsidian exchange and other items exchanged with non-hunter neighbors (see Scheinsohn 2003).

Late Holocene sites are characterized by a rock art style called "Estilo de grecas" (or Fret style; see Menghin 1957), also termed the Complex Geometrical Abstract Trend (CGAT) (Gradin 1999). This geometric style is characterized by broken lines forming complex stepped-crenellated patterns (called *grecas* or frets) as labyrinths or bounding motifs (Plate 11.1). They are accompanied by zigzags, circles, rhombuses, X-figures, crosses, tridents, squares, and other polygons. The style has a wide distribution in Patagonia (from South Mendoza province to 47° south latitude and from the Atlantic coast to the Cordillera) in an approximately synchronic distribution from 400 B.P. onward (as radiocarbon dating in the Piedra Parada locality allows us to infer; see Aschero et al. 1983).

Many interpretations have been postulated to explain the CGAT rock art style:

1. The style is considered as a macroregional system that involved the use of different environments by hunter-gatherers managing a wide interaction network, reflecting a metapopulation (Belardi 2004:592).

2. Some authors have posited the existence of local variants as a stylistic modality particular to the northwest Patagonian lakes and forests, which they call Modalidad del Ambito Lacustre Boscoso (or MALB; Albornoz y Cúneo 2000).

3. Others argue that the style represents territorial circumscription and ethnic differentiation. For instance, Crivelli Montero (2006) has maintained that stepped designs had a prominent or central position, which suggests intergroup receivers. Thus, he claims, this style responds to territorial circumscription triggered by demographic increases. In this context, the *estilo de grecas* or CGAT could communicate messages of ethnic or group membership and territorial claims.

4. Finally, certain researchers have argued that this rock art style is related to Indian travel routes (Belardi 2004; Onelli 1977; Sánchez-Albornoz 1958) and marked privileged places to which return was expected (Aschero 1997).

Evaluating the Models

The various interpretations postulated about the CGAT style, however, can be reduced at their core to two opposing models:

1 *Broad-scale model*: Here the CGAT style reflects a wide interaction network at a macroregional level, with little or no internal differentiation.

2 *Territorial model*: Under this view, CGAT reflects territorial circumscription and ethnic differentiation in the context of incremental increases in population density, territorial sizes, or home range reduction.

The first model has found support from the results of our research project. In 1995, in Northwest Andean Patagonia (specifically in what is called Comarca Andina del Paralelo 42, Parallel 42° Andean Shire), we began an archaeological research project (Bellelli et al. 2003; Bellelli, Pereyra, et al. 2000; Bellelli, Scheinsohn, et al. 2000; Podestá et al. 2000; among others). Within the framework of that project, I began to study archaeological material distributions from the perspective of landscape ecology (Matteucci and Scheinsohn 2004; Scheinsohn 2001; Scheinsohn and Matteucci 2004, 2006, in press). Given the pronounced visibility problems that the dense forest and the rugged topography posed in this region (Scheinsohn 2004), the goal was to construct a spatial model for predicting archaeological distributions. The spatial model was constructed using Binford's (2001) broad behavioral hunter-gatherer and climatic data and the specific spatial configuration of the Comarca Andina del Paralelo 42°. This model allowed us to differentiate corridors[1] and habitat patches using a geographic information system (GIS) and image processing techniques (Matteucci and Scheinsohn 2004; Scheinsohn and Matteucci 2004, 2006, in press). The model consisted in the definition of two kinds of corridors for hunter-gatherers (low-risk and high-risk) and habitat patches. In order to test the model, we have superimposed on it the locational data for known archaeological sites.

Results show that known archaeological sites were located along corridors instead of within habitat patches (see details in Matteucci and Scheinsohn

2004; Scheinsohn and Matteucci 2004, in press), supporting the association between trails and the locations of rock art sites. Given the fact that most of the known sites are actually rock art sites and that they are dated to Late Holocene times, we have interpreted this pattern in terms of "environmental legibility" (Golledge 2003). Environmental legibility consists of behavioral legibility, which is tied to ease of travel or ease of communicating information about how to move within specific environments. The study area, heavily forested, presents difficulties linked to environmental legibility, especially for a colonizing population (particularly if it is arriving from the steppe, as many authors assume). We have therefore hypothesized (Scheinsohn and Matteucci in press) that CGAT rock art sites in Andean Northwest Patagonia could be signaling a "transmitted environment" (Boyd and Richerson 1985). A transmitted environment is one where environmental modifications made for one generation constrain the decisions or learning of the next. Environmental modifications and learning acquired by one generation could be transmitted to other pairs, or to other generations, by means of rock art, as an aid to improving its legibility by acting as landmarks (Golledge 2003), favoring environmental learning and the development of human trail systems (Helbing and Molnar 1995; Helbing et al. 1997; Helbing et al. 2001). In this respect, rock art contributes to the temporal and spatial aspects of information acquisition, circulation, and mobilization (see Whallon, this volume, Chapter 1).

Human trail systems have particular characteristics that should be taken into account when modeling past human spatial circulation or mobility (Lake 2001; Llobera 2000; Scheinsohn and Matteucci in press). Recreational areas located in forested environments must contend with these same characteristics as criteria about how to mark a trail are developed (see, e.g., the document "General principles for signing and marking a footpath" at the European Ramblers' Association website).[2]

In this light, it is important to stress that at least at two excavated sites within the study area (Cerro Pintado and Paredón Lanfré), both ^{14}C-dated occupations, predate the CGAT dating (obtained from indirect evidence at the steppe: Aschero et al. 1983; and see above). Hence, the sites were occupied and known prior to the time the first paintings were made. Since occupation predates the rock art, we can presume that those sites were explored, known, and then "marked" to facilitate their subsequent reoccupation in a dense forested environment (Bellelli et al. 2008).

The position of rock art as facilitating environmental legibility could be included in the broad-scale model. If we have a low-density, colonizing population intending to occupy the forest, we should have a situation similar to the one that McDonald and Veth (this volume, Chapter 10) posited for the initial settlement of the arid zone of Australia, in which rock art was a part of the colonizing social repertoire and shared graphics would be present across thousands of kilometers.

In respect to the second, or territorial, model, if Late Holocene forest exploitation/colonization were undertaken by people occupying the steppe in a context of growing population and competition (Barrientos and Perez 2004), it means that certain groups located on the steppe would claim forest territories in the face of other groups, signaling their claim with rock art. In this situation, we could expect that, if territorial differentiation were strong, very different rock art styles would coexist, or at least that certain types of motifs would appear in some places and not in others (indicating different ethnic group memberships). Those motifs, related to territorial claims, would link certain forest and steppe sites.

To detect this kind of pattern, we decided to employ endemism analysis as it is employed in biogeography. Endemism analysis seeks to obtain maximal concordance in the spatial distribution of organisms. An area is endemic when it has a meaningful number of species that are there and are not in other places (Nelson and Platnick 1981). In this work, which deals with rock art designs, we are not considering that there are "endemic areas" for humans, but rather that identification of endemic areas of rock art motifs could aid us in identifying motifs related to ethnic membership.

The sample analyzed included 38 archaeological sites from northwest Patagonia, located in both steppe and forest and their ecotone (between 40° and 43° parallels; Figure 11.1). All these sites are rock art rockshelters dated post–3000 B.P.

For the analysis, we began with a database of motifs recorded in each site and considered each motif as a character. We followed here the formal method designed by Szumik et al. (2002). This method takes a group of cells in a grid and, following an algorithm, evaluates its endemicity. To do this, we utilized the software NDM and VNDM (Goloboff 2005). The results were presented in Scheinsohn et al. (2009). We detected 18 endemism areas, but most of them have low endemicity values. The areas that obtained the highest values (more than 4) are designated Areas A, B, C, and D.

The first area, Area A (dark gray in Figure 11.2), links most of the analyzed sites, either in steppe or forest. The lack of continuity among the cells located to the north and to the south is due to the absence of sites in those cells. This area defines a first grouping of sites that share a common repertoire, made up of 15 motifs (Figure 11.3). The presence of simple motifs (in

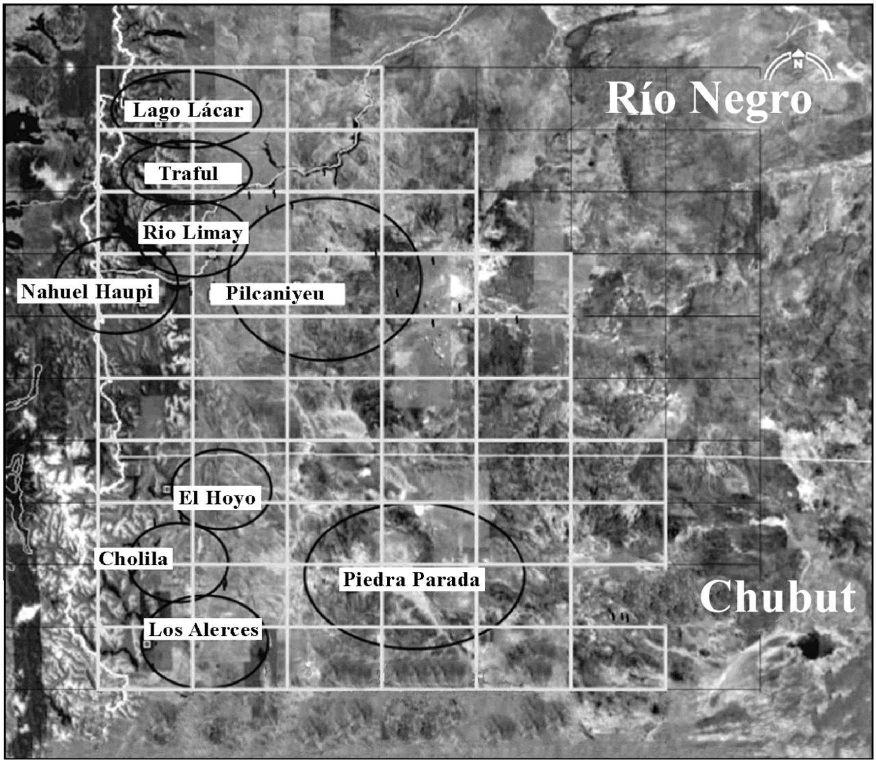

Figure 11.1. The study area.

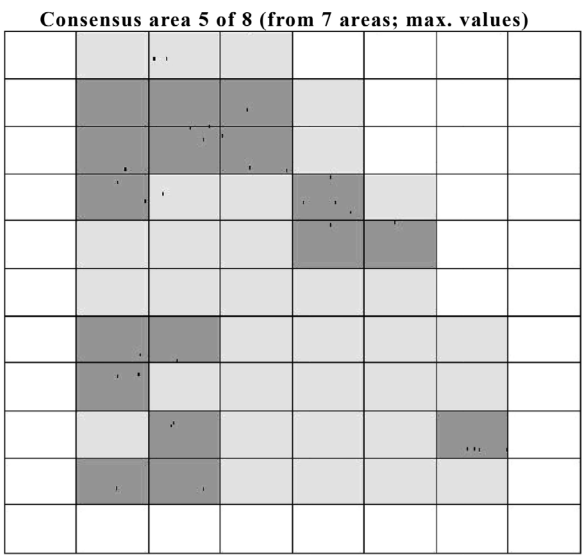

Figure 11.2. Area A. Light gray cells represent the study area. Analyzed sites are identified with black dots. Dark gray cells indicate Area A.

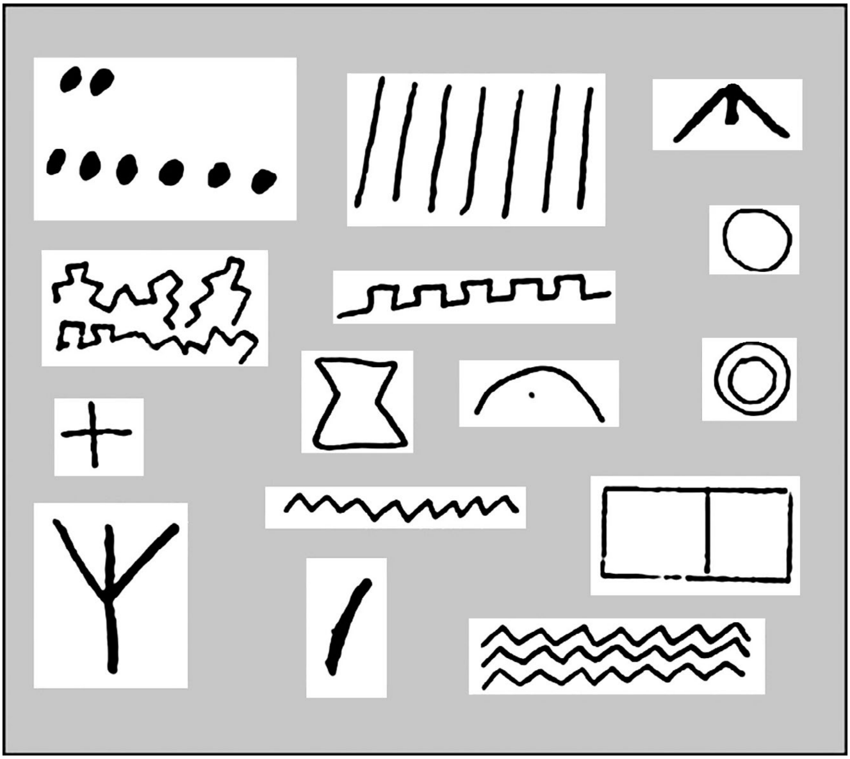

Figure 11.3. The common repertoire of motifs defining Area A.

dots and lines) could lead one to think that this area is grouping only ubiquitous designs in the rock art design suite. However, that interpretation is negated by the presence of other, more complex motifs, such as hourglass, trident, fret, and labyrinth, which are actually the ones that define the CGAT style. What Area A probably represents is the CGAT common repertoire.

With a lower value of endemicity, Area B, defined by 18 motifs, links western sites (Figure 11.4). Area C, defined by seven motifs, links an arc of northern sites (Figure 11.5). Area D is not shown, since it is redundant with Area A.

Area A could be interpreted as a general one which, because of the shared repertoire of designs, signals the flow of information in the study area. We have detected at least two other areas of endemicity that relate to the expected characteristics of forest and steppe sites. But their overlapping hampers their interpretation as exclusively claimed territorial areas.

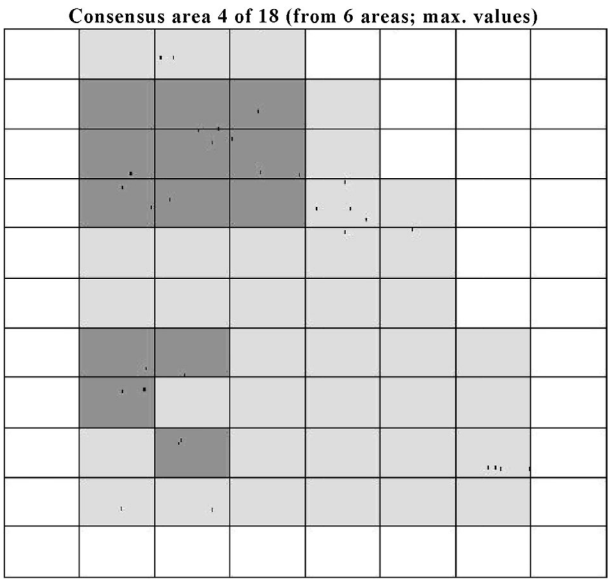

Figure 11.4. Area B. Light gray cells represent the study area. Analyzed sites are identified with black dots. Dark gray cells indicate Area B.

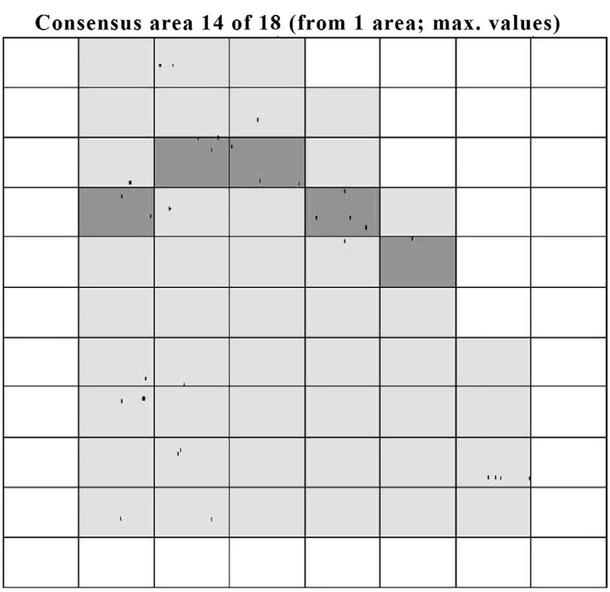

Figure 11.5. Area C. Light gray cells represent the study area. Analyzed sites are identified with black dots. Dark gray cells indicate Area C.

Either these areas are not exclusively claimed, or they could be interpreted differentially. In this respect, it is interesting to point to the overlapping of Areas B and C, and the corridors defined in Scheinsohn and Matteucci (2006; in press). In those works, we established that in the study area, north–south circulation appears easier, owing to the existence of one main north–south corridor, compared with west–east movement/travel, which is limited to some corridors connecting the cordillera (to the west) with the steppe (to the east). At the same time, the presence of west–east corridors to the north of the study area makes west–east circulation easier at the extremes of this area, coinciding with Area C. Whether or not this also contributes to, or represents, an ethnic signal transmission is not yet clear.

Conclusion

While the analysis is still ongoing, our initial results support the broad-scale model. The mere presence of one style across thousands of kilometers should itself be good support. In this case, we are dealing with a low-density population trying to maintain links between different groups. The establishment and maintenance of regional social ties has been recognized as an important part of hunter-gatherer adaptations to uncertain environments in terms of creating a "safety net" of contacts and relations that can be critical to survival (Whallon 2006). We can expect, in this situation, a homogenizing rock art style that allows, among other things, enhancement of the environmental legibility of a new biome, the forest, which Patagonian steppe populations began to exploit/colonize on a continuous basis. In this sense, the lack of differentiation between forest and steppe sites (Scheinsohn and Szumik 2007; Scheinsohn et al. 2009) fits this picture. Also, endemicity analysis did not support the hypothesis that the few rock art differences found could be interpreted in terms of territorial marking.

By contrast, if Late Holocene Patagonia could be depicted as a contested territory experiencing increased population density and demographic expansion (Barrientos and Perez 2004), then we should expect a different picture, one moving from coexisting and competing rock art styles to an emerging social differentiation established by means of emblematic motifs (Wiessner 1983; Wobst 1977). To accommodate this picture but to rule out the territorial model, we would have to establish the recurrence of signs that could be considered as emblematic. In this respect, is worthwhile to recall the recurrence, in the CGAT style, of very complex patterns of labyrinths or bounding motifs (Plate 11.2). I think that these special designs might be interpreted in the light of costly signaling theory (Bliege Bird and Smith 2005). Costly signaling theory proposes that expensive or "wasteful" behavioral or morphological signals are designed to convey honest information benefiting both signalers and observers. Costly signaling theory involves the communication of attributes that are relatively difficult or expensive to perceive directly and that vary in quality, intensity, or degree between signalers (either groups or individuals).The payoff to the observer derives from the information inferred from the signal: he or she should be able to evaluate the signaler's qualities as competitor, mate, or ally by attending to the signal rather than through more costly means of assessing the signaler's abilities, qualities, or motivations (Bliege Bird and Smith 2005). This could be undertaken either at the scale of the individual, wherein a certain individual broadcasts his or her cognitive abilities by means of these representations, or at the scale of the group. In the latter case, complex signs should be broadcasting the abilities of the group and should be considered in terms of ethnic markers. In the context described for the rise of the CGAT style, this makes sense, since decorative styles might converge on common standards in order to facilitate comparison within the group. We are developing this research now in order to establish the distribution of motifs showing a costly signaling.

For the moment, it appears that we have an apparently unique communication or symbolic code in Late Holocene North Patagonia. What is not yet clear are the process by which this communication code was established and the social and demographic context(s) in which it was produced. We have to disentangle the possibility of emblematic motifs and the scale at which costly signaling is acting in order to clarify Northwest Patagonian Holocene rock art informational potential.

NOTES

1 A corridor is a strip of a type of landscape differing from adjacent land on both sides (Forman 1995).

2 See the European Ramblers' Association website at *http://www.era-ewv-ferp.com/upl_files/general_principles_for_marking_-_aj041005.pdf.*

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12 Visits, "Fuegians," and Information Networks

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Fabiana María Martin, and
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Abstract

The well-known descriptions of two hunter-gatherer groups in southern Patagonia, the Aónikenk and the Kawéskar, led ethnographers to conclude that there were wide differences between terrestrial and maritime hunter-gatherer adaptations. Based on the concept of open social formations, and descriptions of mixed groups in the central Strait of Magellan, we believe that the two societies were more connected than is usually assumed. It seems more reasonable to conclude that these groups followed a regimen of visitation than it is to postulate the existence of a different ethnic unit—the Airre, Zapoliens, or Guaycurúes—as some have done. Archaeological evidence, especially that obtained in the zone of the morros and the central strait, can be used to suggest that similar interactions were probably taking place at least since circa 2000 B.P.

The first European explorers to visit the coasts of Patagonia and Tierra del Fuego made many valuable observations of the local inhabitants of those regions. Based on these observations, Europeans concluded there were two indigenous human groups with, apparently, completely different adaptations. The Aónikenk (also known as Tehuelche or Patagones) inhabited the wide steppes of eastern Patagonia; they became known as archetypical terrestrial hunter-gatherers (Steward

1955) (Figure 12.1). They basically hunted guanaco (*Lama guanicoe*) and choique (*Pterocnemia pennata*) using bow-and-arrow and bolas. The Aónikenk were highly mobile and probably lived in small groups. In historical times following European contact, the Aónikenk acquired the horse and changed their settlement patterns to semisedentary aggregations of up to 100 individuals inhabiting large residences known as *toldos*, constructed of as many as 50 joined guanaco hides (Martinic 1995; Martinic et al. 1995; Rogers 1879).

By contrast, the Kawéskar (also known as the Alacaluf) were maritime hunter-gatherers, who, like the Yamana of the Beagle channel and the Chono of the Chono and Guaytecas archipelagos, made their living from products of the sea—mollusks, fish, pinnipeds, and whales. The Kawéskar were usually confined spatially to the western channels of southern Patagonia, which they navigated with canoes, camping near the shores in conical huts made of branches and sea-lion hides and using portages made of logs to cut across islands (Prieto et al. 2000).

This contrast between two apparently quite different cultures, one primarily terrestrial and the other primarily maritime in orientation, was recently reconsidered. Borrero concluded that there is "a level of variation at odds with the oversimplified characterization traditionally applied to these cultures" (1997:60). He also suggested that "[i]t is possible that subtle cultural variations went unrecognized during the early years of contact" (1997: 65). Research on this problem by Massone (1984), Prieto (1988), and San Román (2007) also supports the existence of this range of variation.

Nonetheless, members of these two societies were phenotypically very different. Accordingly, they made different impressions on European travelers. The Aónikenk were tall and strongly constituted (Bórmida 1953–1954; Imbelloni 1937–1938), while the Kawéskar were short and more fragile (Guichón et al. 1989–1990). In the sixteenth century, the Aónikenk were identified with a character of Spanish chivalry tales, the giant Patagon, and were considered giants by the first European explorers (Duviols 1997).

The impression made by the Kawéskar and Yamana in the nineteenth century, however, was very different; they were considered to be examples of the lowest stages of human evolution. In fact, many classic characterizations of hunter-gatherers as living representatives of the "Early Stone Age" were based on these maritime hunter-gatherers. According to Captain Parker King in 1827, "They appeared to be a most miserable, squalid race, very inferior in every respect to the Patagonians" (Beer 1997:146). The "canoe peo-

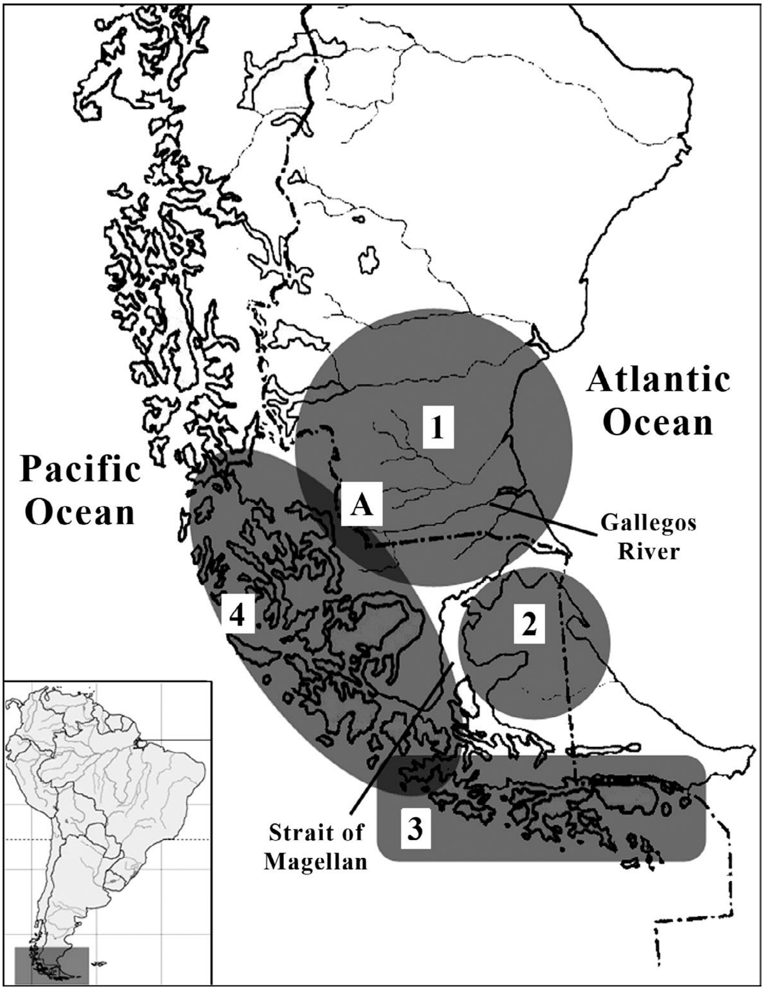

Figure 12.1. Distribution of the main known ethnic groups at the time of European contact. 1: Aónikenk, 2: Selknam, 3: Yamana, 4: Kawéskar. A: The area of the *morros*.

ple" or "Fuegians," as the Kawéskar and Yamana were usually called, became well known to the Europeans, beginning with four individuals who were taken to England by Robert Fitz Roy, captain of the HMS Beagle, between 1830 and 1833 (Fitz Roy 1933) for the explicit purpose of their education. It is clear that Fitz Roy "did not display them . . . He had them educated and looked after. . . . He disliked them being called 'savages'" (Beer 1997:148).

Other groups of "Fuegians" were also taken by force to Europe, but basically to be exhibited in places like the Paris World Fair or the Berlin Zoo (Hazlewood 2000; Mason and Báez 2006; Prieto and Cárdenas 2002). From this European exposure came the fixed notion that these people were low ranked, both in their position in human evolution as well as in their social and psychological capacities. These views contrast sharply with the impression produced by the terrestrial people—the so-called giants—an impression of power and strength and high levels of evolutionary development.

In this paper, we reevaluate these early characterizations of the Aónikenk and Kawéskar in light of the accumulated ethnographic, ethnohistorical, and archaeological records from the region. Further, we explore the nature of their adaptive variations and interactions through the lens of contemporary hunter-gatherer theoretical models.

ETHNOARCHAEOLOGY AND MEMBERSHIP

Ethnoarchaeological notions about hunter-gatherer interactions derive from a series of observations made among hunter-gatherers in different parts of the world (Whallon, this volume, Chapter 1). In-depth studies of the Ju Hoansi produced the impression of constant circulation and flux of population (Kelly 1995; Lee 1979:55; Wiessner 1982), which led to the conclusion that if the Ju Hoansi have boundaries, they "are vague and not defended" (Lee 1979:350). Bands are conceived of as "temporary aggregations of families or individuals, and these families in turn have rights in more than one place, band size can then change very rapidly or melt into nothingness if the need arises" (Yellen 1977:44; see also Stanner 1965:8). The point is that this "almost random movement of individuals and families provides an extremely effective way to adapt to an unpredictable and highly variable environment" (Yellen 1977:43). What is important is the ability to "claim membership rights in a number of territories" instead of restricting oneself to only one (Yellen 1977:44), a behavior that was well known among the Selknam of Tierra del Fuego (Chapman 1986), the Pintupi of the Australian desert (Myers 1988), and the Nukak of Colombia (Politis 2007:164). Of course, there is a large range of variation within this type of behavior. For example, Politis noted that among the Nukak foragers of the Colombian jungle, there are groups "that coreside for most of the year" (Politis 2007:8).

Hunter-gatherers, then, "are characterized by a very fluid patterning of population distribution over the land" (Yellen and Harpending 1972:244).

For ethnoarchaeologists, this pattern of land use seems to lessen the importance of the concept of band, which Binford (2006:16) would restrict to intensified hunter-gatherers. Indeed, many crucial activities, like tool making or hunting, seem poorly related to the band (Yellen and Harpending 1972: 244). It is very difficult to call a band a "unit of cooperation," as Ingold does (1988:277), since hunter-gatherers do not even stay together, nor are they "a temporary aggregation of individuals or families that come together for the purpose of procuring food" (Ingold 1988:279). Instead, in many cases "families are the fundamental units of decision-making" (Binford 2006:17).

Clearly, there is no single way to explain membership among hunter-gatherer societies (Silberbauer 1994), but the ethnoarchaeology of hunter-gatherers is not lacking in examples of extreme social dynamics. This is particularly true near their boundaries, however loose such boundaries might be. These boundaries can form on the basis of "genealogical, social, and ideological ties" (Hitchcock and Bartram 1998:22). Sometimes they may remind us of the "half-half people" of Radcliffe-Brown (1913), those "local groups on tribal borders [who] might occupy indeterminate positions, being regarded as belonging to no tribe in particular" (Stanner 1965:12).

The Status of the "Fuegians"

So, just what was the status of "Fuegians" in their own regions? Some ethnographic information indicates that, contrary to the view of European travelers, "Fuegians" were not considered inferior. Arms and Coan noted in 1833 that a group of "Fuegians" who were camping with the Aónikenk avoided contact with tribes of boreal horsemen because they were afraid of being taken as slaves (Coan 2007; Martinic 2007a). In fact, it was probably their cohabitation with the Aónikenk of San Gregorio that led the "Fuegians" to obtain that information.

In Peckett Harbour there was a "Fuegian" shaman in a camp with an Aónikenk chief. It is well known that people with special physical or psychological characteristics are often selected as shamans (Eliade 1972), and that was probably the case with this individual. The point is that the "Fuegian" was not a slave, nor was he in a low-ranking position. Moreover, as Martinic rightly believes, this same individual was seen by Rogers in 1879 at the Aónikenk camp of Ventura, south of the Gallegos River (Martinic 2007a:833). Certainly, Rogers's description of an old man fits with this interpretation. The long tenure of more than 23 years of this individual as a shaman among the Aónikenk also runs counter to an interpretation of a low-ranked social position. This and other evidence invites us to (re)consider some results obtained by ethnoarchaeological research on membership and information networks.

"Fuegians" and Information

The concept of visits, in which people move around different camps, may be one way to understand social formations like those produced by the Aónikenk and the "Fuegians." A visiting system may be a means of obtaining information about the location and procurement of foods and other materials (Whallon 2006, this volume, Chapter 1). While such information may be the concern of only a few members of an ethnic unit, the situation is different for those living in the outer limits of a society; here an advantage for regularly interacting with people from different societies arises. These are the conditions under which knowledge about routes, passes, and the location of biogeographical barriers in the largely unknown country are decisive. Certainly, visiting is one way to expand kin networks, increasing "an individual's option for marriage, movement, exchange of goods and information" (Binford 2006:12).

It is clear that hunter-gatherers living on the fringes of their habitats would at times find themselves in a situation where information about the location of game and other resources would be required. The need for information is tied to fluctuations in the resource base, certainly expectable in unknown or partially unknown territories (Kelly 2003; Veth et al., this volume, Chapter 9). By acquiring information, the movement of knowledge, food, material items, and people could be planned. In our research, we focus on applying such information concepts to a reevaluation of the Aónikenk/Kawéskar dichotomy.

IMAGES OF THE PAST

Archaeological and associated physical anthropological research in the areas inhabited by the Aónikenk and Kawéskar societies has produced evidence confirming physical or phenotypical differences between the two groups. Human skeletons from the channel regions are small in size, whereas those recovered from the eastern steppes are usually from taller individuals (Bórmida 1953–1954; Oyarzún 1929). There are also associated differences or contrasts between the two groups' archaeologically recovered tool kits, as well as subsistence remains that clearly substantiate the existence of a predominantly terrestrial economic orientation in the east and a maritime orientation in the west. Sites in the southwestern archipelagos routinely produced evidence for high dependency on sea or marine resources, expressed in the frequent presence of shell middens with abundant pinniped, fish, marine bird, and occasionally cetacean bones (Johnson 1976; Legoupil 1989, 1997; San Román 2007). By contrast, the steppe sites are routinely dominated by guanaco remains, with a secondary presence of marine resources on the coasts (Borrero and Barberena 2006; Massone 1979, 1984). These differences notwithstanding, it was asserted that there was "a continuum ranging from strongly maritime cultures in the islands and channels to the west and the far south, to strongly terrestrial cultures in the steppes in the east and far north" (Borrero 1997:65–66), suggesting that the polar contrast between extremes was not as important as the gradation between the two. Stable isotope data on Late Holocene human remains likewise substantiates this claim for a spatial continuum (Borrero et al. 2009).

In any event, archaeological research has produced some evident differences from the view derived from ethnohistoric reports. For example, there is a lack of archaeological evidence for the importance of choique (*Pterocnemia pennata*) exploitation in prehistoric sites of the steppes (Fernández 2000), which, according to written sources, was a staple for the Aónikenk (Beerbohm 1879; Musters 1964). However, these differences have not been sufficiently important to reject the characterization of two groups and their contrasting modes of economic subsistence.

With the information produced by recent research, it has become increasingly clear that both the ethnography and archaeology of the region indicate a slightly more complicated panorama. This is particularly true in the area that covers the center of the Strait of Magellan and the northern hinterland up to the middle basin of the Gallegos River. This area is near the ecotone between the western forests and the eastern steppes (see Prieto 1988). It is characterized in the south by the presence of the Brunswick Isthmus between the Sea of Otway and the Strait of Magellan. To the north, the area probably extended up to the Fitz Roy Channel, Laguna Blanca, and the zone of the *morros* (buttes). Even when exposed to seasonal changes in the availability of resources, the whole area sustains high productivity. The central segment of the strait is one of the richest in resources (Magazzù et al. 1996), and the area of the *morros* corresponds to a mesic steppe with a relatively high carrying capacity (Mazzoni and Vázquez 2004).

Ethnography

Prieto et al. (2000:88) have evaluated the evidence for the presence of an Indian pass or route between the Sea of Otway and the Strait of Magellan at the Brunswick Peninsula, and they speculate that occupations recorded at Elizabeth Island (Ortiz Troncoso 1971) may be related to the use of this pass. However, they also noted that the area within which the pass was located is in a terrestrial hunter-gatherers' zone. This limitation, based on an assumption of rigid spatial partitioning, is overcome if we accept the alternative perspective that it was a dynamic and culturally nonspecific zone (Plate 12.1). It is known that the Kawéskar occupied the seas of Otway and Skyring and "using bark canoes formally occupied the Strait as far as Elizabeth" and other islands (Cooper 1917:7). Circa 1670, Narborough described canoe people on Elizabeth Island (Barros 1988) and, in accord with the testimony of Silas B. Smith in 1844, he saw people moving from Elizabeth Island to Cape Negro (Martinic 2007a:829).

The presence of what appear to be Kawéskar maritime hunter-gatherers was observed among bands of Aónikenk of the central coasts of the Strait of Magellan. Effectively, the area produced interesting ethnographic observations during the seventeenth and eighteenth centuries (Martinic 2006, 2007a), indicating the existence of peculiar social associations. Fitz Roy and other travelers found tall and short people camping together at San Gregorio Bay. Many other sailors made similar observations, and in descriptions of these groups, the smaller people were usually considered vagabonds or belonging to an inferior race (Martinic 2007a:828). They have been called by various different names, including Zapoliens (MacDouall 1833), Guaycurúes (Martinic 2006), Ireys (anonymous writer: Martinic 2007b), and Airre (Casamiquela 1991). The anonymous writer mentioned that the Ireys were made captives by the Aónikenk, who destroyed their canoes in order to prevent their escape. However, this fact is not particularly clear, since the same writer also mentions that sometimes the "Fuegians" destroyed their canoes themselves (Martinic 2007b).

Martinic, on the other hand, treats them as a separate, non-ethnic entity, favoring an explanation of culturally mixed (i.e., multi-ethnic) co-residential peoples (Martinic 2007a:836), a position that we basically share. One difference between his interpretation and ours is that we believe the "Fuegians" were not relegated to a lower social or cultural rank but interacted as equals.

Archaeology

Archaeological research in the study area has not been intensive but is sufficient to elucidate or provide a basic pattern (Figure 12.2). Based on this research, we maintain that there is a spatial division between information originating from the hinterland versus that from the coast—a swath some 50 km wide. The basis for this division is premised in a crucial difference between the hinterland in the northern part of the study area, which apparently had very low prehistoric human demography (population size and density), and the southern part, in the coasts of the Strait of Magellan, where prehistoric human demography was very high.

Coasts

Several sites reveal evidence that terrestrial resources were important for maritime foragers. The bones of guanacos and huemules (*Hippocamelus*

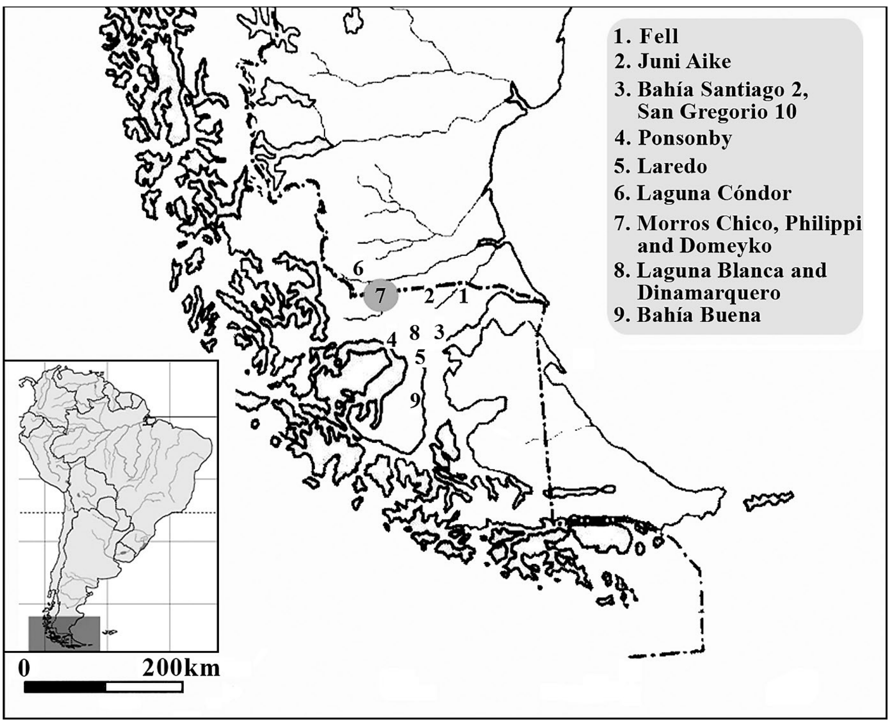

Figure 12.2. Archaeological sites mentioned in the text. The area of the *morros*, number 7, is highlighted.

bisulcus) were present at several sites of the Sea of Otway and nearby channels (San Román et al. 2002), and at Bahía Buena on the coasts of the strait, guanaco consumption was evidently important circa 1600 B.P. (San Román 2007). Abundant guanaco bones found at the site of Ponsonby, level B, led Legoupil (2003) to speak of terrestrial hunters with a mixed economy, while Piana and Orquera (2007) interpret the same evidence as proof of maritime hunters preying on guanacos. Whatever the interpretation, it is abundantly clear that it is difficult to classify the sites of the area in terms of a subsistence dichotomy.

By the same token, there is also compelling evidence for the use of marine resources by so-called terrestrial foragers. Prieto (1988) found evidence of the exploitation of both maritime and terrestrial resources at Laredo-Cape Negro circa 1500 B.P., and he emphasizes the importance of coastal resources for terrestrial hunters (Prieto 1988). Also, several sites, including Laredo and Bahía Santiago 2, have produced artifacts made on lithic raw materials that derive from the Sea of Otway region (Prieto 1993–1994). Massone, working on the coasts of the strait, also found evidence of coastal resources in sites that he interpreted as having been produced by terrestrial hunter-gatherers (Massone 1984). Finally, we must mention archaeological evidence recovered from Elizabeth Island (Ortiz Troncoso 1971). While canoes were required to reach the island, both maritime and terrestrial resources are present in assemblages dating as early as circa 2000 B.P. (San Román, pers. comm.).

There is also abundant evidence for the presence of nonlocal lithic raw materials in both coastal and interior sites (Charlin 2007; Manzi 2004; Morello et al. 2004). Specifically, a fragment of green obsidian was found encrusted/embedded in an Aónikenk skull found at Santiago Bay (Constantinescu 2003), which offers undeniable evidence of interaction.

In sum, on the one hand we have several sites located on the channels, for which a coastal economy was expected but that produced evidence for the significant incorporation of terrestrial resources. On the other hand, we have increasing and complementary evidence of sites located on the eastern steppes that also include coastal resources, and sites in the hinterland with maritime goods (see below).

Hinterland

Some 50 km north of the coasts of the strait, the evidence for human occupation is still abundant, with indications of the use of recurrent camping places like Dinamarquero (Martinic and Prieto 1985–1986). These places are repeatedly mentioned by historical sources as important stopover points for Aónikenk groups (Musters 1964; Rogers 1879). They are represented by extensive concentrations of archaeological materials (Martinic 1984a).

The archaeological record markedly differs north of the Gallegos River, in the area of the *morros*. Several properties of the archaeological record found at the buttes of the middle basin of the Gallegos are important to our discussion and must be mentioned. These include the following observations:

- There is a very sparse archaeological record (Gómez Otero 1991) with few surface scatters of lithics, which contrasts with the situation found in both the lower Gallegos (Carballo Marina 2007) or the Pali Aike Volcanic Field in general (Barberena 2008).

- One of the few classes of archaeological evidence is of burials placed at the top of the *morros* (Plate 12.2). This mode of burial differs from those found in the coasts of the Strait of Magellan (Martinic 1984b; Massone et al. 1985–1986) or in open rockshelters in Laguna Blanca or Juni Aike (Aguilera and Grendi 1996; Bird 1988; Prieto et al. 1998), or in the Pali Aike Volcanic Field (Martin 2006). Effectively, the number and frequency of offerings are higher in the *morros*. Human bodies in the western channels, on the other hand, while characterized by abundant offerings, were not buried but rather were deposited along or within the inner surface of caves (Aspillaga and Ocampo 1996; Legoupil and Prieto 1991; San Román and Morello 2001).

- There is an abundance of green obsidian at the sites of Morro Domeyko (Prieto 1993–1994) and Morro Chico (Stern and Prieto 1991). Green obsidian is completely foreign to the steppes region and can only be obtained in the channels area, more precisely at the Sea of Otway, at least 120 km to the west (Morello et al. 2004). While this is not the only record of green obsidian found at a great distance from the source (Charlin 2007), its abundance makes these burials notable (Manzi 2004; Morello et al. 2004).

- Some of the burial offerings are extremely rare in the region. Red ocher-embedded silex bifaces accompanied a multiple burial at Morro Philippi (H. Roehr, pers. comm.; Ortiz Troncoso 1973) (Plates 12.2, 12.3). The silex is not local, is very rare in the region, and has only been found as small flakes at the site of Bahía Santiago 2 on the coast (Prieto 1993–1994).

- A decorated/carved lignite pendant accompanied human skeletal remains at Morro Chico. The pendant has stylistic affinities with motifs found on bone instruments common to the western channels (Prieto 1984).
- There is a gradual distance decrease in the abundance of marine remains as one moves from the coasts toward the hinterland (Borrero and Barberena 2006; see Table 12.1), although this pattern is more striking when considering the smaller spaces associated with the coast of the Strait of Magellan. The pattern is in contrast with the Atlantic side of the continent, where such evidence is more widespread, and may suggest that there was a more circumscribed use of space in the areas near the strait.
- Even as many specialists claim that the distribution of the huemul included the steppes in the past (Díaz 1993), it is a fact that we rarely find huemul remains in sites located in the steppes, and when they are present they are basically represented only by horns or very few bone fragments; there is no evidence for the killing and butchering of whole animal carcasses. This is the case at Cueva Fell (Poulain-Jossien 1963), Laredo Bay-Cape Negro (Díaz et al. 2007), San Gregorio 10 (Massone 1984), and Laguna Cóndor (unpublished observations). It appears that, given the faunal evidence, a more economical explanation would be to consider that these huemul remains were acquired in and transported from the forest rather than obtained locally. If this is true, then it constitutes yet another measure of low-intensity interaction with the western habitats (Gómez Otero 1986–1987).

In general, the archaeology of the region indicates the presence of human bones, with stable isotopes indicating mixed diets in both the coast and the hinterland (Barberena 2002). This pattern changes approximately 30 km from the strait, where stable isotopes on human bones uniformly display a fully terrestrial diet (Borrero et al. 2009).

Work done by Franco et al. (2005) and Charlin and Cardillo (2005) indicating similarities in the fabrication of projectile points and cores strongly suggests the existence of wide information networks that were operative over

Table 12.1. Marine Items in the Southern Patagonia Hinterland

Site	Distance to coast (km)	Elements	Chronology (B.P.)	References
Alero de los Pescadores	ca. 80	*Fissurella* sp., *Mytilus* sp., *Photinula coerulescens*	—	Molina 1969–1970
Fell	46	Pinniped tooth	—	Saxon 1979
Potrok Aike	68	Pectinidae, Cetaceae, Volutidae	740 ± 180	Gómez Otero 1983–1985: 33, 45
Juni Aike 1	70	Cetaceae	850 ± 40	Gómez Otero 1988
El Volcán 4	36	*Mytilus* sp.	< 3600 ± 100	Sanguinetti de Bórmida 1984:13
Las Buitreras	ca. 80	Mollusks	?	Caviglia and Figuerero T. 1976
Thomas Gould	37	Mollusks	1280 ± 130	Massone 1989–1990
Pali Aike (+)		*Fissurella* sp., indet.		Bird 1988: 88–89
Pali Aike 2	24	Mollusks	2480 ± 100/ 220 ± 45	Massone and Hidalgo 1981: 129
Cañadón Leona 5	ca. 35	Gastropoda		Bird 1988:60
Dinamarquero	ca. 30	*Chlamys patagonicus*, *Aulacomya ater*, *Nacella magellanica*	XIX century	Martinic and Prieto 1985–1986: 68
Kolk Aike	ca. 5	Mollusks	—	Martinic 1984a:22
Cerro Sota	50	Mollusk	—-	Bird 1983
Cóndor 1	32	Pinniped tooth, *Mytilus* sp., Gastropoda	1550 ± 60 < 965 ± 40	

Continued on next page

Table 12.1. Marine Items in the Southern Patagonia Hinterland (*continued*)

Site	Distance to coast (km)	Elements	Chronology (B.P.)	References
Cerro Norte 2	38	Mollusk	< 2070 ± 80	
Cerro Norte 5	38	Mollusk		
Cerro Norte 7	38	Mollusk	< 1640 ± 70	
Frailes 6	24	*Mytilus* sp.		
La Carlota	85	*Mytilus* sp.	> 1070 ± 40	Campan et al. 2007
OB1	16	*Mytilus* sp., *Aulacomya*, marine birds, etc.	3490 ± 50 490 ± 130	L'Heureux 2008
OB2	17	Mollusk		
OB3	17	Mollusks		
OB11	18	Mollusks		
OB16	18	Mollusks		
Morro Philippi	67	Shellfish		Ortiz-Troncoso 1973
Alero del Ocre	ca. 140	*Fisurella* sp., *Mytilus* sp.		
Punta Bonita 2	ca. 140	*Aulacomya* sp., *Fisurella* sp.	2540 ± 70	Carballo Marina et al. 1999

large spaces. More relevant for our discussion is the technological and ethnographic evidence presented by Nami (1989–1990), which lends support to the notion that some of the projectile points recovered at the Laredo locality, on the coast of the central Strait of Magellan, were used as harpoon points.

Discussion

European sailors traversing the Strait of Magellan made many sightings of fires on the coasts of Patagonia (e.g., MacDouall 1833), which they took to mean that the local inhabitants were communicating the arrival of European ships. Other mechanisms of communication that the early explorers witnessed include direct interrogation of people from other areas (Coan 2007), and obtaining help from the local people about ways to exploit local resources (Martinic 2007b). Knowledge about the location of rare raw material sources—such as green obsidian, or pyrite with which to strike fires—operated over long distances. But more local information, like that associated with places or peoples to be avoided, was probably obtained on a case-by-case basis. Hunter-gatherers are always monitoring changes in the availability of resources and people. Within this framework, the existence of mixed groups allows information sharing among people who had access to very different sets of resources and knowledge. This arrangement also offers the chance to share information on the location of human groups, places to camp, and similar matters. This looks exactly like the kind of anucleated organization that Yellen and Harpending consider "optimum for rapid information flow" (Yellen and Harpending 1972:248).

In a sense, in dealing with these mixed groupings we are seeing a degree of heterogeneity in their resource base. This has important consequences for understanding the movement of artifacts and food and, in general, trade. For example, Darwin and Fitz Roy recorded information offered by Captain Low, an experienced man (and sealer) with a lot of experience in the Patagonia channels, about the "canoe people" obtaining dogs, old horses, guanaco meat, and old mantles in exchange for pieces of iron pyrites, their captives, or their children (Martinic 2007a:827). This evidence, as well as observations made by other travelers (Cooper 1917; Martinic 1995), certainly indicate the circulation of various types of goods.

Recalling the strong differentiation between terrestrial and maritime hunter-gatherers used to interpret the ethnography of southern Patagonia, and making use of the ethnographic, archaeological, and ethnoarchaeological information that we have just reviewed, we arrive at a different interpretation of the distribution of hunter-gatherer societies and the nature of their interactions on the central coasts of the strait. We base our interpretation on the concept of open social formations and the existence of supraregional information nets for both maritime and terrestrial hunter-gatherers. We believe that the "Fuegians" and Aónikenk were more connected than has been or is usually assumed to have been the case, and that information sharing and circulation was an important result of those aggregations, if not the main reason behind those contacts. A regimen of visitation makes more sense than the existence of a different ethnic unit, such as the "Airre" postulated by Casamiquela (1973, 1991).

We believe that phenotypic differences have been overstated and that the use of these differences by archaeologists has perpetuated the assumptions underlying early Europeans' characterizations. The point is that cultural variation need not be restricted, and indeed there is no necessary correspondence between material culture and somatological variation. To European eyes, the Kawéskar and the Aónikenk have an asymmetrical relationship. We believe that this was not the case and that interaction between them was important.

The available evidence makes credible the notion that hunter-gatherers of the channels and the steppes communicated, interacted, and cohabited. People from the channels were probably looking for information on the distribution of guanacos, as well as when and how to hunt them. Even during historic times (Darwin 1951:273; Martinic 2007a:827), the Aónikenk—specifically the "more skilled men"—were helping the "Fuegians" to hunt guanacos. This relationship, then, signals information exchange between equals or peers rather than information flowing to lower-status or non-peer "Fuegians." People from the steppes obtained information about the channels, movement of people, and the like. This pattern, one that was observed in historical times, can probably be projected back to the recent prehistoric past on the basis of the distribution of green obsidian, subsistence remains, and stable isotopes on human bones.

The zone of the *morros*, where burials associated with exotics have been found, presented very low population densities in prehistoric times, a conclusion based on an observed decline in the abundance of archaeological remains in that zone. This decline was seen as signaling the western limit in the distribution of the Aónikenk (Gómez Otero 1991), an interpretation that is now being replaced by one in which a relatively unused area (or one with lower residential use and a consequently lower visibility of the archaeological record) is located between two areas with higher human population densities. With the evidence at hand, we can no longer assume that biomass was higher in the area of the *morros*, since all the areas have good productivity. On the other hand, given the low human demography of the region at large and the lack of ethnographic or archaeological evidence for a sustained state of war or regular strife, to talk of a buffer zone appears to be unsupportable (Kay 2007). It may well be that we are just dealing with an area away from one or more core areas of intensive human use.

E. A. Smith considered that "risk reduction through sharing should be greatest if conducted over longer distances" (1988:241). Under those conditions, the expectation is for the movement of people rather than goods, and this is precisely what appears to have been the case in the central Strait of Magellan.

CONCLUSION

In sum, we believe that based on the accumulated sets of archaeological, ethnographic, and ethnohistorical data, and their interpretation within a framework placing emphasis on group interaction and information flow, that the following conclusions can be drawn. First, it is very difficult to consider the area of the *morros*, with its low archaeological signal, as a buffer zone. Second, settlement in the hinterland was simply discontinuous, and there was a tendency to concentrate on the coasts, where the predictability of resources was higher. Third, culturally mixed groups were present in that area at least since the seventeenth century. While the scenario of tall people in the steppes and short people in the channels was used to sustain the perception that social differences were important among tribes, we believe that the scheme of visitation, or similar mechanisms that allow for information exchange as argued for here, makes more sense. Finally, there is clear archaeological evidence to suggest that similar interactions were probably taking place at least since circa 2000 B.P.

Turning to the macroregional scale of southern Patagonia, there is a cultural differentiation between guanaco hunters in the east and maritime foragers in the west. But at the micro-scale of the boundary between these cultural configurations, there was more integration than differentiation. This was probably at the scale of spatial interaction needed to access ecosystems of relatively independent dynamics (see Whallon 2006); that is to say, supraregional integration is firmly based on the circulation of information between people from those different habitats (McDonald and Veth, this volume, Chapter 9; Whallon, this volume, Chapter 1). Archaeologically, this dynamic is expressed in the distribution of several archaeological indicators such as marine items, green obsidian, and human bones with different isotopic signals.

The idea that "bands" are flexible units at best, or nonexistent at worst, has yet to be fully incorporated in Patagonian archaeology. Incorporation of that idea in our work leads us to accept the concept of a cultural continuum and regular interaction and information flow between the coastal canoe people and the terrestrial hunter-gatherers.

13 Foraging for Information among Foragers—An Afterword

H. Martin Wobst

Abstract

In a broad-ranging review, dimensions for future research into the archaeological record of foragers are explored. Many axes hold promise for broadening our sense of the diverse, variable, and dynamic roles of information in forager society, on the way to theories about information that broaden our understanding of information and its roles in all human societies.

Information Returns to Forager Studies

The archaeological record of foragers oozes information. Archaeologists discover, develop, transmit, modify, correct, manage, and explain that information, and they often are its custodians and stewards. It is actually the most pervasive currency in their data. Compared with this all-pervasiveness, information as used by foragers is rarely the research goal of forager studies. Where it has been addressed, it has tended to feed specialists. With this book, it is moving into the limelight. Here, it is explicitly the focus of attention.

Information as a subject is growing in importance for a number of reasons. Earlier generations of archaeologists often considered information to be simply unnecessary: if "nature" impinging on foragers was all-powerful, the box between "nature" and decision making (the human brain) could be treated paradigmatically as black. In other words, with forces as severe as foragers were thought to suffer, not much could be learned by studying how information ended up in peoples' heads, what it interacted with there, and how it was translated into decisions actually taken (see, e.g., Flannery's [1973] critique of this approach).

The days are also gone when information and other variables of the mind were thought to be altogether inaccessible to human problem solving, being considered either so particularistic in their implications as to be the proper business of humanists rather than scientists, or utterly irrelevant to the kinds of materialism to which most archaeologists subscribed (see Renfrew and Zubrow 1994 as an example of problem solving vis-à-vis mind).

Descendant populations are another strong force that is bringing information into our discipline. In a decolonizing world, many forager archaeologists cannot avoid encountering those whose ancestors had generated their archaeological data, and, increasingly, descendants are becoming archaeologists themselves. In this process, ethnoarchaeology and ethnohistory are more often being employed to improve forager theory and method. For descendants, the information residing in archaeological data tends to be more important than what archaeologists usually consider significant: descendants often have rich information about how the data got to be the way they are. Deprived of their explanatory monopoly, archaeologists often discover utility for archaeological theory and method in the information-rich descendant paradigms (see Smith and Wobst 2005 for examples)

Both in critiquing forager self-knowledge and in introducing information into contexts left relatively information-free before, history becomes more important as an ally. Often bypassed in the past because of the assumed power of the forcing variables (if "nature" is so strong, how can there be "history" and historic change among foragers?), newly discovered forager histories again underscore the importance of information in helping to constitute the contexts of foraging societies (see, e.g., the discussions around the Kalahari foragers, such as Miracle et al. 1991 or Wilmsen 1989b).

Finally, the flaming battles between processual and postprocessual paradigms have fizzled. This makes it easier to view foragers as agents, and to model the dimensions of that agency in terms of social structure (knowledge of the histograms of previous actions and contexts) and decision making (how to choose among options, given knowledge of contexts, structure, and history). For model builders with agents, information is a central currency, side by side with the various biological variables with which it engages or which it makes visible (see, e.g., Mesoudi and O'Brien 2008; Wobst 1974).

In the future, then, in what dimensions will information impinge upon, change, and advance our understanding of forager populations?

THE NARRATIVITY OF FORAGERS AS BEING IN NATURE

In too much anthropological writing on foragers, nature constructs the payoff matrix that determines human fitness differentials and, thus, "environmental" variables are the usual starting points of explanations. (I use the term "environmental" here as shorthand for the non-human components of ecosystems—the plants, animals, climates, geomorphologies, and the like.) The priority of the modelers has been to assure that their information model helps to overcome environmental risks, constraints, and penalties. Thus, their research lays out how an environmental matrix is perceived, cognized, memorized, communicated, and ultimately acted on. In such a model, the cultural matrix often becomes a machine that serves the hypothesized differential fitness matrix.

Such an approach is relatively easy to develop, since the forager record—ethnographies and site reports—is presented so that, by the time non-"environmental" variables are introduced into one's reports, the foragers are already fully boxed in, if only by the order of introduction of the variables encountered before then (see, e.g., Clark 1954 as an iconic model of this). In other words, the usual data-rich forager ethnography or archaeological site report begins with the description of geomorphology and ground covers, climate, fauna, and flora, in all of their vicissitudes. By the time people enter the writing, little room is left for attributing fitness advantages to more strictly cultural variables (and thus, in terms of our topic here, variables that are also rich in information and relevant to perceived and cognized choices, and choices actually taken). That narrativity of the ethnographic and archaeological records is usually subconscious, rather than a result of the researcher's problem direction, and researchers of quite contrasting paradigms tend to perpetrate the same "environmental" bias in their presentation of forager data.

One wonders what our information models would look like if archaeologists and ethnographers had presented foragers with a different narrativity. Would we then not have an easier time assigning fitness advantages to more narrowly "cultural" rather than "environmental" variables? What if, for example, forager ethnographies and archaeological site reports started with their group's ideologies and paradigms, rituals and ethos, and switched only then to the more mundane "environmental" variables? Wouldn't forager archaeologists, then, have a much easier time incorporating dimensions of the cultural matrix as generating fitness differentials and, thus, requiring attention in models that link information and information processing to the adaptive responses observed?

THE NATURE OF FORAGERS IS ARTIFACTUAL

Another push for cultural variables in forager information modeling will come about when people more consistently apply their knowledge of ecosystem histories to their research. Well beyond the traditional prejudice that foragers are in a state of nature, forager anthropology often assumes forager nature itself to be in such a state. We have learned only very gradually about the extent to which humans are implicated in the so-called environmental variables, which earlier forager experts had taken to be independent of human behavior.

Where anthropologists had previously placed foragers into naturally generated "climax" ecozones, we now know that many forager habitats are not the equilibrium states of "natural" nature, but, rather, of human desire and decision making—that is, human artifacts, produced by conscious and strategic human management. Particularly well published are the many regional fire-ecologies in which, in a process logically parallel to agriculture, forest ecozones are kept artificially young (see, e.g., Lightfoot and Parrish 2009 for California examples). In virtually all regions, the "environment" would change significantly if the foragers with their specific historically evolved practices were removed (as indeed happened where foragers actually were removed; see Australian Government 2009 for the Kakadu Park in Northeast Australia). In other words, environmental variables, to a significant degree, behave in the way they are observed in "nature" as a result of human management and thus should be considered as cultural variables or cultural artifacts. When explanations applaud the brilliance of the information system for cleverly avoiding risks, constraints, and penalties supposedly exerted by these so-called independent "environmental" variables, we are pretty close to circular reasoning.

Plant and Animal Behaviors, Distributions, and Extinction Histories as Artifacts

If we take the previous argument to its logical conclusion, it opens up a whole new dimension of the forager universe for future information research. There is little doubt that humans as foragers have been a significant "environmental" factor in plant and animal behaviors and distributions, either by direct predation or by occupying the top spot in most of the world's food chains. In other words, the structure, distribution, behavior, and extinction history and sequence of many plants and animals are artifacts of human predation strategies (for primates, see, e.g., Fuentes 2006).

In terms of forager archaeology, what gets observed among plants and animals, today and through time, is implied by cultural strategies of information management and decision making, rather than actual traces of essential states of nature. Just like projectile points and pots and living structures (variables that we have no trouble accepting as artifacts of human information management), the "wild" animals and plants in the world of foragers constitute material artifacts of human decision making. Past human decisions are deeply implicated in many of the aspects of environmental variance that can become either advantageous or, alternatively, agents of danger, risk, and penalty to humans. Foragers do not need to be conscious of their impact on the environmental variance that articulates with them; they do not control that environmental variance to significant degrees, and it does present them with massive risks and dangers. Nevertheless, we have known for more than fifty years that the behavior of deer, the distribution of edible plants, the frequency of wildfires, and the relative abundance of ecozones, among many other dimensions of the "wild" habitat, are as much artifacts of past humans and their information strategies as they are inputs into human societies (see, e.g., Thomas 1956). Pursuing this knowledge further will open up many dimensions of our paleobiological record to problem-solving research about past human information strategies, and in the process we will become more sensitive to the potential for circular reasoning in paleoanthropological models that link information with "wild" variables.

Information "Chains" in Forager Flora and Fauna

In the last few decades, we have learned ever more about the information residing in the production history of the more traditional axes of archaeological forager analysis, lithic and ceramic artifacts. The differential complexities and potential constraints residing in production sequences (*chaînes opératoires*) in lithics (after Leroi-Gourhan 1964), or in the technological choices made in ceramics production (Chilton 1999), have yielded rich cultural information. Yet, compared with the intensity with which lithics production has been pursued for clues about information systems, faunal and floral information processing has been relatively flat.

That is all the more baffling since, among most foragers of the ethnographic present, the choices made in the sequence in which, for example, animal carcasses are generated, taken apart, processed, and distributed are without question considered as being deeply "cultural," pervaded and generated by, and helping to constitute, systems of meaning, sociality, and information. This often contrasts with lithics, where the individual steps of reduction and their sequencing are often significantly less interactive with, or constitutive of, other bodies of information. If we routinely paid "lithic" attention to forager faunal "chains," we would increase our knowledge of the roles of information among foragers manifold.

INFORMATION ABOUT FORAGER NATURE IS ETHNOCENTRIC

So far, I have carefully avoided admitting to the essential ethnocentrisms that help to shape the categories within which we model forager information, whether in archaeology or in the ethnographic present. There are very few foragers, indeed, whose information processing classifies the observable world similar to the way archaeologists are accustomed to doing it. As a number of researchers in this book point out, different groups draw their lines between animate and inanimate in different places than we do, they do or don't have a category even remotely similar to our category of art, and where we see "ritual" confined to special contexts, most forager populations consider most realms of their life to be embedded in, in reference to, and constitutive of what we would call ritual.

That is not just an academic question, but one that should propel information research in a number of rewarding directions. For example, where in the observable world one's information system draws the boundary between animate and inanimate, or between what's to be used or discarded, between clean and dirty, ritual and secular, art and craft, or gendered and ungendered—that line determines where it is appropriate to be and do, with whom and what, and under what circumstances, what one should avoid, and where artifacts may ultimately find a resting point. That boundary helps to construct, and exudes, a layer of constraint on human actions that often is significantly more severe than aspects of food and resource variance.

In terms of information, what is the differential utility of various competing ways of enculturating the observable world? Conversely, what damage is done, in which direction do we distort or bias history, if we model information in a given ethnographic or archaeological case as if that information were classifying the observable world in our way rather than in "theirs"? Where are the fitness advantages of drawing the dividing lines between life and death within what we consider the inanimate world?

That kind of question opens up avenues for research into all dimensions of the forager universe, raw material by raw material, tool category by tool category, and realm to realm, in terms of their changing location, articulation, embeddedness, and logical relationships within the forager information systems.

For example, in America today, clay is a pretty vernacular material, it is "thing-ish," cropping up after floods in sheets that inconveniently cover roads and as dirt on one's shoes and clothing if one steps into it (Woods 2009). Among many Native Americans, clay occupies completely other dimensions. To the Indigenous potter, clay is alive and respected, if not honored; it affords pot making and use, and it goes back to its state of living after the pot ceases its function in the household. For Native Americans, interacting with that "raw material" is significantly closer to interacting with people than the kind of commodity trading (and ultimate unceremonious discard) that connects non–Native Americans with clay goods.

Similarly, clams and their shells, which "we" consider to be food and midden fill, to many Native Americans link the underworld with the ground above, and humans are honored by being able to interact with them, though only if they honor them in return by respecting their richly enculturated meaning (see, e.g., Dambach 2009). Shells, like many other food sources that archaeologists consider significant in terms of their nutritional and caloric characteristics, for many Native Americans constitute information and are deeply implicated in other aspects of society.

Clams and shells and clay are not special cases, but tips of a large iceberg. In societies other than the ones most archaeologists hail from, what is gathered and killed often ties humans to a world of spirits and forces that is not easily accessible to ethnographers or archaeologists. What is, for many anthropologists, an intrinsically practical obtaining of foodstuffs, is for the anthropological subject often deeply embedded within, and constitutive of, conceptions and knowledges of the spirit world. Such embeddedness can strikingly affect the actions and behavior and distributions to which the archaeologist has the most immediate access. As many archaeologists have shown, these dimensions of information are accessible to problem-solving research (see, e.g., Kasper and Wobst 2009; Minc 1986; Sassaman and Holly 2010).

Information in Forager Analysis

Archaeologists tend to organize archaeological data according to their own paradigms about what matters and what does not. So, forager information tends to get sorted first on the axis of raw material (chipped stone, polished stone, ceramics, fauna, flora, soil samples, wood charcoal, etc.) and then by presumed "use function." Items are placed into these classes in complete ignorance of what determines an item's classification in the context we are trying to illuminate. That class membership then determines the questions that item is expected to answer, and what expert (or field) will be asked to answer them. Often, the information obtained in the various analysis streams does not meet up again in the same place until the final publication.

What if, to the population who produced the artifacts in question, it was not raw material that served as the first dimension of logical difference, but color, smell, gender, weight, size, shape, or reproducibility, among others? All of these dimensions organize information in some realms among some foragers: they imbue it with, and inseparably embed it in, information about other dimensions of their society. As a matter of fact, it seems as if foragers show a significantly greater range of variation in this than do other human populations (see Wobst 2005 for a similar argument).

What are the payoffs of such a large bandwidth in the axes in which foragers organize their information fields, in contrast to our rather flat categorizations of the same universe? Conversely, how does the imposition of our classifications destroy information about behavioral variance in the specific historic contexts that we are investigating? How do our theories about human materiality suffer if they do not retrodict the data in the ground, but only the readings generated by assuming that our archaeological foragers, in their actions, were trying to replicate our categorizations of the observable world?

Research has only barely begun to focus on how, oft-times with the help of clever method, we can identify the categorizations put to work by the populations that generated the archaeological record. Such research will become vital if we want to feel our way to pan-human theories of information management, rather than to theories that predict how the world would look if all humans behaved like us.

FORAGER CLASSIFICATION IS INFORMATION

Forager archaeology, in time and place, contains significant amounts of essentially unexplained variance. That variance may not even be accessible to observation outside of the world of foragers. After all, it was foragers who, for hundreds of generations, generated a material world that even the most obsessive-compulsive archaeological classifiers find to be virtually unclassifiable, unclassified, and lacking in types. Much of the so-called Lower Paleolithic is virtually devoid of the replication, standardization, and recurrent attribute clusters of artifacts that abound in Neolithic and later populations. Types "originate" during the Paleolithic, and, once they exist, they occur in massively varying proportions across space and time.

In the world of foragers, types become obvious parts of assemblages only in assemblages that are assumed to be the work of modern humans, beginning in the African Middle and Late Stone Age and in the Eurasian Middle and Upper Paleolithic. Paleolithic and later tool makers do not seem to be all that interested in constructing typed *working edges* or in artifact edges that interact with *nature*. Indeed, we see but a small range of choices among actual working edge shapes, between concave and convex, acute and obtuse, serrate or not, and so on. Instead, what varies significantly more, with lithics, is the context in which the working edge is embedded, that 99% of an artifact that comprises the remainder of the object (including the haft or the handle or the blank to which a working edge and "a type" was added). These parts of the artifact definitely do not directly interact with the "natural" environment. One assumes that the extra caloric expenditure involved in their making must have satisfied some important social, and particularly informational, functions. What these functions may be is still a relatively open question, even though that explanation has been part of normal archaeological science for the last few decades.

Our present data give us no purchase in explaining the variance in the prevalence of forager types. When there are types, they will usually be reported, but data about their relative prevalence in the places with types rarely makes it into print. This makes it difficult to attack questions of causation, association, and other relationships among variables. We don't know their proportions, and the *absence* of types is usually only anecdotal. What is interesting in terms of forager information processing, though, is that once types appear, they don't simply increase in prevalence through time; rather, their relative prevalence waxes and wanes in forager history and space. Except for having been "explained" as simply due to changes in forager information systems, there has been little problem-directed research as of yet to get us beyond broad generalities in explaining this variance (see, e.g., Wobst 1999).

The Typology of Types as Information

If it were just a matter of documenting nonrandom associations of attributes among foragers and relating them to the information payoffs that they facilitated, our typological analyses would soon run out of theoretically interesting projects. One could, of course, instruct one's data cruncher to find all the nonrandom associations of attributes in our assemblages, and that machine would shuffle attributes until some such nonrandom associations of attribute clusters had actually been found (which is probably not too far from present practices in normal science). But there is a potentially infinite number of ways in which attributes can nonrandomly associate within archaeological assemblages. To feel our way to the logics of the associations that were actually employed in a given case is methodologically exceptionally challenging even in ethnographic contexts.

A number of quite contrastive utilities may affect what logics will be employed in the creation of types in any given case. Some examples include the ease with which such logics lend themselves to sharing one's artifacts with others or preventing their easy copying by others; the degree to which they jibe with the logic of other information contexts of the group in question, or are logically contrastive to other artifact contexts of one's own group or of the logic of "other" groups' ways of doing things. Different parts of the artifact inventory of the same group may be produced under completely different logics, and the shape of a given artifact, in different stages of its construction, may embody several contrastive logics of typing. In the face of those complexities, our present knowledge of "typology" appears to be curiously shallow and flat, as well as remote from the information dynamics in which artifacts are embedded and which they help to constitute. It is safe to say to that future forager typologies will be significantly richer, more tightly articulated with forager social processes, and directed more aggressively to forager information strategies.

Making Forager Futures Harder to Conceptualize

Artifacts are costly. To produce them requires labor and access to and use of matter, energy, and information. Given those expenses, people would avoid making them if they could get by without them. People make them when they think that life would be worse (or more expensive) without them. Whereas archaeologists look at artifacts as their windows into the past, these are actually devices to bring about desirable, or to avoid undesirable, futures. They are less about successfully transacted behavior than about transacting behavior in the future. They are plans to prevent anticipated change in a present that is valued, or to bring about change if the present is deemed unpleasant (Wobst 2006).

Many ethnographically studied forager populations place their artifact use and production into a time logic that does not differentiate past from present and future. Scientists, on the other hand, tend to be wedded to time being in process, and much of their science generates examples of that in-process-ness. Archaeology and history specifically produce learning aids that make progressing time easier to conceptualize and easier to independently validate. Archaeologists often implicitly model forager thoughts and actions as being motivated by scientific, rather than foragers', time conceptions. For example, the scientific time conception underlies the usual functionalist explanations that subject a nasty selective force (time 1), to forager information processing (time 2), which helps to overcome unpleasant stressors (time 3). If we can independently determine that the foragers in question do indeed share our time notions, then that approach works well.

Artifacts do expose the foragers' plans for the future and reveal that they considered their environment worthy of intervention. That sounds trite, but it is quite complex when we expose it to future-less forager time conceptions. What is the plan behind artifacts when their makers do not separate past present and future? Of course, foragers, like all humans, are fully cognizant of the effects of actions, behavior, and artifacts on the "real world," and they frequently organize themselves to anticipate future conditions or possibilities. Nevertheless, if their ideology does not categorically differentiate past, present, and future, the niche for artifacts, technology, invention, and "progress" is logically different from ours, in its articulations with information. What if the cultural custodians in the archaeological case were championing their own time conception with their artifact inventories? How does that change the scales against which the success or lack of success of artifacts is to be measured?

Archaeological accounts tend to interpret forager solutions in the direction of practical reason, à la Sahlins (1976), in terms of the utility of "working edge" characteristics for overcoming environmental vicissitudes. Practical reason may account for the not-so-major changes in actual working edge shapes in the course of the Pleistocene. Working edges are sharp or dull, backed or not, concave, straight, or convex in the Middle or Upper Pleistocene, in spite of presumed major mental transformations. So that can be only one part of the story and, to my taste, not a particularly interesting one, because it does not help us understand the tremendous variance, in space time and prevalence, of the non-working edges of forager artifacts. Those dimensions are also about futures. Not about future returns from the environment, but future persons, their engagement with social entities, and their adherence to ideologies. Given that dynamism, one wonders if some artifacts whose introduction we now blame on their clever working edges might not have instead originated as more effective or flexible or redundant carriers of plans for managing persons and social entities (compare with Wobst 2000).

In modern societies, artifacts embody information that makes our futures easier to conceive. Where time is not seen to progress, can artifacts make it easier to think about futures that are the same as the present? One way to do this would be to make it harder to differentiate one time of construction from another (and thus make it harder to see or conceive of social difference through time); the same could be accomplished by keeping mnemonic aids to an artifact's authorship, time, or place to the absolute minimum. Forager artifacts in (and in support of) this time logic would simply say: there is no change through time. The information committed to artifacts would be generic, unbranded, and, thus, nontraceable. It would actively champion a time conception in which past, present, and future are one (just as the artifacts that surround us today help us to buy into a world of active processes that propel the past forward into the present and future).

This logic generates a world that looks quite similar to the long, boring chapters of human materiality of the Lower and Middle Pleistocene, an epoch that is usually interpreted as one of mental incompetence, impotence to do better, or a failure to become. Artifacts of that time may not talk about mental capacity at all, but about artifactually effecting a time conception in which pasts, presents, and futures are indistinguishable. That time conception survives into later periods, such as the Upper Paleolithic or the ethnographic present, where it competes materially with other time conceptions. Such competing time logics would help to throw light on variability in other aspects of forager life, such as the differential occurrence of rock art versus sand paintings, or the differential permanence of living structures and ritual constructions.

BY WAY OF CONCLUSION

Foragers ooze information, but that information does not explain itself, even when you examine it directly. To make sense of it requires the kind of problem-directed research that is exemplified in this volume. As a matter of fact, it requires methodological finesse and interdisciplinary problem solving of a degree of complexity and difficulty that archaeologists tend to shrink away from, in favor of "less complex" topics such as "straightforward" lithic, faunal, and floral analyses. Yet even those relatively pedestrian topics, as we have seen in the preceding, gain by being retheorized. Such retheorizing will help us realize how peculiar the information management strategies are in our own society, and how dynamic (and often different) they have been in the universe of foragers that is the topic of this volume.

The result will be an understanding of foragers and information in time and place that is worldwide, and a theoretical understanding of information in human societies that will be all-encompassing. It will certainly give us a better sense and appreciation of the accomplishment of forager societies, a group of human social formations that stretches from the beginnings of humanity to the ethnographic present and thus constitutes the most successful human social formation so far. Such rethinking of information among foragers will help them to reclaim their seat at the table of anthropological research, from which colonialism and many previous anthropological paradigms have excluded them. Since foragers, among human social formations, constitute the largest number of lived experiments, we must take that variation and variability seriously if want to get a robust theoretical understanding of information and humans, in the past and present, and through time and space.

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14 A Synopsis of *Information* and Its Role in Hunter-Gatherer Bands

Robert Whallon and William A. Lovis

Returning to the introductory chapter (Whallon, this volume, Chapter 1), it seems now worthwhile to review briefly the many and various contributions made to our understanding of "information and its role in hunter-gatherer band-level societies" by the chapters in this volume. Reviewing the overview of this topic sketched in the introductory chapter, we find that the other chapters have touched on, exemplified, and expanded on almost all of the points outlined in the introduction.

Beginning with definitions, we find that most authors feel comfortable with a simple, colloquial concept of what "information" is, treating it quite simply as knowledge, as in the introduction, not even bothering with explicitly considering what it is or with attempting a formal definition. An exception to this approach, offering a fully formal definition, is found in Chapter 4 by Fitzhugh, Phillips, and Gjesfjeld, but it appears that, for the most part, an informal approach to the concept proves adequate and allows effective consideration of other aspects of the subject.

All kinds of information identified in the introduction—environmental, technical, and social—are discussed in the various papers in this book. Not all are treated in any one chapter, and most chapters tend to emphasize only one or two of these three kinds of information. It is hard to see a dominance of consideration or interest in any one type of information over another in an overview of all the chapters as a whole. In fact, as pointed out in Hill's Chapter 7, a salient characteristic of much of the information within hunter-gatherer societies is multifunctional in the sense that any piece of knowledge often carries with it information of more than one kind. For example, as Hill points out, the use of a “foreign” loanword for something not only identifies and defines that thing, but at the same time provides social information, indicating that the individual using that word has different and perhaps more extensive external social contacts than others in the group.

However, given their differential treatment among the chapters, it appears that it is probably both useful and accurate to recognize these three kinds of information as at least somewhat separate. It also appears that, given the lack of dominance of any one kind over another among the chapters, it is similarly both useful and accurate to recognize and treat all three as of at least roughly equal importance in hunter-gatherer bands.

ACQUISITION

Although not every aspect of the acquisition of information over space is discussed in each chapter, examples of almost every aspect are found throughout the book. The important points, brought out in multiple chapters, are that acquisition of information over space involves a great deal of intentional, conscious, direct observation, that it typically requires movement, and that much of this movement may be ostensibly for purposes other than the explicit gathering of information. There is also discussion of the point that some of these “other” activities may, in fact, serve as cultural mechanisms to generate information-gathering movement. Fitzhugh, Phillips, and Gjesfjeld note, for instance, that trade or exchange may be one such mechanism, one that was not mentioned in the introduction but which certainly fits that role.

Movement among hunter-gatherers is generally well known to create local groups of fluid composition. In Chapter 12, Borrero, Martin, and Barberena note that in some circumstances, this fluidity of group membership may even lead to groups of mixed “ethnic” composition. In such mixed groups, even more than for groups of normally fluctuating composition, the incorporation of individuals having different sets of social links outside the group allows for a maximum amount of information acquisition from different sources. Such external interactions are often marked by the movement of material goods (“exchange” or “trade”) at both the local and regional scales.

The diversity of social ties outside a group is considered also in Hill's chapter, but she emphasizes not only the existence of such ties and their importance in acquiring information from different sources, but also the social marking of the particular individuals within a group by their use of "foreign" or loanwords. Such differences, of course, lead to or accentuate the differential distribution of information among individuals within a group, an important point addressed below under the topic of information storage.

One aspect of the spatial acquisition of information suggested in the introduction that is not mentioned or discussed in any other chapter is movement specifically for the purpose of information gathering. Upon reconsideration, movement specifically for this purpose, and limited primarily to it, may, in fact, be relatively rare. Embedding the acquisition of information in travel that has other purposes as well, and that is seen as being undertaken primarily for those other purposes, may be most common, if not universal. In retrospect, it seems unlikely that most, if any, movement in hunter-gatherer band society is made with but a single purpose in mind. Most probably, movement in these societies virtually always has multiple rationales and purposes.

The fact that the spatial extent of such direct acquisition of data is invariably limited is also clearly recognized, particularly by Funk in Chapter 2. This spatial limitation is an important driving force behind the extensive circulation of information among individuals and groups, and a great deal of consideration and discussion of such circulation can be found among the various chapters, as noted below.

The distinction made in the introduction between short-term (well within an individual's lifetime) and long-term (intergenerational) acquisition of information is found also among the chapters in this book. The means by which each is accomplished are seen as essentially those outlined in the introduction: conscious observation and absorbing of information about immediate physical and social surroundings for the short term, and socialization, teaching, storytelling, initiation, and the like for the long term.

CIRCULATION

All authors in this volume agree on the central importance of the circulation of information among individuals and groups in hunter-gatherer band-level societies. There is also broad agreement on the fact that different mechanisms circulate different information in different frequencies, quantities, and quality over different spatial scales, ranging from local, minimal band territories to the transfer of information over great distances between maximal bands.

The focus of attention among the chapters in this volume is on the circulation of environmental and social information. The circulation of technical information is essentially given short shrift in these papers, although we all know that it is a topic of major and constant concern in archaeology.

Mechanisms for the spatial and temporal circulation of information are widely recognized here to be both verbal and material. The majority of information transfers are seen to be accomplished by simple conversation, discussion, planning, gossip, and so on (e.g., Hitchcock and Ebert [Chapter 6]), but several papers (Zvelebil [Chapter 8], Veth et al. [Chapter 9], McDonald and Veth [Chapter 10], Scheinsohn [Chapter 11]) are largely concerned with nonverbal means—signs, symbols, styles—of communicating information.

With respect to the latter, at least one chapter (Scheinsohn, Chapter 11) suggests the importance of such material means of transmitting information back to the individuals or groups that encoded it in the first place, essentially circulating information back to oneself. Such return circulation of information (reminding, guiding, reaffirming) is not widely recognized or considered, yet it is perhaps more common and important than we currently think and is worth more careful and focused study.

Some of these chapters also clearly discuss or provide data on the problems of degradation, deterioration, or loss of information as it is circulated over greater and greater spatial and temporal extents. These authors argue, as in the introduction, that this problem of deterioration with distance and with time necessitates regular renewal, refreshing, or reinforcement of information if it is to be accurate and useful when the time comes to draw upon it.

STORAGE

It seems for the most part implicitly assumed by the chapter authors that information is stored simply in the minds of the individual members of hunter-gatherer bands. Relatively little overt attention is paid, therefore, to the question of where information is stored. Where this is discussed (e.g., Funk. Chapter2), the conclusion is explicit that human memory is the locus of information in these societies.

The differential distribution of information storage is highlighted in the introduction as a major, important feature in these societies, but is touched on by only a few of the chapters in this book. This probably reflects the fact that such differential distribution has not yet been widely recognized or investigated. However, Funk's Chapter 2 in particular, and the chapters by Ichikawa, Hattori, and Yasuoka (Chapter 5) and by Lovis and Donahue (Chapter 3), as well, deal in whole or in part with this aspect of information in hunter-gatherer bands, and go a long way toward redressing this general lack of attention to the phenomenon. These authors consider both the qualitative and quantitative aspects of the differential distribution of information, discussing and exemplifying them both with ethnographic data.

Funk illustrates several of the possible axes of differentiation in information (gender [especially], age, individual differences) with concrete examples, and Lovis and Donahue also note significant gender and age differences in both quality and quantity of information held by different individuals. Ichikawa et al., on the other hand, take up questions of how information is differentially acquired and maintained, pointing out that some kinds of information, particularly more specialized medicinal and ritual information, are more likely to be differentially distributed among individuals than other, more mundane information.

Similarly, the significant problems of information deterioration and eventual loss as a consequence of its differential distribution are generally left unexplored by the authors in this volume, although several do touch on the processes of deterioration and loss in the course of information circulation. However, no one here takes up the question of the differential strengths with which different information is held by individuals or groups, nor the cultural and psychological mechanisms for embedding information in people's minds with such different degrees of strength of retention.

It is apparent that this is an area that demands much more attention and research. Some of its possibly significant aspects have been outlined in the introduction, and at least one chapter in this book addresses part of it; yet these efforts represent only a small and partial beginning to what is likely to develop into a substantial area of investigation. We might go so far here as to predict that further work on this subject will ultimately provide us with new and highly worthwhile understanding and insights into the working and consequences of information storage in small-scale hunter-gatherer societies.

MOBILIZATION

The simple use by any individual of the information held in his or her memory is self-obvious and is thus not given any particular specific consideration in this book. The typical, common, and most obvious way in which information is mobilized in hunter-gatherer bands, through conversation, discussion, and open planning, is noted in a number of chapters. This, again, however, is taken as relatively self-evident, and no further special attention is paid to this common process.

Several chapters deal with the encoding of information in signs, symbols, or styles, and in doing so seem to treat the mobilization of such information also as a more or less self-obvious process, with no special attention paid to the ways in which extracting or decoding such information may be done. Here, though, we may wonder if there are not some questions worthy of pursuit. We might ask, for example: Who is capable of extracting such coded information? When is it apparent to all in a society? When restricted to a limited number of individuals, who know the keys to its reading? Is it done openly, in ritual contexts, or in secret? Although not treated in this volume, this subject nonetheless seems worthy of further investigation.

Ritual or ceremonial mobilization of information that is embedded in symbolic belief systems, on the other hand, is noted in one or two chapters, but is not investigated or discussed in any depth. It is simply mentioned as a known but not fully understood mechanism for the mobilization of information. This is the usual treatment of this mechanism. It is known, primarily from one example in the literature, but is very difficult to discern in any other cases from the easily available ethnographic or ethnoarchaeological data. It exists, thus, as a tantalizing suggestion of how relatively long-term information storage and mobilization may be achieved in small-scale hunter-gatherer societies, but, at the same time, further demonstration, examples, and understanding of it remain elusive and beyond our present reach. Here, even more than in the case of the mobilization of information encoded in signs, symbols, and styles, much of apparent unique importance remains to be researched.

SUMMARY

There is substantial diversity of material, approach, and interpretation of "information and its role in hunter-gatherer band-level societies" represented in the various chapters of this book. However, there is uniformity in the position of all authors that information is clearly a critical component of hunter-gatherer band adaptation and survival. An introductory outline attempts to provide a comprehensive, overall framework for viewing, analyzing, and understanding this component of band-level cultural systems, and it is gratifying to see how many of the points developed in this sketched outline have been repeated, investigated, and exemplified by the many authors who have contributed to the book.

Of course, not every point raised in the introduction has been taken up and developed by the contributors. Some points, in fact, appear to remain largely unrecognized or uninvestigated in our field. This is not surprising, since some effort was made in the introduction to draw attention to significant areas or questions that stand as large unknowns in the area of "information and its role in hunter-gatherer band-level societies."

At the same time, there are some aspects of information in small-scale societies raised in the chapters of this book that were not anticipated and considered in the introductory outline. The most prominent of these is that at least some categories of knowledge in these societies are organized and encoded in hierarchical fashion, in which detail is incorporated into successively greater and greater levels of generality. This may be an important characteristic of how knowledge is structured so as to allow larger amounts of information to be retained, manipulated, and mobilized than would otherwise be possible through simple memorization, in a "flat" organizational structure. This is an aspect of how information is acquired, organized, stored, and mobilized in band-level societies that seems worthy of further investigation.

The introductory outline also attempts to emphasize many of the nonmaterial aspects of band-level cultural systems as of at least equal importance to their organization and operation as material, technological, and ecological aspects. This is a point also strongly made by Wobst in his summary overview of the volume (Chapter 13). Wobst points out an important fact: that most of the current and recent approaches to the archaeological (and, we can add, evolutionary biological) description, modeling, and understanding of hunter-gatherer societies begin from a strongly materialist perspective. This has meant that attention has been focused first on such materialist variables as environment, technology, rates of foraging success, levels of nutrition, and so on.

While these are all important factors to consider in attempting to model or explain such societies, beginning with them means, ipso facto, relegating "cultural" variables such as oral tradition, values, world view, and belief systems, and, in general, these groups' accumulation, storage, and circulation of information, to a position of last importance. Wobst maintains that approaching these societies the other way around, considering all such "cultural" variables first and materialist variables last, might result in quite a different picture of how these groups are organized, make decisions, adapt, and evolve. In the end, however, it is not that Wobst is advocating a primacy of one kind or set of variables over another, but, rather, a better balance in considering all the many significant and even crucial variables in modeling and understanding hunter-gatherer groups.

It is one of the purposes of this volume to begin somewhat to redress the current and recent imbalance in the archaeological (and evolutionary biological) approach to these societies by arguing for and demonstrating the central and critical role that information, typically a non-material "intangible," plays in the day-to-day operation of hunter-gatherer bands, their adaptation to the world(s) around them, their evolution, and ultimately their very survival. The other large purpose is to urge forward research into understanding "information and its role in hunter-gatherer band-level societies," both through presenting stimulating and useful data and studies and by attempting a first outline sketch of a general, overall framework within which to advance such research. In doing this, however, at a number of places it has appeared important and useful to point out areas where significant research and advances yet remain to be done. We hope that it has at least somewhat succeeded in all of these ventures.

References

AFLORA Committee

1988 Introduction to AFLORA: An on-line database for plant utilization information of Africa. *African Study Monographs* 9(1):55–64.

Agha, A.

2007 *Language and Social Relations*. Cambridge University Press, New York and London.

Aguilera, N., and P. Grendi

1996 Hallazgo de un chenque Proto-Aónikenk en Juni Aike, Magallanes. *Anales del Instituto de la Patagonia* 24:163–175.

Ahlbäck, H.

2003 Art: Context and tradition in the Palaeolithic-Mesolithic transition in Northern Europe. In *Mesolithic on the Move*, edited by L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund, pp. 467–477. Oxbow Books, Oxford.

Akerman, K.

2009 Interaction between humans and megafauna depicted in Australian rock-art? Project Gallery *Antiquity* 83(322), *http://antiquity.ac.uk/projgall/akerman322/*.

Akerman, K., and T. Willing

2009 An ancient rock painting of a marsupial lion, *Thylacaleo carnifex*, from the Kimberley region, Western Australia. Project Gallery *Antiquity* 83(319), *http://antiquity.ac.uk/projgall/akerman319/*.

Alaska Department of Natural Resources (ADNR)

1984 Alaska Coastline 1:250,000. Alaska Department of Natural Resources, Land Records Information Section. ADNR, LRIS, Anchorage, AK.

Albert, B., and F.-M. Le Tourneau

2007 Ethnogeography and resource use among the Yanomami. *Current Anthropology* 48:584–592.

Albornoz, A. M., and E. M. Cúneo
2000 Análisis comparativo de sitios con pictografías en ambientes lacustres boscosos de Patagonia Septentrional. In *Arte en las Rocas. Arte rupestre, menhires y piedras de colores en Argentina*, edited by M. Podestá and M. de Hoyos, pp. 163–174. Sociedad Argentina de Antropología y Asociación Amigos del INAPL, Buenos Aires.

Allen, J., and C. Gosden (eds.)
1991 *Report of the Lapita Homeland Project*. Australian National University, Canberra.

Allen, J., and J. F. O'Connell
2003 The long and short of it: Archaeological approaches to determining when humans first colonised Australia and New Guinea. *Australian Archaeology* 57:5–19.

Allenby, B., and J. Fink
2005 Toward inherently secure and resilient societies. *Science* 309(5737):1034–1036.

Amano, T.
1979 Ohôtsuku bunka no tenkai to chi'ikisa. *Hoppô Bunka Kenkyû* 12, pp. 75–92 (Japanese).

Andersen, S. H.
1987 Tybring Vig: A submerged Ertebolle settlement in Denmark. In *European Wetlands in Prehistory*, edited by J. M. Coles and A. J. Lawson, pp. 253–281. Clarendon Press, Oxford.

Antanaitis, I.
1998 Interpreting the meaning of East Baltic Neolithic symbols. *Cambridge Archaeological Journal* 8:55–68.

Aporta, C., and E. Higgs
2005 Satellite culture: Global positioning systems, Inuit wayfinding, and the need for a new account of technology. *Current Anthropology* 46:729–753.

Applegate, R.
1980 Ethnosemantics of the dream helper in south-central California. In *American Indian and Indo-European Studies, Papers in Honor of Madison S. Beeler*, edited by M. Langdon and S. Silver, pp. 3–9. Mouton: The Hague.

Arias, P., A. Armendariz, R. de Balbín, M. A. Fano, J. Fernández-Tresguerres, M. R. González Morales, M. J. Iriarte, R. Ontanón, J. Alcolea, E. Álvarez-Fernández, F. Etxeberria, M. D. Garralda, M. Jackes, and Á. Arrizabalaga
2009 Burials in the cave: New evidence on mortuary practices during the Mesolithic of Cantabrian Spain. In *Mesolithic Horizons* (Vol. I), edited by S. B. McCartan, R. Schulting, G. Warren, and P. Woodman, pp. 650–656. Oxbow Books, Oxford.

Aschero, C. A.
1997 De cómo interactúan emplazamientos, conjuntos y temas. *Actas y memorias del XI Congreso nacional de arqueología Argentina (cuarta parte). Revista del Museo de Historia Natural de San Rafael* XVI (1/4):17–28, Mendoza.

Aschero, C. A., C. Pérez de Micou, M. Onetto, C. Bellelli, L. Nacuzzi, and A. Fisher
1983 *Arqueología del Chubut*. El Valle de Piedra Parada. Dirección Provincial de Cultura, Rawson, Chubut.

Aspillaga, E., and C. Ocampo
1996 Restos óseos humanos de la isla Karukinka (Seno Almirantazgo, Tierra del Fuego). Informe preliminar. *Anales del Instituto de la Patagonia* 24:153–161.
Australian Government
2009 *Kakadu National Park. Fire Management*. Department of the Environment, Water, Heritage and the Arts. Electronic document, accessed April 30, 2009: *http://www.environment.gov.au/parks/kakadu/management/programs/fire.html*.
Baba, M. O.
1937 Hunting and fishing implements of the Kuril Islands. *Minzokugaka Kenkyu* 3(2):295–337.
1939 The northern Kurile Islands from the viewpoint of archaeology. Reprinted in *Archaeology and Ethnology of Sakhalin and the Kuriles* (Dr. O. Baba's Collected Papers, Vol. 3), pp. 6–162 (in Japanese). Hokkaido Shupan Kikaku Senta, Sapporo.
Baba, M. O., and M. Oka
1938 Archaeological investigations of Shumushu in the Kuril Islands and Tariaka, Sakhalin. *Minzokugaka Kenkyu* 4(3):117–180.
Bakka, E.
1975 *Geologically Dated Arctic Rock Carvings at Hammer near Steinkjer in Nord-Trøndelag*. Arkeologiske Skrifter fra Historisk Museum vid Universitetet i Bergen 2.
Balée. W.
1994 *Footprints of the Forest: Ka'apor Ethnobotany—The Historical Ecology of Plant Utilization by an Amazonian People*. Columbia University Press, New York.
2000 Antiquity of traditional ethnobiological knowledge in Amazonia: The Tupí-Guaraní family and time. *Ethnohistory* 47:399–422.
Balme, J.
1995 30,000 years of fishery in western NSW. *Archaeology in Oceania* 30:1–21.
Balme, J., and K. Morse
2006 Shell beads and social behaviour in Pleistocene Australia. *Antiquity* 80:9–811.
Balme, J., I. Davidson, J. McDonald, N. Stern, and P. Veth
2009 Symbolic behaviour and the peopling of the southern arc route to Australia. *Quaternary International* 202:59–68.
Barberena, R.
2002 *Los límites del mar. Isótopos estables en Patagonia maridional*. Sociedad Argentina de Antropología, Buenos Aires.
2008 *Arqueología y biogografía humana en Patagonia meridional*. Sociedad Argentina de Antropología, Buenos Aires.
Barnard, A.
1992 *Hunters and Herders of South Africa: A Comparative Ethnography of the Khoisan Peoples*. Cambridge University Press, Cambridge and New York.
Barrett, J. C.
1991 Towards an archaeology of ritual. In *Sacred and Profane*, *Proceedings of a Conference on Archaeology*, *Ritual and Religion*, *Oxford*, *1989*, edited by P. Garwood, D. Jennings, R. Skeates, and J. Toms, pp. 1–9. Monograph 32. Oxford University Committee for Archaeology, Oxford.

Barrientos, G., and S. I. Perez
2004 La expansión y dispersión de poblaciones del norte de Patagonia durante el Holoceno tardío: Evidencia arqueológica y modelo explicativo. In *Contra Viento y Marea. Arqueología de Patagonia. V Jornadas de Arquelogía de la Patagonia*, edited by M. T. Civalero, P. M. Fernández, and A. G. Guráieb, pp. 179–195. Instituto Nacional de Antropología y Pensamiento Latinoamericano y Sociedad Argentina de Antropología, Buenos Aires.

Barros, J. M.
1988 La expedición de Narborough a Chile: Nuevos antecedentes. *Anales del Instituto de la Patagonia* 18:35–59.

Barton, C., G. A. Clark, and A. Cohen
1994 Art as information: Explaining Upper Palaeolithic art in Western Europe. *World Archaeology* 26:185–207.

Barton, N., A. J. Roberts, and D. A. Roe
1991 *The Late Glacial in North-west Europe*. CBA Research Report 77. Council for British Archaeology, London.

Bartram, L.
1993 An Ethnoarchaeological Analysis of Kua San (Botswana) Bone Food Refuse. Ph.D. dissertation, University of Wisconsin, Madison.

Bar-Yosef, O.
2002 The Upper Palaeolithic revolution. *Annual Review of Anthropology* 31(1): 363–393.

Baudou, E.
1977 Den Förhistoriska fångstkulturen I Västernorrland. *Västernorrlands Förhistoria*: 11–152. Härnösand.
1992 Boplatsen vid Nämforsen. *Arkeologi i Nor* 3:71–82.
1993 Hällristningarna vid Nämforsen—datering och kulturmiljö: Ekonomi och näringsformer i nordisk bronsålder. *Studia Archaeological Universitatis Umensis* 3:247–261.

Bean, L. J., and K. Siva Saubel
1972 *Temalpakh: Cahuilla Indian Knowledge and Usage of Plants*. Malki Museum Press, Banning, CA.

Beer, G.
1997 Travelling the other way. In *Patagonia. Natural History, Prehistory and Ethnography at the Uttermost End of the Earth*, edited by C. McEwan, L. A. Borrero, and A. Prieto, pp. 140–152. British Museum Press, London.

Beerbohm, J.
1879 *Wanderings in Patagonia or Life among the Ostrich-Hunters*. Chatto and Windus, London.

Belardi, J. B.
2004 Más vueltas que una greca. In *Contra Viento y Marea. Arqueología de Patagonia. V Jornadas de Arquelogía de la Patagonia*, edited by M. T. Civalero, P. M. Fernández, and A. G. Guráieb, pp. 591–603. Instituto Nacional de Antropología y Pensamiento Latinoamericano y Sociedad Argentina de Antropología, Buenos Aires.

Bell, D.
1993 *Daughters of the Dreaming*. University of Minnesota Press, Minneapolis.

Bellelli, C., V. Scheinsohn, and M. Podestá
2008 Arqueología de pasos cordilleranos: Un caso de análisis en la Comarca Andina del Paralelo 42° y áreas vecinas durante el Holoceno Tardío. *Boletín del Museo Chileno de Arte Precolombino* 13(2):37–55. Santiago de Chile.

Bellelli, C., M. Carballido, P. Fernández, and V. Scheinsohn
2003 El pasado entre las hojas. Nueva información arqueológica del noroeste de la provincia de Chubut, Argentina. *Werken* 4:25–42.

Bellelli, C., F. Pereyra, P. Fernández, V. Scheinsohn, M. Carballido, and M. Podestá
2000 Aproximación geoarqueológica del sector sur de la Comarca Andina del Paralelo 42° (Cholila, Chubut). *Cuaternario y Ciencias Ambientales* 1:15–21.

Bellelli, C., V. Scheinsohn, P. Fernández, F. Pereyra, M. Podestá, and M. Carballido
2000 Arqueología de la Comarca Andina del Paralelo 42°. Localidad de Cholila. Primeros resultados. In *Desde el país de los gigantes. Perspectivas arqueológicas en Patagonia*, pp. 587–602. Universidad Nacional de la Patagonia Austral, Río Gallegos.

Bengtsson, L.
2003 Knowledge and interaction in the Stone Age: Raw materials for adzes and axes, their sources and distributional patterns. In *Mesolithic on the Mov*e, edited by L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund, pp. 388–394. Oxbow Books, Oxford.

Bergsvick, K. A.
2009 Caught in the middle: Functional and ideological aspects of Mesolithic shores in Norway. In *Mesolithic Horizons* (Vol. I), edited by S. B. McCartan, R. Schulting, G. Warren, and P. Woodman, pp. 602–609. Oxbow Books, Oxford.

Bergsvick, K. A., and A. B. Olsen
2003 Traffic in stone adzes in Mesolithic western Norway. In *Mesolithic on the Move*, edited by L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund, pp. 395–404. Oxbow Books, Oxford.

Berlin, B.
1992 *Ethnobiological Classification: Principles of Categorization of Plants and Animals in Traditional Societies*. Princeton University Press, Princeton, NJ.

Berndt, R. M., and C. H. Berndt
1964 *The World of the First Australians*.Ure Smith, Sydney.
1999 *The World of the First Australians: Aboriginal Traditional Life: Past and Present*. Aboriginal Studies Press, Canberra. (Originally published: 1964).

Bevan, L.
2003 Stag nights and horny men: Antler symbolism and interaction with the animal world during the Mesolithic. In *Peopling the Mesolithic in a Northern Environment*, edited by L. Bevan and J. Moore, pp. 35–44. British Archeological Reports, International Series 1157. Archaeopress, Oxford.

Biesele, M.
1978 Sapience and scarce resources: Communication systems of the !Kung and other foragers. *Social Science Information* 17:921–947.

1993 *Women Like Meat. The Folklore and Foraging Strategy of the Kalahari Ju/'hoan*. Witwatersrand University Press, Pretoria.

Biesele, M., and S. Barclay

2001 Ju/'hoan women's tracking knowledge and its contribution to their husband's hunting success. In *African Hunter-Gatherers: Persisting Cultures and Contemporary Problems*, edited by J. Tanaka, M. Ichikawa and D. Kimura. *African Study Monographs, Supplementary Issue* 26:67–84.

Binford, L. R.

1978 *Nunamiut Ethnoarchaeology*. Academic Press, New York.

1980 Willow smoke and dogs' tails: Hunter-gatherer settlement systems and archaeological site formation. *Journal of Anthropological Archaeology* 1:4–20.

1982 The archaeology of place. *Journal of Anthropological Archaeology* 1:5–31.

1983 Long term land use patterns: Some implications for archaeology. In *Lulu Linear Punctated: Essays in Honor of George Irving Quimby*, edited by R. C. Dunnell and D. K. Grayson, pp. 27–54. Anthropological Papers 72. Museum of Anthropology, University of Michigan, Ann Arbor.

2001 *Constructing Frames of Reference: An Analytic Method for Archaeological Theory Building Using Ethnographic and Environmental Data Sets*. University of California Press, Berkeley and London.

2006 Bands as characteristic of "mobile hunter-gatherers" may exist only in the history of anthropology. In *Archaeology and Ethnoarchaeology of Mobility*, edited by F. Sellet, R. Greaves, and P.-L. Yu, pp. 3–22. University of Florida Press, Gainesville.

Bird, J.

1983 Enterratorios paleo-indios con cremación en las cuevas de Pali-Aike y Cerro Sota en Patagonia meridional. *Anales del Instituto de la Patagonia* 14: 55–63.

1988 *Travels and Archaeology in South Chile*. University of Iowa Press, Iowa City.

Birdsell, J. B.

1953 Some environmental and cultural factors influencing the structuring of Australian Aboriginal populations. *American Naturalist* 87:171–207.

1977 The recalibration of a paradigm for the first peopling of Greater Australia. In *Sunda and Sahul: Prehistoric Studies in Southeast Asia, Melanesia and Australia*, edited by J. Allen, J. Golson, and R. Jones, pp. 113–167. Academic Press, London.

Bliege Bird, R., and E. A. Smith

2005 Signaling theory, strategic interaction, and symbolic capital. *Current Anthropology* 46:221–248.

Bloch, M.

1977 The past and the present in the present. *Man* 12:278–292.

1985 From cognition to ideology. In *Power and Knowledge: Anthropological and Sociological Approaches*, edited by R. Fardon, pp. 21–48. Scottish Academic Press, Edinburgh.

Boas, F.

1927 [1955] *Primitive Art*. New York.

Bórmida, M.

1953–1954 Los antiguos patagones. Estudio de craneología. *Runa* 6:5–96.

Borrero, L. A.
1989–1990 Evolución cultural divergente en la Patagonia Austral. *Anales del Instituto de la Patagonia* 19:133–140.
1994–1995 Arqueologia de la Patagonia. *Palimpsesto* 4:9–69.
1997 The origins of ethnographic subsistence patterns in Fuego-Patagonia. In *Patagonia. Natural History, Prehistory and Ethnography at the Uttermost End of the Earth*, edited by C. McEwan, L. A. Borrero, and A. Prieto, pp. 60–81. British Museum Press, London.
2001a Cambios, continuidades, discontinuidades: Discusiones sobre arqueología Fuego-Patagónica. In *Historia Argentina prehispánica*, edited by E. A. Berberián and A. Nielsen, pp. 815–838. Editorial Brujas, Córdoba.
2001b *El poblamiento de la Patagonia. toldos, milodones y volcanes*. Editorial Emecé, Buenos Aires.

Borrero, L. A., and R. Barberena
2006 Hunter-gatherer home ranges and marine resources. *Current Anthropology* 47(5):855–867.

Borrero, L. A., R. Barberena, N. V. Franco, J. Charlin, and R. H. Tykot
2009 Isotopes and rocks: Geographical organization of Patagonian hunter-gatherers. *International Journal of Osteoarchaeology* 19(2):309–327.

Bouzek, J.
1993 The shifts of the amber route. In *Amber in Archaeology. Proceedings of the Second International Conference on Amber in Archaeology, Liblice 1990*, edited by C. W. Beck and J. Bouzek, pp. 141–146. Institute of Archaeology, Prague.

Bowler, J. M., H. Johnston, J. M. Olley, J. R. Prescott, R. G. Roberts, W. Shawcross, and N. A. Spooner
2003 New ages for human occupation and climatic change at Lake Mungo, Australia. *Nature* 421:837–840.

Boyd, R., and P. Richerson
1985 *Culture and the Evolutionary Process*. University of Chicago Press, Chicago.

Bradley, R.
1998 *The Significance of Monuments*. Routledge, London.
2000 *An Archaeology of Natural Places*. Routledge, London.

Brandenburgh, R. L.
1991 An Assessment of Pastoral Impacts on Basarwa Subsistence: An Evolutionary Ecological Analysis in the Kalahari. M.A. thesis, University of Nebraska, Lincoln.

Brody, H.
1981 *Maps & Dreams*. Douglas & McIntyre Ltd., Vancouver.

Brown, C. H.
1985 Mode of subsistence and folk biological taxonomy. *Current Anthropology* 26:43–62.

Bruggmann, M., and P. R. Gerber
1987 *Indians of the Northwest Coast*. Facts on File, Oxford.

Brumm, A., and M. W. Moore
2005 Symbolic revolutions and the Australian archaeological record. *Cambridge Archaeological Journal* 15:157–175.

Burov, G. M.

1989 Some Mesolithic wooden artefacts from the site of Vis I in the European North East of the U.S.S.R. In *The Mesolithic in Europe*, edited by C. Bonsall, pp. 391–401. John Donald, Edinburgh.

Cahill, L., and J. L. McGaugh

1998 Mechanisms of emotional arousal and lasting declarative memory. *Trends in Neurosciences* 21:294–299.

Callaghan, C.

1997 Evidence for Yok-Utian. *International Journal of American Linguistics* 63: 18–64.

Campan, P. A., F. Carballo Marina,, and L. M. Manzi

2007 Arqueología de Estancia La Carlota (Campo Volcánico Pali Aike, Argentina). *Arqueología de Fuego-Patagonia. Levantando piedras, desenterrando huesos… y develando arcanos*, edited by F. Morello, A. Prieto, M. Martinic, and G. Bahamondes. Ediciones CEQUA, Punta Arenas.

Campbell, A. C.

1979 The 1960s drought in Botswana. In *Proceedings of the Symposium on Drought in Botswana*, edited by M. T. Hinchey, pp. 98–109. Botswana Society in collaboration with Clark University Press, Gaborone.

Campbell, A. C., and G. Child

1971 The impact of man on the environment of Botswana. *Botswana Notes and Records* 3:91–110.

Campbell, A., M. Main, and R. K. Hitchcock

2006 Land, livestock, and labor in rural Botswana: The western Sandveld region of central district as a case study. In *Updating the San: Image and Reality of an African People in the 21st Century*, edited by R. K. Hitchcock, K. Ikeya, M. Biesele, and R. B. Lee, pp. 183–228. Senri Ethnological Studies 70. National Museum of Ethnology, Osaka, Japan.

Cantor, J., and R. W. Engle

1993 Working-memory capacity as long-term memory activation: An individual-differences approach. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 19:1101–1314.

Carballo Marina, F.

2007 La cuenca superior del río Santa Cruz: Las poblaciones humanas y el uso del espacio. Tesis de Doctorado, UNLP.

Carballo Marina, F., L. A. Borrero, N. V. Franco, J. B. Belardi, V. D. Horwitz, P. A. Campan, F. M. Martin, A. S. Muñoz, F. Borella, M. F. García, and J. L. Lanata

1999 Arqueología de la costa del lago Argentino, río La Leona y pampas altas intermedias. *Praehistoria* 3:13–33.

Carlsson, T.

2003 Expressing identities. Contact as a social strategy during the Mesolithic. In *Uniting Sea. Stone Age Societies in the Baltic Sea Region*, edited by C. Samuelsson and N. Ytterberg, pp. 43–50. Department of Archaeology and Ancient History, Uppsala.

Casamiquela, R. M.
1973 Alacalufes canoeros occidentales y pueblos marginales o metamórficos. *Relaciones de la Sociedad Argentina de Antropología* 7:125–143.
1991 Bosquejo de una etnología de la Patagonia austral. *Waxen* 6 (3):41–80.
Caviglia, S. E., and M. J. Figuerero Torres
1976 Material faunístico de la cueva “Las Buitreras”. *Relaciones de la Sociedad Argentina de Antropología* 10:315–319.
Chaloupka, G.
1984 *From Palaeoart to Casual Paintings*. Monograph Series 1. Northern Territory Museum of Arts and Sciences, Darwin.
1993 *Journey in Time. The World's Longest Continuing Art Tradition. The 50,000-Year Story of the Australian Aboriginal Rock Art of Arnhem Land*. Reed, Sydney.
Chapman, A.
1986 *Los Selk'nam. La vida de los Onas*. Emecé, Buenos Aires.
Charlin, J.
2007 Explorando la intensidad de uso de las materias primas líticas en Pali Aike (Prov. Santa Cruz, Argentina). *Intersecciones en Antropología* 8:287–299.
Charlin, J. E., and M. Cardillo
2005 Análisis comparativo de núcleos procedentes del extremo Sur de Patagonia continental: Materias primas y técnicas de reducción. *Magallania* 33(2):57–67.
Charlton, T. H., D. L. Nichols, and C. O. Charlton
1991 Aztec craft production and specialization: Archaeological evidence from the city-state of Otumba, Mexico. *World Archaeology* 23(1):98–114.
Chatterton, R.
2003 Star Carr reanalysed. In *Peopling the Mesolithic in a Northern Environment*, edited by L. Bevan and J. Moore, pp. 69–80. British Archaeological Reports, International Series 1157. Archaeopress, Oxford.
2006 Ritual. In *Mesolithic Britain and Ireland: New Approaches*, edited by C. Conneller and G. Warren, pp. 101–120. Tempus, Stroud.
Chiba, S., M. N. Aita, K. Tadokoro, T. Saino, H. Sugisaki, and K. Nakata
2008 From climate regime shift to lower-trophic level phenology: Synthesis of recent progress in retrospective studies of the western North Pacific. *Progress in Oceanography* 77:112–126.
Child, G.
1972 Observations on a wildebeest dieoff in Botswana. *Arnoldia* (Rhodesia) 5 (31):1–13.
Chilton, E. S.
1999 One size fits all: Typology and alternatives in New England ceramic research. In *Material Meanings: Critical Approaches to the Interpretation of Material Culture*, edited by E. S. Chilton, pp. 44–60. University of Utah Press, Salt Lake City.
Chippendale, C., and P. S. C. Taçon
1998 The many ways of dating Arnhem Land rock art, north Australia. In *The Archaeology of Rock-Art*, edited by C. Chippendale and P. S. C. Taçon (eds.) pp. 90–111. Cambridge University Press, Cambridge.

Chippendale, C., C. Smith, and P. S. C. Taçon
2000 Visions of dynamic power: Archaic rock paintings, altered states of consciousness and "Clever Men" in Western Arnhem Land (NT) Australia. *Cambridge Archaeological Journal* 10:63–101.

Clark, G.
1954 *Excavations at Star Carr: An Early Mesolithic Site at Seamer near Scarborough, Yorkshire*. Cambridge University Press, Cambridge.

Clark, J. G. D.
1975 *The Earlier Stone Age Settlement of Scandinavia*. Cambridge University Press, Cambridge.
1980 *Mesolithic Prelude*. Edinburgh University Press, Edinburgh.

Cleland, C. E.
1991 From ethnohistory to archaeology: Ottawa and Ojibwa band territories of the Northern Great Lakes. In *Text Aided Archaeology*, edited by B. J. Little, pp. 97–102. The Telford Press, Caldwell, NJ.

Coan, T.
2007 *Aventuras en Patagonia. Un viaje de exploraciones de dos misioneros norteamericanos, Noviembre 1833–Marzo 1834*. Zagier & Urruty, Buenos Aires.

Cobb, H. L., E. Coward, L. Grimshaw, and S. Price
2005 *Investigating Prehistoric Hunter-Gatherer Identities: Case Studies from Palaeolithic and Mesolithic Europe*. British Archaeological Reports, International Series 1411. Archaeopress. Oxford.

Coles, J. M.
1991 Elk and Ogopogo. Belief systems in the hunter-gatherer rock art of northern lands. *Proceedings of the Prehistoric Society* 57 (Part 1):129–148.

Cole, N., and A. Watchman
2005 AMS dating of rock art in the Laura region, Cape York Peninsula, Australia—Protocols and results of recent research. *Antiquity* 79:661–678.

Conkey, M. W.
1978 Style and information in cultural evolution. In *Advances in Archaeology*, edited by M. Schiffer, pp. 61–85. Academic Press, New York.
1980 The identification of hunter-gatherer aggregation sites—The case of Altamira. *Current Anthropology* 21(5):609–630.
1985 Ritual communication, social elaboration, and variable trajectories of Paleolithic material culture. In *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity*, edited by T. D. Price and J. A. Brown, pp. 299–324. Academic Press, Orlando.

Conkey, M. W., and C. A. Hastorf (eds.)
1990 *The Uses of Style in Archaeology*. Cambridge University Press, Cambridge.

Conneller, C. J.
2000 Fragmented space? Hunter-gatherer landscapes in the Vale of Pickering. In *New Approaches to the Palaeolithic and Mesolithic*, special issue edited by C. J. Conneller. *Archaeological Review from Cambridge* 17(1):138–147.
2003 Star Carr recontextualised. In *Peopling the Mesolithic in a Northern Environment*, edited by L. Bevan and J. Moore, pp. 81–86. British Archaeological Reports, International Series 1157. Archaeopress, Oxford.

Constantinescu, F.
2003 Obsidiana verde incrustada en un cráneo Aónikenk: ¿Tensión social intra-étnica … o interétnica? We'll never know! *Magallania* 3:149–153.
Cooper, J.
1917 Analytical and critical bibliography of the tribes of Tierra del Fuego and adjacent territory. *Bulletin 63*, Smithsonian Institution, Bureau of American Ethnology, Washington, DC.
Coughenour, M. B.
2008 Causes and consequences of herbivore movement in landscape ecosystems. In *Fragmentation in Semi-Arid and Arid Landscapes: Consequences for Human and Natural Systems*, edited by K. A. Galvin, R. S. Reid, R. H. Behnke, Jr., and N. T. Hobbs, pp. 45–91. Springer, Dordrecht, The Netherlands.
Crapo, R. H.
1976 *Big Smokey Valley Shoshoni*. Desert Research Institute Publications in the Social Sciences No. 10. Desert Research Institute, Reno and Las Vegas.
Crivelli Montero, E.
2006 Frecuencia de creación de sitios de arte rupestre en la cuenca media y superior del río Limay (Noroeste Patagónico). In *Tramas en la piedra. Producción y usos del arte rupestre*, edited by D. Fiore and M. Podestá. AINA, WAC and Sociedad Argentina de Antropología, Buenos Aires.
Cruikshank, J.
1990 Getting the words right: Perspectives on naming and places in Athapaskan oral history. *Arctic Anthropology* 27:52–65.
1995 "Pete's Song": Establishing meanings through story and song. In *When Our Words Return: Writing, Hearing and Remembering Oral Traditions of Alaska and the Yukon*, edited by P. Morrow and W. Schneider, pp. 53–75. Utah State University Press, Logan.
1998 *The Social Life of Stories: Narrative and Knowledge in the Yukon Territory*. University of Nebraska Press, Lincoln.
Cupillard, C., and Richard, A.
1998 *Les derniers Chasseurs-Cueilleurs du massif jurassien et de ses marges*. Centre Jurassien du Patrimoine, Lons-le-Saunier.
Dambach, K.
2009 Decolonizing archaeological shellfish: A view from southern New England. Paper presented at the 74th Annual Meeting of the Society for American Archaeology, Atlanta, GA.
Danchin, E., L.-A. Giraldeau, T. J. Valone, and R. H. Wagner
2004 Public information: From nosy neighbors to cultural evolution. *Science* 305: 487–491.
Dargin, W. L.
2004 The 18th and 19th Century Cree Landscape of West Central Saskatchewan: Implications for Archaeology. Ph.D. dissertation, University of Saskatchewan, Saskatoon.
Darwin, C.
1951 *Viaje de un naturalista alrededor del mundo*. El Ateneo, Buenos Aires.

David, B.
2002 *Landscapes, Rock-Art and the Dreaming: An Archaeology of Preunderstanding*. Leicester University Press, London.
Davidson, I.
1999a First people becoming Australian. *Anthropologie (Brno)* 37(1):125–141.
1999b Symbols by nature: Animal frequencies in the Upper Palaeolithic of Western Europe and the nature of symbolic representation. *Archaeology in Oceania* 34:121–131.
2010a Stone tools and the evolution of hominin and human cognition. In *Stone Tools and the Evolution of Human Cognition*, edited by A. Nowell and I. Davidson, pp. 185–205. Colorado University Press, Boulder.
2010b The colonization of Sunda and Sahul and the evolution of modern cognition. *Current Anthropology* 51:s177–s189.
Davidson, I., N. D. J. Cook, M. Fischer, M. Ridges, J. Ross, and S. A. Sutton
2005 Archaeology in another country: Exchange and symbols in North West Central Queensland. In *Many Exchanges: Archaeology, History, Community and the Work of I. McBryde*, edited by I. Macfarlane, M.-J. Mountain, and R. Paton, pp. 101–128. Aboriginal History Monographs 11. Aboriginal History Inc., Canberra.
Davidson, I. and W. C. McGrew
2005 Stone tools and the uniqueness of human culture. *Journal of the Royal Anthropological Institute* 11:793–817.
Davidson, I., and W. Noble
1992 Why the first colonisation of the Australian region is the earliest evidence of modern human behaviour. *Archaeology in Oceania* 27:135–142.
Dayley, J. P.
1989 *Tümpisa (Panamint) Shoshone Dictionary*. University of California Publications in Linguistics Vol. 116. University of California Press, Berkeley.
Deary, I.
2008 Why do intelligent people live longer? *Nature* 456:175–176.
Derrida, J.
1978 [1967] *Writing and Difference*. Trans. A. Bass. Routledge and Kegan Paul, London.
Díaz, N.
1993 Changes in the range distribution of *Hippocamelus bisulcus* in Patagonia. *Zeitschrift für Säugetierkunde* 58:344–351.
Díaz, N., A. Prieto, and G. Bahamonde
2007 Guanacos tímidos, huemules confiados: El límite occidental de los cazadores terrestres australes. *Magallania* 35(1):133–138.
Dikov, N. N.
2003 [1977] *Archaeological Sites of Kamchatka, Chukotka, and the Upper Kolyma*. Trans. R. L. Bland. U.S. Department of the Interior, National Park Service, Shared Beringian Heritage Program, Anchorage.
Dikova, T. M.
1983 *South Kamchatka Archaeology in Connection with the Ainu Occupation Problem*. Nauka, Moscow.

Dillehay, T.
1989 *Monte Verde. Late Pleistocene Settlement in Chile.* Vol. 1: *Paleoenvironment and Site Context*. Smithsonian Institution Press, Washington and London.
Dix, W.
1977 Facial representations in the Pilbara rock engravings. In *Form in Indigenous Art*, edited by P. J. Ucko, pp. 277–285. Duckworth, London.
Dolukhanov, P. M.
1986 The late Mesolithic and the transition to food production in Eastern Europe. In *Hunters in Transition*, edited by M. Zvelebil, pp. 109–120. Cambridge University Press, Cambridge.
Donahue, R. E., and W. A. Lovis
2006 Regional settlement systems in Mesolithic northern England: Scalar issues in mobility and territoriality. *Journal of Anthropological Archaeology* 25(2): 248–258.
Doring, J. (ed.)
2000 *Gwion Gwion: Secret and Sacred Pathways of the Ngarinyin Aboriginal People of Australia*. Konemann, Bonn.
Dortch, C. E.
1984 *Devil's Lair, A Study in Prehistory*. Western Australian Museum, Perth.
Dowson, T.
1998 Rock art: Handmaiden to studies of cognitive evolution. In *Cognition and Material Culture: The Archaeology of Symbolic Storage*, edited by C. Renfrew and C. Scarre, pp. 67–76. McDonald Institute Monographs, Cambridge.
Drozda, R. M.
1995 "They talked of the land with respect": Interethnic communication in the documentation of historical places and cemetery sites. In *When Our Words Return: Writing, Hearing and Remembering Oral Traditions of Alaska and the Yukon*, edited by P. Morrow and W. Schneider, pp. 99–122. Utah State University Press, Logan.
Dukas, R.
1998 *Cognitive Ecology: The Evolutionary Ecology of Information Processing and Decision Making*. University of Chicago Press, Chicago.
Dumond, D. E.
1984 Prehistory: Summary. *In Handbook of North American Indians*, Vol. 5, *Arctic*, edited by D. Damas, pp. 72–79. Smithsonian Institution, Washington, DC.
1987 *The Eskimos and Aleuts*. Rev. ed. Thames and Hudson, London.
Duncan, J. S. (ed.)
1982 *Atlas of Victoria*. A Victorian Government, Melbourne.
Duviols, J.-P.
1997 The Patagonian "Giants." In *Patagonia. Natural History, Prehistory and Ethnography at the Uttermost End of the Earth*, edited by C. McEwan, L. A. Borrero, and A. Prieto, pp. 127–139. British Museum Press, London.
Ebert, D.
2008 Aboriginal toponymy as a data source for predictive modeling: A conceptual model. Presented at the Annual Meeting of the Canadian Archaeological Association, Peterborough, Ontario, Canada. Used with permission of the author.

Ebert, J. I.
1992 *Distributional Archaeology.* University of New Mexico Press, Albuquerque.
Ebert, J. I., A. Thoma, M. C. Ebert, R. K. Hitchcock, and M. Oabile
1976 *Report and Recommendations for Land Allocations and Basarwa Development in the Sandveld Region of the Central District, Botswana*. Report to the Central District Council, Serowe, and the Ministry of Local Government and Lands, Gaborone, Botswana.
Edsman, C.-M.
1965 The hunter, the games and the unseen powers. Lappish and Finnish bear rites. In *Hunting and Fishing*, edited by H. Hvarfner, pp. 159–188. Norrbottens Museum, Sweden.
Edwards. R.
1968 Prehistoric rock engravings at Thomas Reservoir, Cleland Hills, western central Australia. *Records of the South Australian Museum* 15(4):647–670.
1971 Art and aboriginal prehistory. In *Aboriginal Man and Environment in Australia*, edited by D. J. Mulvaney and J. Golson, pp. 356–377. ANU Press, Canberra.
Eliade, M.
1972 *Shamanism: Archaic Techniques of Ecstasy*. Princeton University Press, Princeton, NJ.
Ellen, R.
1999 Models of subsistence and ethnobiological knowledge: Between extraction and cultivation in Southeast Asia. In *Folkbiology*, edited by D. L. Medin and S. Atran, pp. 91–118. MIT Press, Cambridge, MA.
Elliott, E.
1999 A Dictionary of Rincon Luiseño. Ph.D. dissertation, University of California San Diego.
Engle, R. W., M. J. Kane, and S. W. Tuholski
1999 Individual difference in working memory capacity and what they tell us about controlled attention, general fluid intelligence, and functions of the prefrontal cortex. In *Models of Working Memory: Mechanisms of Active Maintenance and Executive Control*, edited by A. Miyake and P. Shah, pp. 102–133. Cambridge University Press, Cambridge.
Engle, R. W., S. W. Tuholski, J. E. Laughlin, and A. R. A. Conway
1999 Working memory, short term memory and general fluid intelligence: A latent variable approach. *Journal of Experimental Psychology: General* 128: 309–331.
Eriksen, B. V.
2002 Fossil molluscs and exotic raw materials in late glacial and early postglacial find contexts—A complement to lithic studies. In *Lithic Raw Material Economy in Late Glacial and Postglacial Western Europe*, edited by L. E. Fischer and B. V. Eriksen, pp. 27–52. British Archaeological Reports, International Series 1093. Archaeopress, Oxford.
Evans, A. A., J. L. Langer, R. E. Donahue, Y. B. Wolframm, and W. A. Lovis
2010 Lithic raw material sourcing and the assessment of Mesolithic landscape organization and mobility strategies in northern England. *The Holocene* 20(7):1157-1163.

Evans, A. A., Y. B. Wolframm, R. E. Donahue, and W. A. Lovis

2007 The sourcing of "black chert": Implications for Mesolithic hunter-gatherer mobility strategies in northern England. *Journal of Archaeological Science* 34: 2161–2169.

Evans, N.

1988 Arguments for Pama-Nyungan as a genetic subgroup, with particular reference to initial laminalization. *Australian Linguistics* 1:90–110.

Evans, N., and R. Jones

1997 The cradle of the Pama-Nyungans: Linguistic and archaeological speculations In. *Archaeology and Linguistics: Global Perspectives on Ancient Australia*, edited by P. McConvell and N. Evans, pp. 385–415. Oxford University Press, Melbourne.

Fernández, P.

2000 Rendido a tus pies. In *Desde el país de los gigantes*, pp. 573–585. UNPA, Río Gallegos.

Fienup-Riordan, A.

1982 Navarin Basin Sociocultural Systems Baseline Analysis. Technical Report No. 70. Alaska OCS Socioeconomic Studies Program. Report on file at the Anchorage Office of the Juneau Bureau of Indian Affairs.

1983 *The Nelson Island Eskimo*. Alaska Pacific University Press, Anchorage.

1984 Regional groups on the Yukon-Kuskokwim Delta. *Inuit Studies* 8 Supplementary Issue: 63–94.

1986 *When Our Bad Season Comes: A Cultural Account of Subsistence Harvesting and Harvest Disruption on the Yukon Delta*. Alaska Anthropological Association Monograph Series No. 1.

2007 Introduction: Yup'ik and Iñupiaq literature in translation. In *Words of the Real People: Alaska Native Literature in Translation*, edited by A. Fienup-Riordan and L. Kaplan, pp. xiv–xxxiii. University of Alaska Press, Fairbanks.

Fischer, A.

2003 Exchange: Artefacts, people and ideas on the move in Mesolithic Europe. In *Mesolithic on the Move*, edited by L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund, pp. 385–387. Oxbow Books, Oxford.

Fischer, A. (ed.)

1995 Man and sea in the Mesolithic. *Proceedings of the International Symposium, Kalundborg, Denmark 1993*. Oxbow Monograph 53. Oxbow Books, Oxford.

Fitz Roy, R.

1933 [1838] *Narración de los viajes de levantamiento de los buques de S.M. "Adventure" y "Beagle" en los años 1826 a 1836; exploración de las costas meridionales de la América del Sud y viaje de circunnnavegación de la "Beagle."* 4 vols. Centro Naval, Buenos Aires.

Fitzhugh, B.

2004 Colonizing the Kodiak Archipelago: Trends in raw material use and lithic technologies at the Tanginak Spring site. *Arctic Anthropology* 41(1):14–40.

Fitzhugh, B., and D. J. Kennett

2010 Seafaring intensity and island-mainland interaction along the Pacific Coast of North America. In *Global Origins and Development of Seafaring*, edited by A. Anderson and K. Boyle. McDonald Institute, Cambridge.

Fitzhugh, B., S. Moore, C. Lockwood, and C. Boone
2004 Archaeological paleobiogeography in the Russian Far East: The Kuril Islands and Sakhalin in comparative perspective. *Asian Perspectives* 43(1): 92–121.

Fitzhugh, B., S. C. Phillips, M. Etnier, S. Anderson, J. Taylor, M. Walsh, B. MacInnes, and J. Bourgeois
2008 Report of Archaeological Field Research in 2007, including Geological Descriptions of Archaeological Locales. Kuril Biocomplexity Project unpublished project report.

Fitzhugh, B., V. Shubin, K. Tezuka, Y. Ishizuka, and C. A. S. Mandryk
2002 Archaeology in the Kuril Islands: Advances in the study of human paleobiogeography and Northwest Pacific prehistory. *Arctic Anthropology* 39(1–2): 69–94.

Fitzhugh. W. W.
1999 Ainu ethnicity: A history. In *Ainu: Spirit of a Northern People*, edited by W. W. Fitzhugh and C. O. Dubreuil, pp. 9–29. Smithsonian Institution Press, Washington, DC.

Flannery, K. V.
1972 The cultural evolution of civilizations. *Annual Review of Ecology and Systematics* 3:399–422.
1973 Archaeology with a capital "S". In *Research and Theory in Current Archaeology*, edited by C. Redman, pp. 47–53. John Wiley and Sons, New York.

Floss, H.
1994 *Rohmaterialversorgung im Paläolithikum des Mittelrheingebietes*. Römisch-Germanisches Sentralmuseum, Forschungsinstitut für Vor- und Frühgeschichte, Monograph 21. Dr. Rudolf Habelt, Bonn.

Forman, R. T. T.
1995 *Land Mosaics: The Ecology of Landscapes and Regions*. Cambridge University Press, Cambridge.

Forsberg, L.
1985 Site variability and settlement patterns: An analysis of the hunter-gatherer settlement system in the Lule River Valley, 1500 BC–BC/AD. *Archaeology and Environment* 5. Department of Archaeology, Umeå University, Umeå.

Foucault, M.
1981 *The Order of Discourse*. In *Untying the Text, A Post-Structuralist Reader*, edited by R. Young, pp. 48–78. Routledge & Kegan Paul, Boston and London.

Fowler, C. S.
1972 Comparative Numic Ethnobiology. Ph.D. dissertation, University of Utah.

Fowler, C. S., and N. J. Turner
1999 Ecological/cosmological knowledge and land management among hunter-gatherers. In *The Cambridge Encyclopedia of Hunters and Gatherers*, edited by R. B. Lee and R. Daly, pp. 419–425. Cambridge University Press, New York.

Franco, N. V., M. Cardillo, and L. A. Borrero
2005 Una primera aproximación a la variabilidad presente en las puntas denominadas "Bird IV." *Werken* 6:17–24.

Franklin, N. R.
2004 *Explorations of Variability in Australian Prehistoric Rock Engravings*. BAR International Series 1318. British Archaeological Reports, Oxford.
Frink, L.
2003 A Tale of Three Villages: Archaeological Investigation of Late Prehistoric and Historic Culture Change in Western Alaska. Ph.D. dissertation, Department of Anthropology, University of Wisconsin, Madison.
2007 Storage and status in precolonial and colonial coastal western Alaska. *Current Anthropology* 48(3):349–374.
Fuentes, A.
2006 Human-nonhuman primate interconnections and their relevance to anthropology. *Ecological and Environmental Anthropology* 2(2):1–11.
Funk, C. L.
2004 Optimal foraging theory and cognitive archaeology: Cup'ik cultural perception in southwestern Alaska. In *Hunters and Gatherers in Theory and Archaeology*, edited by G. M. Crothers, pp. 279–298. Center for Archaeological Investigations, Southern Illinois University, Carbondale.
2005 Evolutionary and Cognitive Influences on Hunter-gatherer Settlement Location in the Yukon-Kuskokwim Delta of Alaska. Ph.D. dissertation, Department of Anthropology, University of Wisconsin-Madison. University Microfilms International, Inc., Ann Arbor.
2010 The bow and arrow war days on the Yukon-Kuskokwim Delta of Alaska. *Ethnohistory* 57(4).
Galvin, K. A., R. S. Reid, R. H. Behnke, Jr., and N. T. Hobbs (eds.)
2008 *Fragmentation in Semi-Arid and Arid Landscapes: Consequences for Human and Natural Systems*. Springer, Dordrecht, The Netherlands.
Gamble, C.
1980 Information exchange in the Palaeolithic. *Nature* 283:522–523.
1982 Interaction and alliance in Palaeolithic society. *Man* 17(1):92–107.
1991 The social context for European Paleolithic art. *Proceedings of the Prehistoric Society* 57:3–15.
1993 *Timewalkers: The Prehistory of Global Colonization*. Harvard University Press, Cambridge, MA.
1998 Palaeolithic society and the release from proximity: A network approach to intimate relations. *World Archaeology* 29:426–449.
Garfinkel, A. P.
2007 *Archaeology and Rock Art of the Eastern Sierra and Great Basin Frontier*. Maturango Press, Ridgecrest, CA.
Gendel, P.
1987 Socio-stylistic analysis of lithic artefacts from the Mesolithic of northwestern Europe. In *Mesolithic Northwest Europe: Recent Trends*, edited by P. Rowley-Conwy, M. Zvelebil, and H. P. Blankholm, pp. 65–73. Charlesworth, Huddersfield.
Gibbs, M., and P. Veth
2002 Ritual engines and the archaeology of territorial ascendancy. *Tempus* 7:11–19. University of Queensland Anthropology Museum, St Lucia.

Gilberg, R.
1984 Polar Eskimo. In *Handbook of North American Indians*, Vol. 5, *Arctic*, edited by D. Damas, pp. 577–594. Smithsonian Institution, Washington, DC.
Gillespie, R.
2002 Dating the first Australians. *Radiocarbon* 44(2):455–72.
Givon, T.
1979 *Ute Dictionary*. Ute Press, Ignacio, CO.
Goldhahn, J.
2002 Roaring rocks: An audio-visual perspective on hunter-gatherer engravings in northern Sweden and Scandinavia. *Norwegian Archaeological Review* 35: 29–61.
Goldhahn, J. (ed.)
1999 *Rock Art as Social Representation*. British Archaeological Reports, International Series 794. Archaeopress, Oxford.
Golla, V.
2007 Linguistic prehistory. In *California Prehistory: Colonization, Culture and Complexity*, edited by T. L. Jones and K. A. Klar, pp. 71–82. Altamira Press, Lanham, MD.
Golledge, R.
2003 Human wayfinding and cognitive maps. In *Colonization of Unfamiliar Landscapes. The Archaeology of Adaptation*, edited by M. Rockman and J. Steele, pp. 25–43. Routledge, London.
Goloboff, P.
2005 NDM/VNDM ver. 2.7. Programs for identification of areas of endemism. Programs, documentation, and source code available at *www.zmuc.dk/public/phylogeny/endemism*.
Gómez Otero, J.
1983–1985 Investigaciones arqueológicas en las cuencas media y superior del río Gallegos. Informe Final de Beca de Perfeccionamiento, CONICET.
1986–1987 Investigaciones arqueológicas en el alero Potrok-Aike (Provincia de Santa Cruz): Una revisión sobre los períodos IV y V de Bird. *Relaciones de la Sociedad Argentina de Antropología* 17(1):173–219.
1988 Investigaciones arqueológicas binacionales en la zona fronteriza argentino-chilena (paralelo 52° S), entre el valle del río Chico y el del Gallegos Chico. Informe de Beca de Formación Superior, CONICET.
1991 Discusión sobre el límite occidental del territorio de los Proto-Tehuelches y Tehuelches meridionales en el extremo sud de Patagonia (cuenca del río Gallegos). *Waxen* 6(3):3–22.
Gould, R. A.
1969 *Yiwara: Foragers of the Australian Desert*. Collins, London and Sydney.
1977 *Puntutjarpa Rockshelter and the Australian Desert Culture*. Anthropological Papers 54. American Museum of Natural History, New York.
Gradin, C.
1999 Sobre las tendencias del arte rupestre de Patagonia argentina. In *Segundas jornadas de investigadores en arqueología y etnohistoria del centro-oeste del país*,

edited by M. Tamagnini, pp. 85–99. Universidad Nacional de Río Cuarto, Río Cuarto.

Groube, L.

1989 The taming of the rainforests: A model for late Pleistocene forest exploitation in New Guinea. In *Foraging and Farming: The Evolution of Plant Exploitation*, edited by D. R. Harris and G. C. Hillman, pp. 292–304. Unwin Hyman, London.

Groube, L., J. Chappell, J. Muke, and D. Price

1986 A 40,000 year old occupation site at Huon Peninsula, Papua New Guinea. *Nature* 324:453–455.

Guichón, R., I. Martí, E. Aspillaga, J. A. Cocilovo, and F. Rothhammer

1989–1990 El poblamiento tardío de Tierra del Fuego. *Runa* 19:27–39.

Gurina, N. N.

1956 *Oleneostrovski Mogilnik*. Materialy i Issledovaniya po Arkheologii SSSR 47.

Haberle, S. G., and B. David

2004 Climates of change: Human dimensions of Holocene environmental change in low latitudes of the PEPII transect. *Quaternary International* 118–119: 165–179.

Habgood, P. J., and N. R. Franklin

2008 The revolution that didn't arrive: A review of Pleistocene Sahul. *Journal of Human Evolution* 55:187–222.

Hacker, W. R.

1951 The Kuril and Ryukyu islands. In *Geography of the Pacifi*c, edited by O. W. Freeman, pp. 495–521. John Wiley and Sons, New York.

Hajduk A., A. Albornoz, and M. Lezcano

2004 El "Mylodon" en el patio de atrás. Informe preliminar sobre los trabajos en el sitio El Trébol, ejido urbano de San Carlos de Bariloche, Provincia de Río Negro. In *Contra Viento y Marea: Arqueología de Patagonia. V Jornadas de Arquelogía de la Patagonia*, edited by M. T. Civalero, P. M. Fernández, and A. G. Guráieb, pp. 715–731. Instituto Nacional de Antropología y Pensamiento Latinoamericano y Sociedad Argentina de Antropología, Buenos Aires.

Hällström, G.

1960 *Monumental Art of Northern Sweden from the Stone Age*. Almquist and Wiksell International, Stockholm.

Hattori, S.

2007 Variability of plant knowledge concerning vernacular names of plants and their uses among adult Baka hunter-gatherers in Cameroonian rainforests. *Journal of African Studies* 71:21–40 (Japanese with English summary).

Hayden, B.

2003 *Shamans, Sorcerers and Saints*. Smithsonian Books, Washington, DC.

Hazlewood, M.

2000 *Savage. The Life and Times of Jemmy Button*. Hodder & Stoughton, London.

Hegmon, M., and L. E. Fisher

1991 Information strategies in hunter-gatherer societies. In *Foragers in Context: Long-Term, Regional, and Historical Perspectives in Hunter-Gatherer Studies*, edited by P. T. Miracle, L. E. Fisher, and J. Brown, pp. 127–145. Michigan

Discussions in Anthropology, Department of Anthropology, University of Michigan, Ann Arbor.

Heileman, S., and I. Belkin

2008 Oyashio current LME. In *The UNEP Large Marine Ecosystem Report: A Perspective On Changing Conditions in LMEs of the World's Regional Seas*, edited by K. Sherman and G. Hempel. UNEP Regional Seas Report and Studies No. 182. United Nations Environment Programme, Nairobi.

Helbing, D., J. Keltsch, and P. Molnár

1997 Modelling the evolution of human trail systems. *Nature* 388:47–50.

Helbing, D., and P. Molnar

1995 Social force model for pedestrian dynamics. *Physical Review* E 51:4282–4286 (1995).

Helbing, D., P. Molnar, I. J. Farkas, and K. Bolay

2001 Self-organizing pedestrian movement. *Environment and Planning* B 28: 361–383.

Helms, M. W.

1988 *Ulysses' Sail: A Ethnographic Odyssey of Power, Knowedge, and Geographical Distance*. Princeton University Press, Princeton, NJ.

Helskog, K.

1985 Boats and meaning: A study of change and continuity in the Alta fjord, Arctic Norway, from 4200 to 500 years B.C. *Journal of Anthropological Archaeology* 4:177–205.

Henrich, J.

2004 Demography and cultural evolution: Why adaptive cultural processes produced maladaptive losses in Tasmania. *American Antiquity* 69:197–21.

Hernek, R.

2009 Soul-trips to the underworld? Interpretations of a decorated slate pickaxe from western Sweden. In *Mesolithic Horizons* (Vol. I), edited by S. B. McCartan, R. Schulting, G. Warren, and P. Woodman, pp. 621–626. Oxbow Books, Oxford.

Hewlett, B. S., and L. L. Cavalli-Sforza

1986 Cultural transmission among the Aka Pygmies. *American Anthropologist* 88: 922–934.

Hill, J. H.

2001 Proto-Uto-Aztecans: A community of cultivators in Mesoamerica? *American Anthropologist* 103:913–934.

2003 Proto-Uto-Aztecan and the northern devolution. In *Examining the Farming/Language Dispersal Hypothesis*, edited by P. Bellwood and C. Renfrew, pp. 331–340. McDonald Institute for Archaeological Research, Cambridge.

2008 Northern Uto-Aztecan and Kiowa-Tanoan: Evidence of contact between the protolanguages? *International Journal of American Linguistics* 74:152–185.

Hill, K., and K. Kintigh

2009 Can anthropologists distinguish good and poor hunters? Implications for hunting hypotheses, sharing conventions, and cultural transmission. *Current Anthropology* 50:369–378.

Hiscock, P., and L. Wallis
2005 Pleistocene settlement of deserts from an Australian perspective. In *Desert Peoples: Archaeological Perspectives*, edited by P. Veth, M. Smith, and P. Hiscock, pp. 58–77. Blackwell, Oxford.

Hiss, T.
1990 *The Experience of Place*. Random House, New York.

Hitchcock, R. K.
1977 *Central District Reconnaissance: Report on Visits to Two Areas, August 1–9*. Consultancy Report No. 1. Ministry of Local Government and Lands, Gaborone, Botswana.
1978 *Kalahari Cattle Posts*. Ministry of Local Government and Lands, Gaborone, Botswana.
1982 The Ethnoarchaeology of Sedentism: Mobility Strategies and Site Structure among Foraging and Food Producing Populations in the Eastern Kalahari Desert, Botswana. Ph.D. dissertation, University of New Mexico, Albuquerque.
1996 Subsistence hunting and special game licenses in Botswana. *Botswana Notes and Records* 28:55–64.
2002 "We are the first people": Land, natural resources, and identity in the central Kalahari, Botswana. *Journal of Southern African Studies* 28(4):797–824.
2004 Mobility, sedentism, and intensification: Organizational responses to environmental and social change among the San of Southern Africa. In *Processual Archaeology: Exploring Analytical Strategies, Frames of Reference, and Culture Process*, edited by A. Johnson, pp. 95–133. Praeger, Westport, CT.

Hitchcock, R. K., and W. A. Babchuk
2007 Kalahari San foraging, territoriality, and land use: Implications for the future. *Before Farming: The Archaeology and Anthropology of Hunter-Gatherers* 2007/3:169–181.

Hitchcock, R., and L. Bartram
1998 Social boundaries, technical systems, and the use of space and technology in the Kalahari. In *The Archaeology of Boundaries*, edited by M. T. Stark, pp. 12–49. Smithsonian Institution Press, Washington, DC.

Hitchcock, R. K. and R. R. B. Masilo
1995 *Subsistence Hunting and Resource Rights in Botswana*. Department of Wildlife and National Parks, Gaborone, Botswana.

Hobbs, N. T., R. S. Reid, K. A. Galvin, and J. E. Ellis
2008 Fragmentation of arid and semi-arid ecosystems: Implications for people and animals. In *Fragmentation in Semi-Arid and Arid Landscapes: Consequences for Human and Natural Systems*, edited by K. A. Galvin, R. S. Reid, R. H. Behnke, Jr. and N. T. Hobbs, pp. 25–44. Springer, Dordrecht, The Netherlands.

Hope, G.
2009 Environmental change and fire in the Owen Stanley Ranges, Papua New Guinea. *Quaternary Science Reviews* 28:2261–2276.

Hope, G., A. P. Kershaw, S. van der Kaars, S. Xiangjun, P.-M. Liew, L. E. Heusser, H. Takahara, M. McGlone, N. Miyoshi and P. T. Moss
2004 History of vegetation and habitat change in the Austral-Asian region. *Quaternary International* 118–119:103–126.

Howell, H., C.
1965 *Early Man*. Time-Life Books, New York.
Hudjashova, G., T. Kivisild, P. A. Underhill, P. Endicott, J. J. Sanchez, A. A. Lin, P. Shen, P. Oefner, C. Renfrew, R. Villems, and P. Forster
2007 Revealing the prehistoric settlement of Australia by Y chromosome and mtDNA analysis. *Proceedings of the National Academy of Sciences* 104(21): 8726–8730.
Hudson, M. J.
2004 The perverse realities of change: World system incorporation and the Okhotsk culture of Hokkaido. *Journal of Anthropological Archaeology* 23:290–308.
Hultkrantz, Å.
1986 Rock drawings as evidence of religion: Some principal points of view. In *Words and Objects, Towards a Dialogue between Archaeology and History of Religion*, edited by G. Steinsland, pp. 42–66. Norwegian University Press, Oslo.
1989 The place of shamanism in the history of religions. In *Shamanism Past and Present*, edited by M. Hoppál and O. von Sadovsky, pp. 43–52. MTA Ethnographic Institute, Budapest and Los Angeles.
Hunn, E.
1994 Place names, population density, and the magic number 500. *Current Anthropology* 35(1):81–85.
1999 Size as limiting the recognition of biodiversity in folkbiological classifications: One of four factors governing the cultural recognition of biological taxa. In *Folkbiology*, edited by D. L. Medin and S. Atran, pp. 47–70. MIT Press, Cambridge, MA.
Huoponen K., T. G. Schurr, Y.-S. Chen, and D. C. Wallace
2001 Mitochondrial DNA variation in an Aboriginal Australian population: Evidence for genetic isolation and regional differentiation. *Human Immunology* 62(9):954–969.
Hvarfner, H. (ed.)
1965 *Hunting and Fishing*. Norrbottens Museum, Denmark.
Ichikawa, M.
1982 *The Forest Hunters*. Jinbun-shoin, Kyoto (Japanese).
1983 An examination of the hunting-dependent life of the Mbuti Pygmies, eastern Zaire. *African Study Monographs* 4:55–76.
1987 Food restrictions of the Mbuti Pygmies, eastern Zaire. *African Study Monographs*, Supplementary Issue, 6:97–121.
2007 L'évitement alimentaire des viandes d'animaux sauvages chez les chasseurs-cueilleurs d'Afrique centrale. In *Le Symbolisme des animaux—L'animal "Clé de Voûte" dans la tradition orale et les interactions homme-nature*, edited by E. Dounias, E. Motte-Florac, and M. Mesnil. Colloques et Séminaires-IRD, Paris.
Ichikawa, M., and H. Terashima
1996 Cultural diversity in the use of plants by Mbuti hunter-gatherers in northeastern Zaire: An ethnobotanical approach. In *Cultural Diversity among Twentieth-Century Foragers*, edited by S. Kent, pp. 276–293. Cambridge University Press, Cambridge.

Ichikawa, M., D. Kimura, and H. Terashima
2001 AFlora: A database of traditional plant use in Africa. *Systematics and Geography of Plants* 71:749–756.
Imamura, K.
1996 *Prehistoric Japan: New Perspectives on Insular East Asia*. UCL Press, London.
Imbelloni, J.
1937–1938 Fuéguidos y Láguidos. Posición actual de la raza paleo-americana de Lagoa Santa. *Anales del Museo Argentino de ciencias naturales Bernardino Rivadavia* 39:79–103.
Ingold, T.
1986 *The Appropriation of Nature. Essay on Human Ecology and Social Relations*. Manchester University Press, Manchester.
1988 Notes on the foraging mode of production. In *Hunters and Gatherers*, Vol. 1: *History, Evolution, and Social Change*, edited by T. Ingold, D. Riches, and J. Woodburn, pp. 269–286. Berg, Oxford.
2000 *The Perception of the Environment, Essays in Livelihood, Dwelling, and Skill*. Routledge, New York.
Isaac, G.
1981 Stone Age visiting cards: Approaches to the study of early land-use patterns. In *Pattern of the Past*, edited by I. Hodder, G. Isaac, and N. Hammond, pp. 131–155. Cambridge University Press, Cambridge.
Ishizuka, Y.
2001 Volcanic activity and recent tephras in the Kuril Islands: Field result during the International Kuril Island Project (IKIP) 2000. Report on file with Ben Fitzhugh (Project PI), University of Washington. Available at: *http://www.anthro.washington.edu/Archy/IKIP/Geology/volcanismindex.htm*.
Istomin, K. V., and M. J. Dwyer
2009 Finding the way. *Currrent Anthropology* 50(1):29–49.
Jablonka, E., and M. Lamb
2006 The evolution of information in the major transitions. *Journal of Theoretical Biology* 239:236–246.
Jacobi, R.
1979 Early Flandrian hunters in the South West. *Proceedings of the Devon Archaeological Society* 37:48–93.
Jacobs, M.
1981 *The Tropical Rain Forest: A First Encounter.* Springer-Verlag, Berlin.
James, H. V. A., and M. D. Petraglia
2005 Modern human origins and the evolution of behavior in the later Pleistocene record of South Asia. *Current Anthropology* 46:S3–S27.
Jochim, M. A.
1983 Palaeolithic cave art in ecological perspective. In *Hunter-Gatherer Economy in Prehistory: A European Perspective*, edited by G. Bailey, pp. 212–219. Advances in Archaeological Method and Theory. Cambridge University Press, Cambridge.

2008 The Mesolithic of the Upper Danube and Upper Rhine. In *Mesolithic Europe*, edited by G. Bailey and P. Spikins, pp. 203–220. Cambridge University Press, Cambridge.

Johnson, C. N.

2005 What can the data on late survival of Australian megafauna tell us about the cause of their extinction? *Quaternary Science Reviews* 24:2167–2172.

Johnson, G. A.

1978 Information sources and the development of decision-making organizations. In *Social Archeology: Beyond Subsistence and Dating*, edited by C. L. Redman, M. J. Berman, E. V. Curtin, and W. J. Langhorne, pp. 87–112. Academic Press, New York.

Johnson, L.

1976 Informe sobre propspección arqueológica en Magallanes. *Anales del Instituto de la Patagonia* 7:87–94.

Johnston, H., and P. Clark

1998 Willandra Lakes archaeological investigations 1968–98. *Archaeology in Oceania* 33(3):105–119.

Jordan, P. D.

2001 The materiality of shamanism as a "world-view": Praxis, artefacts and landscape. In *The Archaeology of Shamanism*, edited by N. Price, pp. 87–104. Routledge, London.

2006 Analogy. In *Mesolithic Britain and Ireland*, edited by C. Conneller and G. Warren, pp. 83–100. Stroud, Tempus.

Jordan, P., and M. Zvelebil (eds.)

2010 *Ceramics before Farming, The Dispersal of Pottery among Prehistoric Eurasian Hunters and Gatherers*. Left Coast Press, Walnut Creek, CA.

Just, M. A., and P. Carpenter

1992 A capacity theory of comprehension: Individual differences in working memory. *Psychological Review* 99:122–149.

Kador, T.

2009 Prehistoric chain reactions—Stories that help us understand the distant past. In *From Bann Flakes to Bushmills*, edited by N. Finlay, S. McCartan, N. Milner, and C. Wickham-Jones, pp. 31–42. Oxbow Books, Oxford.

Kamei, N.

2006 Play among Baka children in Cameroon. In *Hunter-Gatherer Childhoods*, edited by B. S. Hewlett and M. E. Lamb, pp. 343–359. Aldine Transaction, New Brunswick and London.

Kaplan, H., and K. Hill

1992 The evolutionary ecology of food acquisition. In *Evolutionary Ecology and Human Behavior*, edited by E. A. Smith and B. Winterhalder, pp. 167–201. Aldine de Gruyter, Hawthorn, NY.

Kasai, H., T. Ono, and K. Hirakawa

2009 Seasonal variability of primary production off Abashiri, the southern Okhotsk Sea. In *Proceedings of the Fourth Workshop on the Okhotsk Sea and Adjacent Areas of the North Pacific*, edited by M. Kashiwai and G. A. Kantakov. PICES Scientific Report No. 36, pp. 68–71.

Kasper, K., and H. M. Wobst (organizers)
2009 Indigenous materialities and archaeological analysis in the Eastern Woodlands. Symposium. Annual Meeting of the Society for American Archaeology, Atlanta.

Kay, C. E.
2007 Were native people keystone predators? A continuous-time analysis of wildlife observations made by Lewis and Clark in 1804–1806. *The Canadian Field Naturalist* 121(1):1–16.

Keen, I.
2004 *Aboriginal Economy and Society: Australia at the Threshold of Colonisation*. Oxford University Press, Oxford.

Kelly, R. L.
1995 *The Foraging Spectrum. Diversity in Hunter-Gatherer Lifeways*. Smithsonian Institution Press, Washington, DC.
2003 Colonization of new land by hunter-gatherers. Expectations and implications based on ethnographic data. In *Colonization of Unfamiliar Landscapes. The Archaeology of Adaptation*, edited by M. Rockman and J. Steele. Routledge, London.

Kikuchi, T.
1999 Ainu ties with ancient cultures of Northeast Asia. In *Ainu: Spirit of a Northern People*, edited by W. W. Fitzhugh and C. O. Dubreuil, pp. 47–51. Smithsonian Institution Press, Washington, DC.

Kilgour, B., and L. Hatch (compilers)
2002 *Australian Bathymetry and Topography Images*. Digital datasets. Geoscience Australia, Canberra.

Klar, K.
1977 Topics in Historical Chumash Grammar. Ph.D. dissertation, University of California Berkeley.

Knutsson, K., P. Falkenström, and K.-F. Lindberg
2003 Appropriation of the past. Neolithisation in the northern Scandinavian perspective. In *Mesolithic on the Move*, edited by L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund, pp. 414–430. Oxbow Books, Oxford.

Kono, M., and W. W. Fitzhugh
1999 Ainu and Northwest Coast peoples: A comparison. In *Ainu: Spirit of a Northern People*, edited by W. W. Fitzhugh and C. O. Dubreuil, pp. 116–124. Smithsonian Institution Press, Washington, DC.

Kornfeld, M., and A. J. Osborn, (eds.)
2003 *Islands on the Plains: Ecological, Social, and Ritual Use of Landscapes*. University of Utah Press, Salt Lake City.

Krasheninnikov, S. P.
1972 *Explorations of Kamchatka, 1735–1741*. Translation by E. A. P. Crownhart-Vaughan of the original 1955 Russian publication. Oregon Historical Society, Portland.

Kristan-Graham, C.
1993 The business of narrative at Tula: An analysis of the Vestibule Frieze, trade, and ritual. *Latin American Antiquity* 4(1):2–21.

Kroeber, A. L.
1925 [1976] *Handbook of the Indians of California*. Dover Publications, Inc., New York.
1963 *Yokuts Dialect Survey*. Anthropological Records Vol. 11, No. 3. University of California Press, Berkeley and Los Angeles.
Kuhn, S. L., M. C. Stiner, D. S. Reese, and E. Gulec
2001 Ornaments of the earliest Upper Palaeolithic: New insights from the Levant. *Proceedings of the National Academy of the Sciences of the United States of America* 98(13):7641–7646.
Lake, M.
2001 The use of pedestrian modelling in archaeology, with an example from the study of cultural learning. *Environment and Planning B*: 28:385–403.
Lampert, R.
1981 *The Great Kartan Mystery*. Terra Australis 5. Department of Prehistory, Research School of Pacific Studies, ANU, Canberra.
Lane, P., A. Reid, and A. Segobye
1998 *Ditswa Mmung: The Archaeology of Botswana*. Pula Press and the Botswana Society, Gaborone.
Langer, J. L.
2007 Characterisation of Black Chert from Northern England Using LA-ICP-MS. Master's dissertation, Department of Archaeological Sciences, University of Bradford, Bradford, UK.
Langer, J. L., A. A. Evans, Y. B. Wolframm, R. E. Donahue, and W. A. Lovis
2008 Black chert sourcing and implications for assessing hunter-gatherer mobility strategies in northern England. Paper presented at the 73rd Annual Meeting of the Society for American Archaeology, Vancouver.
Larsson. L.
1989 Ethnicity and traditions in Mesolithic mortuary practices of southern Scandinavia. In *Archaeological Approaches to Cultural Identity*, edited by S. J. Shennan, pp. 210–218. Unwin Hyman, London.
1990 Dogs in fraction—Symbols in action. In *Contributions to the Mesolithic in Europe. Papers Presented at the Fourth International Symposium "The Mesolithic in Europe,"* edited by P. M. Vermeersch and P. Van Peer, pp. 153–160. Leuven University Press, Leuven.
2004 The Mesolithic period in southern Scandinavia: With special reference to burials and cemeteries. In *Mesolithic Scotland and Its Neighbours*, edited by A. Saville, pp. 371–392. Society of Antiquaries Scotland, Edinburgh.
Larsson, L., and I. Zagorska (eds.)
2006 Back to the origin. New research in the Mesolithic-Neolithic Zvejniecki cemetery and environment, northern Latvia. *Acta Archaeologica Lundensia*, Series in 8°, 52. Almqvist and Wiksell International, Stockholm.
Larsson, L., H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund (eds.)
2003 *Mesolithic on the Move*. Oxbow Books, Oxford.
Leacock, E.
1954 The Montagnais "hunting territory" and the fur trade. Memoir 78. *American Anthropologist* 56(5), Part 2.

1955 Matrilocality in a simple hunting economy (Montagnais-Naskapi). *Southwestern Journal of Anthropology* 11(1):31–47.

1969 The Montagnais-Naskapi Band. In *Contributions to Anthropology: Band Societies*, edited by D. Damas, pp. 1–18. Bulletin 228. National Museums of Canada, Ottawa.

Leavesley, M.

2007 A shark-tooth ornament from Pleistocene Sahul. *Antiquity* 81:308–315.

Lee, R. B.

1968 What hunters do for a living, or, how to make out on scarce resources. In *Man the Hunter*, edited by R. B. Lee and I. DeVore, pp. 30–48. Aldine, Chicago.

1969 !Kung Bushmen subsistence: An input-output analysis. In *Contributions to Anthropology: Ecological Essays*, edited by D. Damas, pp. 73–94. National Museums of Canada, Ottawa.

1979 *The !Kung San: Men, Women, and Work in a Foraging Society*. Cambridge University Press, Cambridge.

Lee, R. B., and I. DeVore (eds.)

1968 *Man the Hunter*. Aldine, Chicago.

Legoupil, D.

1989 *Ethno-archéologie dans les archipels de Patagonie: Les nomads de Punta Baja*. Recherche sur les Civilisations, Paris.

1997 *Bahía Colorada (Ile Englefield)*. Recherche sur les Civilisations, Paris.

2003 Cazadores recolectores de Ponsonby (Patagonia Austral) y su paleoambiente desde el milenio VI al III milenio J.-C. *Magallania* 31. Punta Arenas.

Legoupil, D., and A. Prieto

1991 Sepultura de niños canoeros en un abrigo pintado en Ultima Esperanza. *Anales del Instituto de la Patagonia* 20:133–138.

Legros, D.

1985 Wealth, poverty, and slavery among XIXth century Tutchone Athapaskan. *Research in Economic Anthropology* 7:37–64.

Leonov, A.

1990 *The Sea of Okhotsk*. National Technological Information Service, Springfield, VA.

Leroi-Gourhan, A.

1964 *Le geste et la parole 1: Technique et langage*. Albin Michel, Paris.

1973 *Le geste et la parole*. Japanese translation by T. Araki. Shinchosha, Tokyo.

Levi-Strauss, C.

1966 *The Savage Mind*. Weidenfeld and Nicholson, London.

Lewis, D.

1988 *The Rock Paintings of Arnhem Land, Australia: Social, Ecological and Material Culture Change in the Post-Glacial Period*. BAR International Series 415. Oxford.

Lewis, J.

2008 Ekila: Blood, bodies and egalitarian societies. *Journal of the Royal Anthropological Institute* (N.S.) 14:297–315.

Lewis Williams, J., and T. Dowson

1988 The signs of all times: Entoptic phenomena in Upper Palaeolithic Art. *Current Anthropology* 29:201–245.

L'Heureux, G. L.
2008 La arqueofauna del Campo Volcánico Pali Aike. *Magallania* 36(1):65–78.
Liebenberg, L.
2001 *The Art of Tracking: The Origin of Science*. David Philip, Cape Town.
Lightfoot, K. G., and O. Parrish
2009 *California Indians and Their Environment: An Introduction*. University of California Press, Berkeley.
Lindgren, C.
2009 Between the rock and the sea: Site location and ritual practise in the Mesolithic in eastern central Sweden. In *Mesolithic Horizons* (Vol. I), edited by S. B. McCartan, R. Schulting, G. Warren and P. Woodman, pp. 610–613. Oxbow Books, Oxford.
Lindqvist, C.
1994 *Fångstfolkets Bilder*. Theses and Papers in Archaeology, N.S. A5 (monograph). Stockholm.
Livingstone, D.
1857 *Missionary Travels and Researches in South Africa*. John Murray, London.
Llobera, N.
2000 Understanding movement: A pilot model towards the sociology of movement. In *Beyond the Map: Archaeology and Space Technologies*, edited by G. Lock, pp. 65–84. IOS Press, Amsterdam.
Lødøen, T.
2009 Confronting important animals. In *Mesolithic Horizons* (Vol. I), edited by S. B. McCartan, R. Schulting, G. Warren, and P. Woodman, pp. 576–582. Oxbow Books, Oxford.
Loether, C.
1998 Yokuts and Miwok loanwords in Western Mono. In *The Life of Language, Papers in Linguistics in Honor of WIlliam Bright*, edited by J. H. Hill, P.-J. Mistry, and L. Campbell, pp. 100–121. Mouton de Gruyter, Berlin.
Lourandos, H.
1983 Intensification. A late Pleistocene – Holocene archaeological sequence from Southwestern Victoria. *Archaeology in Oceania* 18: 81-94.
Lovis, W. A., R. E. Donahue, and M. B. Holman
2005 Long distance logistic mobility as an organizing principle among northern hunter-gatherers: A Great Lakes Middle Holocene settlement system. *American Antiquity* 70:669–693.
Loze, I.
1998 The adoption of agriculture in the area of present-day Latvia (the Lake Lubana Basin). *Baltic-Pontic Studies* 5:59–84.
Lucier, C. V., and J. W. VanStone
1995 Traditional beluga drives of the Inupiat. *Fieldiana: Anthropology* (n.s.) 25. Field Museum, Chicago.
MacDouall, J.
1833 *Narrative of the Voyage to Patagonia and Terra del Fuego through the Straits of Magellan, in H.M.S. Adventure and Beagle, in 1826 and 1827*. Renshaw and Rush, London.

Hiscock, P., and L. Wallis
2005 Pleistocene settlement of deserts from an Australian perspective. In *Desert Peoples: Archaeological Perspectives*, edited by P. Veth, M. Smith, and P. Hiscock, pp. 58–77. Blackwell, Oxford.

Hiss, T.
1990 *The Experience of Place*. Random House, New York.

Hitchcock, R. K.
1977 *Central District Reconnaissance: Report on Visits to Two Areas, August 1–9*. Consultancy Report No. 1. Ministry of Local Government and Lands, Gaborone, Botswana.
1978 *Kalahari Cattle Posts*. Ministry of Local Government and Lands, Gaborone, Botswana.
1982 The Ethnoarchaeology of Sedentism: Mobility Strategies and Site Structure among Foraging and Food Producing Populations in the Eastern Kalahari Desert, Botswana. Ph.D. dissertation, University of New Mexico, Albuquerque.
1996 Subsistence hunting and special game licenses in Botswana. *Botswana Notes and Records* 28:55–64.
2002 "We are the first people": Land, natural resources, and identity in the central Kalahari, Botswana. *Journal of Southern African Studies* 28(4):797–824.
2004 Mobility, sedentism, and intensification: Organizational responses to environmental and social change among the San of Southern Africa. In *Processual Archaeology: Exploring Analytical Strategies, Frames of Reference, and Culture Process*, edited by A. Johnson, pp. 95–133. Praeger, Westport, CT.

Hitchcock, R. K., and W. A. Babchuk
2007 Kalahari San foraging, territoriality, and land use: Implications for the future. *Before Farming: The Archaeology and Anthropology of Hunter-Gatherers* 2007/3:169–181.

Hitchcock, R., and L. Bartram
1998 Social boundaries, technical systems, and the use of space and technology in the Kalahari. In *The Archaeology of Boundaries*, edited by M. T. Stark, pp. 12–49. Smithsonian Institution Press, Washington, DC.

Hitchcock, R. K. and R. R. B. Masilo
1995 *Subsistence Hunting and Resource Rights in Botswana*. Department of Wildlife and National Parks, Gaborone, Botswana.

Hobbs, N. T., R. S. Reid, K. A. Galvin, and J. E. Ellis
2008 Fragmentation of arid and semi-arid ecosystems: Implications for people and animals. In *Fragmentation in Semi-Arid and Arid Landscapes: Consequences for Human and Natural Systems*, edited by K. A. Galvin, R. S. Reid, R. H. Behnke, Jr. and N. T. Hobbs, pp. 25–44. Springer, Dordrecht, The Netherlands.

Hope, G.
2009 Environmental change and fire in the Owen Stanley Ranges, Papua New Guinea. *Quaternary Science Reviews* 28:2261–2276.

Hope, G., A. P. Kershaw, S. van der Kaars, S. Xiangjun, P.-M. Liew, L. E. Heusser, H. Takahara, M. McGlone, N. Miyoshi and P. T. Moss
2004 History of vegetation and habitat change in the Austral-Asian region. *Quaternary International* 118–119:103–126.

Howell, H., C.
1965 *Early Man*. Time-Life Books, New York.
Hudjashova, G., T. Kivisild, P. A. Underhill, P. Endicott, J. J. Sanchez, A. A. Lin, P. Shen, P. Oefner, C. Renfrew, R. Villems, and P. Forster
2007 Revealing the prehistoric settlement of Australia by Y chromosome and mtDNA analysis. *Proceedings of the National Academy of Sciences* 104(21): 8726–8730.
Hudson, M. J.
2004 The perverse realities of change: World system incorporation and the Okhotsk culture of Hokkaido. *Journal of Anthropological Archaeology* 23:290–308.
Hultkrantz, Å.
1986 Rock drawings as evidence of religion: Some principal points of view. In *Words and Objects, Towards a Dialogue between Archaeology and History of Religion*, edited by G. Steinsland, pp. 42–66. Norwegian University Press, Oslo.
1989 The place of shamanism in the history of religions. In *Shamanism Past and Present*, edited by M. Hoppál and O. von Sadovsky, pp. 43–52. MTA Ethnographic Institute, Budapest and Los Angeles.
Hunn, E.
1994 Place names, population density, and the magic number 500. *Current Anthropology* 35(1):81–85.
1999 Size as limiting the recognition of biodiversity in folkbiological classifications: One of four factors governing the cultural recognition of biological taxa. In *Folkbiology*, edited by D. L. Medin and S. Atran, pp. 47–70. MIT Press, Cambridge, MA.
Huoponen K., T. G. Schurr, Y.-S. Chen, and D. C. Wallace
2001 Mitochondrial DNA variation in an Aboriginal Australian population: Evidence for genetic isolation and regional differentiation. *Human Immunology* 62(9):954–969.
Hvarfner, H. (ed.)
1965 *Hunting and Fishing*. Norrbottens Museum, Denmark.
Ichikawa, M.
1982 *The Forest Hunters*. Jinbun-shoin, Kyoto (Japanese).
1983 An examination of the hunting-dependent life of the Mbuti Pygmies, eastern Zaire. *African Study Monographs* 4:55–76.
1987 Food restrictions of the Mbuti Pygmies, eastern Zaire. *African Study Monographs*, Supplementary Issue, 6:97–121.
2007 L'évitement alimentaire des viandes d'animaux sauvages chez les chasseurs-cueilleurs d'Afrique centrale. In *Le Symbolisme des animaux—L'animal "Clé de Voûte" dans la tradition orale et les interactions homme-nature*, edited by E. Dounias, E. Motte-Florac, and M. Mesnil. Colloques et Séminaires-IRD, Paris.
Ichikawa, M., and H. Terashima
1996 Cultural diversity in the use of plants by Mbuti hunter-gatherers in northeastern Zaire: An ethnobotanical approach. In *Cultural Diversity among Twentieth-Century Foragers*, edited by S. Kent, pp. 276–293. Cambridge University Press, Cambridge.

Ichikawa, M., D. Kimura, and H. Terashima
2001 AFlora: A database of traditional plant use in Africa. *Systematics and Geography of Plants* 71:749–756.
Imamura, K.
1996 *Prehistoric Japan: New Perspectives on Insular East Asia*. UCL Press, London.
Imbelloni, J.
1937–1938 Fuéguidos y Láguidos. Posición actual de la raza paleo-americana de Lagoa Santa. *Anales del Museo Argentino de ciencias naturales Bernardino Rivadavia* 39:79–103.
Ingold, T.
1986 *The Appropriation of Nature. Essay on Human Ecology and Social Relations*. Manchester University Press, Manchester.
1988 Notes on the foraging mode of production. In *Hunters and Gatherers*, Vol. 1: *History, Evolution, and Social Change*, edited by T. Ingold, D. Riches, and J. Woodburn, pp. 269–286. Berg, Oxford.
2000 *The Perception of the Environment, Essays in Livelihood, Dwelling, and Skill*. Routledge, New York.
Isaac, G.
1981 Stone Age visiting cards: Approaches to the study of early land-use patterns. In *Pattern of the Past*, edited by I. Hodder, G. Isaac, and N. Hammond, pp. 131–155. Cambridge University Press, Cambridge.
Ishizuka, Y.
2001 Volcanic activity and recent tephras in the Kuril Islands: Field result during the International Kuril Island Project (IKIP) 2000. Report on file with Ben Fitzhugh (Project PI), University of Washington. Available at: *http://www.anthro.washington.edu/Archy/IKIP/Geology/volcanismindex.htm*.
Istomin, K. V., and M. J. Dwyer
2009 Finding the way. *Currrent Anthropology* 50(1):29–49.
Jablonka, E., and M. Lamb
2006 The evolution of information in the major transitions. *Journal of Theoretical Biology* 239:236–246.
Jacobi, R.
1979 Early Flandrian hunters in the South West. *Proceedings of the Devon Archaeological Society* 37:48–93.
Jacobs, M.
1981 *The Tropical Rain Forest: A First Encounter.* Springer-Verlag, Berlin.
James, H. V. A., and M. D. Petraglia
2005 Modern human origins and the evolution of behavior in the later Pleistocene record of South Asia. *Current Anthropology* 46:S3–S27.
Jochim, M. A.
1983 Palaeolithic cave art in ecological perspective. In *Hunter-Gatherer Economy in Prehistory: A European Perspective*, edited by G. Bailey, pp. 212–219. Advances in Archaeological Method and Theory. Cambridge University Press, Cambridge.

2008 The Mesolithic of the Upper Danube and Upper Rhine. In *Mesolithic Europe*, edited by G. Bailey and P. Spikins, pp. 203–220. Cambridge University Press, Cambridge.

Johnson, C. N.

2005 What can the data on late survival of Australian megafauna tell us about the cause of their extinction? *Quaternary Science Reviews* 24:2167–2172.

Johnson, G. A.

1978 Information sources and the development of decision-making organizations. In *Social Archeology: Beyond Subsistence and Dating*, edited by C. L. Redman, M. J. Berman, E. V. Curtin, and W. J. Langhorne, pp. 87–112. Academic Press, New York.

Johnson, L.

1976 Informe sobre propspección arqueológica en Magallanes. *Anales del Instituto de la Patagonia* 7:87–94.

Johnston, H., and P. Clark

1998 Willandra Lakes archaeological investigations 1968–98. *Archaeology in Oceania* 33(3):105–119.

Jordan, P. D.

2001 The materiality of shamanism as a "world-view": Praxis, artefacts and landscape. In *The Archaeology of Shamanism*, edited by N. Price, pp. 87–104. Routledge, London.

2006 Analogy. In *Mesolithic Britain and Ireland*, edited by C. Conneller and G. Warren, pp. 83–100. Stroud, Tempus.

Jordan, P., and M. Zvelebil (eds.)

2010 *Ceramics before Farming, The Dispersal of Pottery among Prehistoric Eurasian Hunters and Gatherers*. Left Coast Press, Walnut Creek, CA.

Just, M. A., and P. Carpenter

1992 A capacity theory of comprehension: Individual differences in working memory. *Psychological Review* 99:122–149.

Kador, T.

2009 Prehistoric chain reactions—Stories that help us understand the distant past. In *From Bann Flakes to Bushmills*, edited by N. Finlay, S. McCartan, N. Milner, and C. Wickham-Jones, pp. 31–42. Oxbow Books, Oxford.

Kamei, N.

2006 Play among Baka children in Cameroon. In *Hunter-Gatherer Childhoods*, edited by B. S. Hewlett and M. E. Lamb, pp. 343–359. Aldine Transaction, New Brunswick and London.

Kaplan, H., and K. Hill

1992 The evolutionary ecology of food acquisition. In *Evolutionary Ecology and Human Behavior*, edited by E. A. Smith and B. Winterhalder, pp. 167–201. Aldine de Gruyter, Hawthorn, NY.

Kasai, H., T. Ono, and K. Hirakawa

2009 Seasonal variability of primary production off Abashiri, the southern Okhotsk Sea. In *Proceedings of the Fourth Workshop on the Okhotsk Sea and Adjacent Areas of the North Pacific*, edited by M. Kashiwai and G. A. Kantakov. PICES Scientific Report No. 36, pp. 68–71.

Kasper, K., and H. M. Wobst (organizers)
2009 Indigenous materialities and archaeological analysis in the Eastern Woodlands. Symposium. Annual Meeting of the Society for American Archaeology, Atlanta.
Kay, C. E.
2007 Were native people keystone predators? A continuous-time analysis of wildlife observations made by Lewis and Clark in 1804–1806. *The Canadian Field Naturalist* 121(1):1–16.
Keen, I.
2004 *Aboriginal Economy and Society: Australia at the Threshold of Colonisation*. Oxford University Press, Oxford.
Kelly, R. L.
1995 *The Foraging Spectrum. Diversity in Hunter-Gatherer Lifeways*. Smithsonian Institution Press, Washington, DC.
2003 Colonization of new land by hunter-gatherers. Expectations and implications based on ethnographic data. In *Colonization of Unfamiliar Landscapes. The Archaeology of Adaptation*, edited by M. Rockman and J. Steele. Routledge, London.
Kikuchi, T.
1999 Ainu ties with ancient cultures of Northeast Asia. In *Ainu: Spirit of a Northern People*, edited by W. W. Fitzhugh and C. O. Dubreuil, pp. 47–51. Smithsonian Institution Press, Washington, DC.
Kilgour, B., and L. Hatch (compilers)
2002 *Australian Bathymetry and Topography Images*. Digital datasets. Geoscience Australia, Canberra.
Klar, K.
1977 Topics in Historical Chumash Grammar. Ph.D. dissertation, University of California Berkeley.
Knutsson, K., P. Falkenström, and K.-F. Lindberg
2003 Appropriation of the past. Neolithisation in the northern Scandinavian perspective. In *Mesolithic on the Move*, edited by L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund, pp. 414–430. Oxbow Books, Oxford.
Kono, M., and W. W. Fitzhugh
1999 Ainu and Northwest Coast peoples: A comparison. In *Ainu: Spirit of a Northern People*, edited by W. W. Fitzhugh and C. O. Dubreuil, pp. 116–124. Smithsonian Institution Press, Washington, DC.
Kornfeld, M., and A. J. Osborn, (eds.)
2003 *Islands on the Plains: Ecological, Social, and Ritual Use of Landscapes*. University of Utah Press, Salt Lake City.
Krasheninnikov, S. P.
1972 *Explorations of Kamchatka, 1735–1741*. Translation by E. A. P. Crownhart-Vaughan of the original 1955 Russian publication. Oregon Historical Society, Portland.
Kristan-Graham, C.
1993 The business of narrative at Tula: An analysis of the Vestibule Frieze, trade, and ritual. *Latin American Antiquity* 4(1):2–21.

Kroeber, A. L.
1925 [1976] *Handbook of the Indians of California*. Dover Publications, Inc., New York.
1963 *Yokuts Dialect Survey*. Anthropological Records Vol. 11, No. 3. University of California Press, Berkeley and Los Angeles.

Kuhn, S. L., M. C. Stiner, D. S. Reese, and E. Gulec
2001 Ornaments of the earliest Upper Palaeolithic: New insights from the Levant. *Proceedings of the National Academy of the Sciences of the United States of America* 98(13):7641–7646.

Lake, M.
2001 The use of pedestrian modelling in archaeology, with an example from the study of cultural learning. *Environment and Planning B*: 28:385–403.

Lampert, R.
1981 *The Great Kartan Mystery*. Terra Australis 5. Department of Prehistory, Research School of Pacific Studies, ANU, Canberra.

Lane, P., A. Reid, and A. Segobye
1998 *Ditswa Mmung: The Archaeology of Botswana*. Pula Press and the Botswana Society, Gaborone.

Langer, J. L.
2007 Characterisation of Black Chert from Northern England Using LA-ICP-MS. Master's dissertation, Department of Archaeological Sciences, University of Bradford, Bradford, UK.

Langer, J. L., A. A. Evans, Y. B. Wolframm, R. E. Donahue, and W. A. Lovis
2008 Black chert sourcing and implications for assessing hunter-gatherer mobility strategies in northern England. Paper presented at the 73rd Annual Meeting of the Society for American Archaeology, Vancouver.

Larsson. L.
1989 Ethnicity and traditions in Mesolithic mortuary practices of southern Scandinavia. In *Archaeological Approaches to Cultural Identity*, edited by S. J. Shennan, pp. 210–218. Unwin Hyman, London.
1990 Dogs in fraction—Symbols in action. In *Contributions to the Mesolithic in Europe. Papers Presented at the Fourth International Symposium "The Mesolithic in Europe*," edited by P. M. Vermeersch and P. Van Peer, pp. 153–160. Leuven University Press, Leuven.
2004 The Mesolithic period in southern Scandinavia: With special reference to burials and cemeteries. In *Mesolithic Scotland and Its Neighbours*, edited by A. Saville, pp. 371–392. Society of Antiquaries Scotland, Edinburgh.

Larsson, L., and I. Zagorska (eds.)
2006 Back to the origin. New research in the Mesolithic-Neolithic Zvejniecki cemetery and environment, northern Latvia. *Acta Archaeologica Lundensia*, Series in 8°, 52. Almqvist and Wiksell International, Stockholm.

Larsson, L., H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund (eds.)
2003 *Mesolithic on the Move*. Oxbow Books, Oxford.

Leacock, E.
1954 The Montagnais "hunting territory" and the fur trade. Memoir 78. *American Anthropologist* 56(5), Part 2.

1955 Matrilocality in a simple hunting economy (Montagnais-Naskapi). *Southwestern Journal of Anthropology* 11(1):31–47.

1969 The Montagnais-Naskapi Band. In *Contributions to Anthropology: Band Societies*, edited by D. Damas, pp. 1–18. Bulletin 228. National Museums of Canada, Ottawa.

Leavesley, M.

2007 A shark-tooth ornament from Pleistocene Sahul. *Antiquity* 81:308–315.

Lee, R. B.

1968 What hunters do for a living, or, how to make out on scarce resources. In *Man the Hunter*, edited by R. B. Lee and I. DeVore, pp. 30–48. Aldine, Chicago.

1969 !Kung Bushmen subsistence: An input-output analysis. In *Contributions to Anthropology: Ecological Essays*, edited by D. Damas, pp. 73–94. National Museums of Canada, Ottawa.

1979 *The !Kung San: Men, Women, and Work in a Foraging Society*. Cambridge University Press, Cambridge.

Lee, R. B., and I. DeVore (eds.)

1968 *Man the Hunter*. Aldine, Chicago.

Legoupil, D.

1989 *Ethno-archéologie dans les archipels de Patagonie: Les nomads de Punta Baja*. Recherche sur les Civilisations, Paris.

1997 *Bahía Colorada (Ile Englefield)*. Recherche sur les Civilisations, Paris.

2003 Cazadores recolectores de Ponsonby (Patagonia Austral) y su paleoambiente desde el milenio VI al III milenio J.-C. *Magallania* 31. Punta Arenas.

Legoupil, D., and A. Prieto

1991 Sepultura de niños canoeros en un abrigo pintado en Ultima Esperanza. *Anales del Instituto de la Patagonia* 20:133–138.

Legros, D.

1985 Wealth, poverty, and slavery among XIXth century Tutchone Athapaskan. *Research in Economic Anthropology* 7:37–64.

Leonov, A.

1990 *The Sea of Okhotsk*. National Technological Information Service, Springfield, VA.

Leroi-Gourhan, A.

1964 *Le geste et la parole 1: Technique et langage*. Albin Michel, Paris.

1973 *Le geste et la parole*. Japanese translation by T. Araki. Shinchosha, Tokyo.

Levi-Strauss, C.

1966 *The Savage Mind*. Weidenfeld and Nicholson, London.

Lewis, D.

1988 *The Rock Paintings of Arnhem Land, Australia: Social, Ecological and Material Culture Change in the Post-Glacial Period*. BAR International Series 415. Oxford.

Lewis, J.

2008 Ekila: Blood, bodies and egalitarian societies. *Journal of the Royal Anthropological Institute* (N.S.) 14:297–315.

Lewis Williams, J., and T. Dowson

1988 The signs of all times: Entoptic phenomena in Upper Palaeolithic Art. *Current Anthropology* 29:201–245.

O'Connor, S., and P. Veth
2006 Revisiting the past: Changing interpretations of Pleistocene settlement subsistence and demography in northern Australia. In *Archaeology of Oceania: Australia and the Pacific Islands*, edited by I. Lilley, pp. 31–47. Blackwell Publishing, Carlton.

O'Connor, S., and P. Veth (eds.)
2000 East of Wallace's Line: Studies of past and present maritime cultures in the Indo-Pacific region. *Modern Quaternary Research in South East Asia* 16: V–VI. A. A. Balkema, Rotterdam.

O'Shea, J., and M. Zvelebil
1984 Oleneostrovskii Mogilnik: Reconstructing social and economic organization of prehistoric hunter-fishers in northern Russia. *Journal of Anthropological Archaeology* 3:1–40.

O'Connor, S., P. Veth, and C. Campbell
1998 Serpent's Glen: A Pleistocene archaeological sequence from the Western Desert. *Australian Archaeology* 46:12–22.

Oesterheld, M., O. E. Sala, and S. J. McNaughton
1992 Effect of animal husbandry on herbivore-carrying capacity at a regional scale. *Nature* 356:234–236.

Okada, H.
1998 Maritime adaptations in northern Japan. *Artic Anthropology* 35:335–339.

Okada, Y.
2003 Jomon culture of northeastern Japan and the Sannai Maruyama site. In *Hunter-Gatherers of the North Pacific Rim*, edited by J. Habu, J. Savelle, S. Koyama, and H. Hongo, pp. 173–186. Senri Ethnological Studies 63. National Museum of Osaka.

Onelli, C.
1977 *Trepando los Andes.* Marymar, Buenos Aires.

Ortiz Troncoso, O.
1971 Antecedentes históricos y prospección arqueológica de las islas Isabel, Santa Marta, Magdalena y Contramaestre, Estrecho de Magallanes. *Anales del Instituto de la Patagonia* 2:20–27.
1973 Artefactos de silex de una tumba de Morro Philippi, valle medio del río Gallegos. *Anales del Instituto de la Patagonia* 4(2):131–139.

Otterman, J.
1977 Baring high-albedo soils by overgrazing: A hypothesized desertification mechanism. *Science* 186:531–533.

Oyarzún, A.
1929 Los aborígenes de la Tierra del Fuego y de la Patagonia occidental. *Revista Chilena de Historia y Geografía* 64:144–178.

Pardoe, C.
1994 Bioscapes: The evolutionary landscape of Australia. *Archaeology in Oceania* 29:182–190.
2006 Becoming Australian: Evolutionary processes that structure biological variation from origin to modern times. *Before Farming* 2006 (1): Article 4.

Peirce, C. S.
1986 Logic as semiotic: The theory of signs. In *Semiotics. An Introductory Anthology*, edited by R. E. Innis, pp. 1–23. Hutchinson, London.

Pentikäinen, J.
1998 *Shamanism and Culture*. Ernika Co, Helsinki.

Pentikäinen, J., T. Jaatinen, I. Lehtinen, and M.-R. Salonoiemi (eds.)
1998 *Shamans*. Tampere Museum, Tampere.

Perkins, J. S.
1991 The Impact of Borehole Dependent Cattle Grazing on the Environment and Society of the Eastern Kalahari Sandveld, Central District, Botswana. Ph.D. dissertation, University of Sheffield, Sheffield.

Perkins, J. S., and D. S. G. Thomas
1993 Spreading deserts or spatially confined environmental impacts? Land degradation and cattle ranching in the Kalahari of Botswana. *Land Degradation and Rehabilitation* 4:179–194.

Peters, P. E.
1994 *Dividing the Commons: Politics, Policy, and Culture in Botswana*. University Press of Virginia, Charlottesville.

Pétrequin, P., and A.-M. Pétrequin
1993 *Écologie d'un outil: La Hache en pierre en Irian Jaya (Indonésie)*. CNRS Éditions, Paris.

Phillips, S. C., and R. J. Speakman
2009 Initial source evaluation of archaeological obsidian from the Kuril Islands of the Russian Far East using portable-XRF. *Journal of Archaeological Science* 36:1256–1263.

Piana, E. L., and L. A. Orquera
2007 Diferencias regionales y temporales en el litoral sudoccidental de Sudamérica. In *Arqueología de Fuego-Patagonia. Levantando piedras, desenterrando huesos … develando arcanos*, edited by, F. Morello, M. Martinic, A. Prieto, and G. Bahamonde, pp. 311–323. Ediciones CEQUA, Punta Arenas.

Pietsch, T. W., V. V. Bogatov, K. Amaoka, Y. N. Zhuravlev, V. Y. Barkalov, S. Gage, H. Takahashi, A. S. Lelej, S. Y. Storozhenko, N. Minakawa, D. J. Bennett, T. R. Anderson, M. Ôhara, L. A. Prozorova, Y. Kuwahara, S. K. Kholin, M. Yabe, D. E. Stevenson, and E. L. MacDonald
2003 Biodiversity and biogeography of the islands of the Kuril Archipelago. *Journal of Biogeography* 30(9):1297–1310.

Pluciennik, M.
2008 The coastal Mesolithic of the European Mediterranean. In *Mesolithic Europe*, edited by G. Bailey and P. Spikins, pp. 328–356. Cambridge University Press, Cambridge.

Podestá, M., C. Bellelli, P. Fernández, M. Carballido, and M. Paniquelli
2000 Arte rupestre de la Comarca Andina del paralelo 42º: Un caso de análisis regional para el manejo de recursos culturales. In *Arte en las rocas, arte rupestre, menhires y piedras de colores en la Argentina*, edited by M. Podestá, and M. de Hoyos, pp. 175–201. Sociedad Argentina de Antropología, Buenos Aires.

Politis, G. G.
2000 Plant exploitation among the Nukak hunter-gatherers of Amazonia: Between ecology and ideology. In *The Prehistory of Food: Appetites for Change*, edited by C. Gosden and J. Hather, pp. 99–126. One World Archaeology. Routledge, London.
2007 *Nukak. Ethnoarchaeology of an Amazon People*. Left Coast Press, Walnut Creek, CA.

Poulain-Jossien, T.
1963 La grotte Fell. Étude de la faune. *Journal de la Société des Américanistes* 52: 230–254.

Powell, A., S. Shennan, and M. G. Thomas
2009 Late Pleistocene demography and the appearance of modern human behavior. *Science* 324 (5932):1298–1301.

Pratt, K. L.
1984a Classification of Eskimo groupings in the Yukon-Kuskokwim region: A critical analysis. *Inuit Studies* 8 Supplementary Issue: 45–62.
1984b Yukon-Kuskokwim Eskimos, Western Alaska: Inconsistencies in Group Identification. Master's thesis, Western Washington University, Department of Anthropology, Bellingham, WA.
1992 Documenting Alaska Native cultural history: ANCSA and the role of the Bureau of Indian Affairs. *Arctic Research* 6 (Fall):74–77.

Pratt, K. L., and D. C. Slaughter
1989 Summary of archaeological research on the ANCSA 14(h)(1) Project. *Federal Archaeology Repor*t 2(3):5–7.

Press, M. L.
1979 *Chemehuevi: A Grammar and Lexicon*. University of California Publications in Linguistics 92. University of California Press, Berkeley and Los Angeles.

Preucel, R. W.
2006 Archaeological semiotics. In *Social Archaeology*, edited by I. Hodder, pp. 44–66. Blackwell Publishing, Oxford.

Price, N. S.
2001 An archaeology of altered states: Shamanism and material culture studies. In *The Archaeology of Shamanism*, edited by N. Price, pp. 3–16. London, Routledge.

Prieto, A.
1984 Hallazgo de un colgante en morro Chico (Magallanes). *Anales del Instituto de la Patagonia* 15:59–61.
1988 Cazadores-recolectores del istmo de Brunswick. *Anales del Instituto de la Patagonia* 18:113–131.
1993–1994 Algunos datos en torno a los enterratorios humanos de la región continental de Magallanes. *Anales del Instituto de la Patagonia* 22 (Serie Ciencias Humanas): 91–100.

Prieto, A., and R. Cárdenas
2002 Las colecciones etnográficas fuego-patagónicas en los museos europeos. *Anales del Instituto de la Patagonia* 30:65–77.

Prieto, A., D. Chevallay, and D. Ovando
2000 *Los pasos de Indios en Patagonia Austral. Desde el país de los gigantes*, pp. 87–94. UNPA, Río Gallegos.

Prieto, A., F. Morello, R. Cárdenas, and M. Christensen
1998 Canadón Leona: A sesenta años de su descubrimiento. *Anales del Instituto de la Patagonia* 26:77–92.

Pugsley, L. B.
2005 Sex, gender and sexuality in the Mesolithic. In *Mesolithic Studies at the Beginning of the 21st Century*, edited by N. Milner and P. Woodman, pp. 164–175. Oxbow Books, Oxford.

Qiu, B.
2001 Kuroshio and Oyashio Currents. In *Encyclopedia of Ocean Sciences*, pp. 1413–1425. Academic Press, New York.

Radcliffe-Brown, A. R.
1913 Three tribes of Western Australia. *Journal of the Royal Anthropological Institute* 43:143–194.

Ramqvist, P.
2002 Rock-art and settlement: Issues of spatial order in the prehistoric rock-art of Fenno-Scandinavia. In *European Landscapes of Rock-Art*, edited by G. Nash and C. Chippendale, pp. 144–157. Routledge, London.

Ramqvist, P. H., L. Forsberg, and M. Backe
1985 …And here was an elk too… A preliminary report of new petroglyphs at Stornorrfors, Ume River. In *Honorem Evert Baudou: Archaeology and Environment 4*, pp. 313–337. Department of Archaeology, Umeå University, Umeå.

Ravdonikas, W.
1936 Les gravures rupestres des bords du lac Onega. *Travaux de l'Institute d'Ethnographie de l'U.R.S.S.* 9.

Read, D.
2006 Tasmanian knowledge and skill: Maladaptive imitation or adequate technology? *American Antiquity* 71:164–184.

Reid, R. S., K. A. Galvin, and R. S. Kruska
2008 Global significance of extensive grazing lands and pastoral societies: An introduction. In *Fragmentation in Semi-Arid and Arid Landscapes: Consequences for Human and Natural Systems*, edited by K. A. Galvin, R. S. Reid, R. H. Behnke, Jr., and N. T. Hobbs, pp. 1–24. Springer, Dordrecht, The Netherlands.

Renfrew, C., and E. B. W. Zubrow (eds.)
1994 *The Ancient Mind: Elements of Cognitive Archaeology*. Cambridge University Press, New York.

Reynolds, R. G.
1984 A computational model of hierarchical decision systems. *Journal of Anthropological Archaeology* 3:159–189.

Richards, P. W.
1964 *The Tropical Rain Forest*. Cambridge University Press, Cambridge.

Richardson, B.
1991 *Strangers Devour the Land*. Chelsea Green Publishing Company, Post Mills, VT.

Roberts, H., and R. V. N. Ahlstrom (eds.)
2003 *The Coral Canyon Project: Archaeological Investigations in the St. George Basin, Southwestern Utah.* HRA Papers in Archaeology No. 3. HRA, Inc. Conservation Archaeology, Las Vegas, NV.

Roberts, R. G.
2000 Luminescence dating of Kimberley rock art. In *Bradshaw Art of the Kimberley*, edited by G. L. Walsh, pp. 46–49. Takarakka Nowan Kas Publications, Toowong (Queensland).

Roberts, R. G., R. Jones, N. A. Spooner, M. J. Head, A. S. Murray, and M. A. Smith
1994 The human colonisation of Australia: Optical dates of 53,000 and 60,000 years bracket human arrival at Deaf Adder Gorge, Northern Territory. *Quaternary Science Reviews* 13:575–583.

Roberts, R. G., L. Walsh, A. Murray, J. Olley, R. Jones, M. Morwood, C. Tuniz, E. Lawson, M. MacPhail, D. Bowdery, and I. Naumann
1997 Luminescence dating of rock art and past environments using mud-wasp nests in northern Australia. *Nature* 387:696–699.

Robinson, L. W., and J. Armagost
1990 *Comanche Dictionary and Grammar*. Summer Institute of Linguistics, Dallas.

Rogers, E. S.
1969 Band organization among the Indians of eastern subarctic Canada. In *Contributions to Anthropology: Band Societies*, edited by D. Damas, pp. 21–50. Bulletin 228. National Museums of Canada, Ottawa.
1973 *The Quest for Food and Furs: The Mistassini Cree, 1953–1954*. Publications in Ethnology 5. National Museums of Canada, Ottawa.

Rogers, T.
1879 Expedición a la parte austral de la Patagonia por el teniente Segundo Don Juan Tomas Rogers. *Anuario Hidrográfico de la Marina de Chile*, Tomo V: 56–95. Santiago.

Rosenfeld, A.
1993 A review of the evidence for the emergence of rock art in Australia. In *Sahul in Review: Pleistocene Archaeology in Australia, New Guinea and Island Melanesia*, edited by M. A. Smith, M. Spriggs, and B. Fankhauser, pp. 71–80. Research School of Pacific Studies, Australian National University, Canberra.

Rosenfeld A., D. Horton, and J. Winter
1981 *Early Man in North Queensland: Art and Archaeology in the Laura Area*. Terra Australis 6. Research School of Pacific Studies. Australian National University, Canberra.

Rostov, I., G. I. Yurasov, N. I. Rudyh, V. V. Moroz, E. V. Dmitrieva, A. A. Nabiullin, F. F. Khrapchenkov, V. I. Rostov, and V. M. Bunin

2001 *Oceanographic Atlas of the Bering, Okhotsk and Japan/East Sea*. Pacific Oceanographical Institute, Russian Academy of Sciences, Far Eastern Branch, Vladivostok.

Rowe, M. W.

2001 Dating by AMS radiocarbon analysis. In *Handbook of Rock Art Research*, edited by D. S. Whitley, pp. 139–166. AltaMira Press, Walnut Creek, CA.

Sackett, J. R.

1982 Approaches to style in lithic archaeology. *Journal of Anthropological Archaeology* 1:59–112.

1990 Style and ethnicity in archaeology: The case for isochrestism. In *The Uses of Style in Archaeology*, edited by M. Conkey, and C. Hastorf, pp. 32–43. New Directions in Archaeology. Cambridge University Press, Cambridge.

Sahlins, M. D.

1972 *Stone Age Economics*. Tavistock, London.

1976 *Culture and Practical Reason*. University of Chicago Press, Chicago.

Samarin, I. A., and O. A. Shubina

2007 Fortified settlements of the Chasi Type on Kunashir Island: Kurile Isles of the Russian Far East. *North Pacific Prehistory*, Vol. 1. (Pleistocene-Holocene Archaeology of North-East Asia), pp. 235–236.

San Román, M.

2007 La explotación de mamíferos en el sitio de Bahia Buena: Economía de canoeros tempranos de Patagonia (estrecho de Magallanes, Chile). In *Arqueología de Fuego-Patagonia*, edited by F. Morello, M. Martinic, A. Prieto, and G. Bahamonde, pp. 295–310. Ediciones CEQUA, Punta Arenas.

San Román, M., and F. Morello

2001 Canal Maule: Nuevos antecedentes sobre prácticas funerarias en el archipiélago fueguino. *Anales del Instituto de la Patagonia* 29:149–161.

San Román, M., F. Morello, and A. Prieto

2002 Nuevos antecedentes sobre la explotación de recursos faunísticos en el mar de Otway y canales adyacentes. *Anales del Instituto de la Patagonia* 30:147–154.

Sánchez-Albornoz, N.

1958 Pictografías del valle de El Bolsón (Río Negro) y del lago Puelo (Chubut), Argentina. *Acta Praehistorica* II:146–175. Buenos Aires.

Sanday, P. R.

1981 *Female Power and Male Dominance: On the Origins of Sexual Inequality*. Cambridge University Press, Cambridge.

Sanguinetti de Bórmida, A. C.

1984 Noticia sobre el sitio El Volcán, su relación con el poblamiento tardío de las cuencas de los ríos Gallegos y Chico. *Informes de Investigación* 1:5–37.

Sassaman, K. E., and D. H. Holly Jr. (eds.)

2010 *Hunter-Gatherer Archaeology as Historical Process*. University of Arizona Press, Tucson.

Saussure, F. de

1978 *Course in General Linguistics*. Peter Owen, London.

Saxon, E. C.
1979 Natural prehistory. The archaeology of Fuego-Patagonian ecology. *Quaternaria* 21:329–356.
Scheinsohn, V.
2001 2001: Odisea del Espacio. Paisajes y distribuciones artefactuales en arqueología, resultados y propuestas. *Relaciones de la Sociedad Argentina de Antropología* 26:285–301.
2003 Hunter-gatherer archaeology in South America. *Annual Reviews of Anthropology* 32:339–361.
2004 "En el país de los ciegos el tuerto es rey": Visibilidad arqueológica y paisaje en la localidad Cholila. In *Contra Viento y Marea: Arqueología de Patagonia. V Jornadas de Arquelogía de la Patagonia*, edited by M. T. Civalero, P. M. Fernández, and A. G. Guráieb, pp. 581–590. Instituto Nacional de Antropología y Pensamiento Latinoamericano and Sociedad Argentina de Antropología, Buenos Aires.
2006 El desierto habitado. *UBA: Encrucijadas* 37:71–76.
Scheinsohn, V., and S. D. Matteucci
2004 Spaces and species: Archaeology, landscape ecology and spatial models in northern Patagonia. *Before Farming* 2004(1): article 2. Online.
2006 Obtención de un modelo regional de distribuciones arqueológicas mediante SIG. In *Problemáticas de la arqueología contemporánea*, edited by M. Tamagnini, pp. 197–199. Córdoba.
In press A regional model of archaeological distributions for Comarca Andina del paralelo 42º, Patagonia, Argentina. In *Uso de sistemas de información geográfica (SIG) en la arqueología Sudamericana*, edited by M. J. Figuerero Torres and A. Izeta. British Archaeological Reports, International Series. Archaeopress, Oxford.
Scheinsohn V., and C. Szumik
2007 Distribuciones arqueológicas en la Patagonia norte: Una perspectiva biogeográfica. In *Arqueología de Fuego-Patagonia. Levantando piedras, desenterrando huesos…y develando arcanos*, edited by F. Morello, M. Martinic, A. Prieto, and G. Bahamonde, pp. 427–442. Ediciones CEQUA, Punta Arenas.
Scheinsohn, V., C. Szumik, S. Leonardt, and F. Rizzo
2009 Distribución espacial del arte rupestre en el bosque y la estepa del norte de Patagonia. Nuevos resultados. In *Arqueología de Patagonia: Una mirada desde el último confín*, edited by M. Salemme, F. Santiago, M. Álvarez, E. Piana, M. Vázquez, and M. E. Mansur, pp. 541–560. CADIC-CONICET. Editorial Utopías, Ushuaia.
Schmidt, R. A.
2000 Shamans and northern cosmology: The direct historical approach to Mesolithic sexuality. In *Archaeologies of Sexuality*, edited by R. A. Schmidt and B. L. Voss, pp. 220–235. Routledge, London.
Schrire, C.
1982 *The Alligator Rivers: Prehistory and Ecology in Western Arnhem Land.* Terra Australis 7. Research School of Pacific Studies, Australian National University, Canberra.

Sea Around Us Project

n.d. LME: Okhotsk Sea (primary productivity data visualization tool). *http://www.seaaroundus.org/lme/52.aspx*. University of British Columbia and Pew Charitable Trust.

Seiler, H., and K. Hioki

1979 *Cahuilla Dictionary*. Malki Museum Press, Banning, CA.

Shanks, M., and C. Y. Tilley

1987 *Social Theory and Archaeology*. Polity Press, Cambridge.

Shannon, C. E., and W. Weaver

1949 *The Mathematical Theory of Communication*. University of Illinois Press, Champaign.

Shaw, R. D.

1998 An archaeology of the central Yupik: A regional overview for the Yukon-Kuskokwim Delta, northern Bristol Bay, and Nunivak Island. *Arctic Anthropology* 35(1):234–246.

Shennan, S.

1993 Amber and its value in the British Bronze Age. In *Amber in Archaeology. Proceedings of the Second International Conference on Amber in Archaeology, Liblice 1990*, edited by C. W. Beck and J. Bouzek, pp. 59–66. Institute of Archaeology, Prague.

2001 Demography and cultural innovation: A model and its implications for the emergence of modern human culture. *Cambridge Archaeological Journal* 11 (1):5–16.

2008 *Pattern and Progress in Cultural Revolution*. University of California Press, Los Angeles.

Shubin, V. O.

1994 Aleut in the Kuril Islands. In *Anthropology of the North Pacific Rim*, edited by W. W. Fitzhugh and V. Chaussonet, pp. 337–345. Smithsonian Institution, Washington, DC.

Silberbauer, G. B.

1965 *Report to the Government of Bechuanaland on the Bushman Survey*. Government Printer, Gaberones, Bechuanaland.

1979 Social hibernation: The response of the G/wi Band to seasonal drought. In *Symposium on Drought in Botswana*, edited by M. T. Hinchey, pp. 112–120. Botswana Society, Gaborone, Botswana, and University of New England Press, Hanover, NH.

1981a *Hunter and Habitat in the Central Kalahari Desert*. Cambridge University Press, Cambridge.

1981b Hunter/gatherers of the Central Kalahari. In *Omnivorous Primates: Gathering and Hunting in Human Evolution*, edited by R. S. O. Harding and G. Teleki, pp. 455–498. Columbia University Press, New York.

1994 A sense of place. In *Key Issues in Hunter-Gatherer Research*, edited by E. S. Burch, Jr., and L. J. Ellanna, pp. 119–143. Berg, Oxford and Providence.

Silverman, I., and M. Eals

1992 Sex differences in spatial abilities: Evolutionary theory and data. In *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*, edited by

J. H. Barkow, L. Cosmidies, and J. Tooby, pp. 533–549. Oxford University Press, New York.

Silverman, I., J. Choi, and M. Peters

2007 The hunter-gatherer theory of sex differences in spatial abilities: Data from 40 countries. *Archives of Sexual Behavior* 36(2):261–268.

Silverstein, M.

1976 Shifters, linguistic categories and cultural description. In *Meaning in Anthropology*, edited by K. Basso and H. Selby, pp. 11–55. University of New Mexico Press, Albuquerque.

1979 Language structure and linguistic ideology. In *The Elements: A Parasession on Linguistic Units and Levels*, edited by P. R. Clyne, W. F. Hanks, and C. L. Hofbauer, pp. 193–247. Chicago Linguistic Society, Chicago.

Slobodkin, L. B., and A. Rapoport

1974 An optimal strategy of evolution. *The Quarterly Review of Biology* 49(3):181–200.

Smith, C.

1989 Designed Dreaming: Assessing the Relationship between Style, Social Structure and Environment in Aboriginal Australia. B.A. (Honors) thesis, University of New England, Armidale.

Smith, C., and H. M. Wobst (eds.)

2005 *Indigenous Archaeologies: Decolonizing Theory and Practice*. Routledge, London.

Smith, E. A.

1988 Risk and uncertainty in the "original affluent society": Evolutionary ecology of resource-sharing and land tenure. In *Hunters and Gatherers.* Vol. 1: *History, Evolution, and Social Change*, edited by T. Ingold, D. Riches, and J. Woodburn, pp. 222–250. Berg, Oxford.

1991 *Inujjuamiut Foraging Strategies: Evolutionary Ecology of an Arctic Hunting Economy*. Aldine de Gruyter, New York.

Smith, K. P.

1988 Ritual and resource variability: Mechanisms for the transmission and storage of information regarding low-frequency resource cycles in hunter-gatherer societies. In *Diet and Subsistence: Current Archaeological Perspectives*, edited by B. V. Kennedy and G. M. LeMoine, pp. 86–107. Proceedings of the Nineteenth Annual conference, Chacmool, The Archaeological Association of the University of Calgary.

Smith, M. A.

1989 The case for a resident human population in the central Australian ranges during full glacial aridity. *Archaeology in Oceania* 24(3):93–105.

2006 Characterising late Pleistocene and Holocene stone artefact assemblages from Puritjarra rock shelter: A long sequence from the Australian desert. *Records of the Australian Museum* 58(3):371–410.

Smith, M. A., and P. Hesse (eds.)

2005 *23° S: Archaeology and Environmental History of the Southern Deserts*. National Museum of Australia Press, Canberra.

Smith, M. A., and J. Ross
2008a What happened at 1500–1000 BP in central Australia? Timing, impact, and archaeological signatures. *The Holocene* 18(3):387–396.
2008b Glen Thirsty: The history and archaeology of a desert well. *Australian Archaeology* 66:45–59.
Smith, M. A., B. Frankhauser, and M. Jercher
1998 The changing provenance of red ochre at Puritjarra rock shelter, central Australia: Late Pleistocene to present. *Proceedings of the Prehistoric Society* 64: 275–292.
Smith, M. A., J. R. Prescott, and M. J. Head
1997 Comparison of ^{14}C and luminescence chronologies at Puritjarra rock shelter, central Australia. *Quaternary Science Reviews* 16:299–320.
Smithers, R. H. N.
1971 *The Mammals of Botswana*. Museum Memoir No. 4. Trustees of the National Museums of Rhodesia, Harare, Zimbabwe (Salisbury, Rhodesia).
Sobel, E., and G. Bettles
2000 Winter hunger, winter myths: Subsistence risk and mythology among the Klamath and Modoc. *Journal of Anthropological Archaeology* 19:276–316.
Sognnes, K.
1998 Symbols in a changing world: Rock-art and the transition from hunting to farming in mid Norway. In *The Archaeology of Rock-Art*, edited by C. Chippendale and P. S. C. Taçon, pp. 146–162. Cambridge University Press, Cambridge.
2002 Land of elks—sea of whales: Landscapes of Stone Age rock-art in central Scandinavia. In *European Landscapes of Rock-Art*, edited by G. Nash and C. Chippendale, pp. 195–212. Routledge, London.
Speck, F. G.
1923 Mistassini hunting territories in the Labrador Peninsula. *American Anthropologist*, N.S. 25(4):452–471.
1927 Family hunting territories of the Lake St. John Montagnais and neighboring bands. *Anthropos* 22:387–402.
1935 *Naskapi, The Savage Hunters of the Labrador Peninsula*. University of Oklahoma Press, Norman.
Speck, F. G., and L. C. Eiseley
1942 Montagnais-Naskapi bands and family hunting districts of the central and southeastern Labrador Peninsula. *Proceedings of the American Philosophical Society* 85(2):215–242.
Spinage, C.
1992 *History and Evolution of the Fauna Conservation Laws of Botswana*. Botswana Society, Gaborone.
Sporton, D., and D. S. G. Thomas (eds.)
2002 *Sustainable Livelihoods in Kalahari Environments: A Contribution to Global Debates*. Oxford University Press, Oxford.
Stander, P. E., //.chau, D. Tsisaba, //.Oma, and //.ui
1997 Tracking and interpretation of spoor: A scientifically sound method in ecology. *Journal of the Zoological Society of London* 242:329–341.

Stanner, W. E. H.
1965 Aboriginal territorial organization: Estate, range, domain and regime. *Oceania* 36(1):1–26.

Steelman, K. L., J. Mackey, and J. Loewen
2008 *Radiocarbon Dating of Charcoal Rock Paintings, Western Desert, Australia*. University of Central Arkansas report to AIATSIS, Canberra.
1974 *The Kuril Islands: Russo-Japanese Frontier in the Pacific*. Clarendon Press, Oxford.

Stern, N.
2009 The archaeological record of modern behavioural origins: Perspectives from Sahul on the periphery of the modern human range. In *Transformations in Prehistory. Papers in Honor of Ofer Bar-Yosef*, edited by D. E. Lieberman and J. J. Shea, pp. 258–288. American School of Prehistoric Research, Cambridge.

Stern, C. R., and A. Prieto
1991 Obsidiana verde de los sitios arqueológicos en los alrededores del mar de Otway, Magallanes, Chile. *Anales del Instituto de la Patagonia* 20 (Serie Ciencias Sociales):139–144.

Steward, J.
1955 *A Theory of Culture. The Methodology of Multilinear Evolution*. University of Illinois Press, Chicago.

Stiner, M.
2002 Carnivory, coevolution, and the geographic spread of the genus *homo*. *Journal of Archaeological Research* 10(1):1–63.

Sulgostowska, Z.
1990 Occurrence and utilization of local ochre resources during the early Holocene in the Oder and Vistula River basins. In *Contributions to the Mesolithic in Europe*, edited by P. M. Vermeersch and P. van Peer, pp. 317–321. Leuven University Press, Leuven.
2006 Mesolithic mobility and contacts on areas of the Baltic Sea watershed, the Sudety and Carpathian Mountains. *Journal of Anthropological Archaeology* 25:193–203.

Szumik C., F. Cuezzo, P. Goloboff, and A. Chalup
2002 An optimality criterion to determine areas of endemism. *Systematics Biology* 51:806–816.

Taçon, P., and C. Chippendale
1994 Australia's ancient warriors: Changing depictions of fighting in the rock art of Arnhem Land, N.T. *Cambridge Archaeological Journal* 4 (2):211– 248.

Taçon, P., M. Wilson, and C. Chippindale
1996 Birth of the Rainbow Serpent in Arnhem Land rock art and oral history. *Archaeology in Oceania* 31(3):103–124.

Takada, A.
2006 Explaining pathways in the central Kalahari. In *Updating the San: Image and Reality of an African People in the 21st Century*, edited by R. K. Hitchcock, K. Ikeya, M. Biesele, and R. B. Lee, pp. 102–127. Senri Ethnological Studies 70. National Museum of Ethnology, Osaka.

Tanaka, J.
1980 *The San, Hunter-Gatherers of the Kalahari. A Study in Ecological Anthropology*. Tokyo University Press, Tokyo.
Terashima, H., and M. Ichikawa
2003 Comparative ethnobotany of the Mbuti and Efe hunter-gatherers in the Ituri forest, Democratic Republic of Congo. *African Study Monographs* 1/2: 1–168.
Terashima, H., M. Ichikawa, and I. Ohta
1991 *AFLORA: Catalog of Useful Plants of Tropical Africa*, Part 1: *Forest Areas*. African Study Monographs, Supplementary Issue 16:1–195.
Terberger, T.
2003 Decorated objects of the older Mesolithic from the northern lowlands. In *Mesolithic on the Move*, edited by L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund, pp. 547–557. Oxbow Books, Oxford.
Thomas, D. S. G., and P. A. Shaw
1991 *The Kalahari Environment*. Cambridge University Press, Cambridge.
Thomas, W. L. (ed.)
1956 *Man's Role in Changing the Face of the Earth*. University of Chicago Press, Chicago.
Tilley, C. Y.
1991 *Material Culture and Text: The Art of Ambiguity*. Routledge, London.
1994 *A Phenomenology of Landscape: Places, Paths and Monuments*. Berg, London.
Timbrook, J.
2007 *Chumash Ethnobotany: Plant Knowledge among the Chumash People of Southern California*. Santa Barbara Museum of Natural History Monographs No. 5, Publications in Anthropology No. 1. Santa Barbara Museum of Natural History, Santa Barbara, CA, and Heyday Books, Berkeley, CA.
Tindale, N. B.
1974 *Aboriginal Tribes of Australia*. University of California Press, Berkeley.
Tonkinson, R.
1974 *The Jigalong Mob: Aboriginal Victors of the Desert Crusade*. Cummings Publishing Company, Menlo Park, CA.
2002 *The Mardu Aborigines: Living the Dream in Australia's Desert. Case Studies in Cultural Anthropology*. Wadsworth, Belmont, CA.
Torrence, R., V. Neall, T. Doelman, E. Rhodes, C. McKee, H. Davies, R. Bonetti, A. Guglielmetti, A. Manzoni, M. Oddone, J. Parr, and C. Wallace
2004 Pleistocene colonisation of the Bismarck Archipelago: New evidence from West New Britain. *Archaeology in Oceania* 39:101–130.
Tuholski, S. W., R. W. Engle, and G. C. Baylis
2001 Individual differences in working memory capacity and enumeration. *Memory & Cognition* 29:484–492.
Turney, C. S. M., M. I. Bird, L. K. Fifield, R. G. Roberts, M. Smith, C. E. Dortch, R. Grun, E. Lawson, L. K. Ayliffe, G. H. Miller, J. Dortch, and R. G. Cresswell
2001 Early human occupation at Devil's Lair, Southwestern Australia 50,000 years ago. *Quaternary Research* 55:3–13.

UAH (University of Alabama, Huntsville)
2008 Climate Data Global Temperature Report: September 2008. Raw data: *http://vortex.nsstc.uah.edu/public/msu/t2lt/tltglhmam_5.2*

Valiente-Noailles, C.
1993 *The Kua: Life and Soul of the Central Kalahari Bushmen*. A. A. Balkema, Rotterdam.

van Holst Pellekaan, S. M., M. Ingman, J. Roberts-Thomson, and R. Harding
2006 Mitochondrial genomics identifies major haplogroups in Aboriginal Australians. *American Journal of Physical Anthropology* 131(2):282–294.

Vankina, L. V.
1970 *Torfyanikovaya Stoyanka Sarnate*. Zinatne, Riga.

Vansina, J.
1985 *Oral Tradition as History*. University of Wisconsin Press, Madison.

VanStone, J. W.
1972 The first Peary collection of Polar Eskimo material culture. *Fieldiana: Anthropology* 63(2):31–80. Field Museum of Natural History, Chicago.

Vasilevsky, A., and O. Shubina
2006 Neolithic of the Sakhalin and southern Kurile Islands. In *Archaeology of the Russian Far East: Essays in Stone Age Prehistory*, edited by S. M. Nelson, A. Derevianko, Y. Kuzmin, and R. Bland, pp. 151–166. BAR International Series 1540. Archaeopress, Oxford.

Verhart, L.
2008 New developments in the study of the Mesolithic of the Low Countries. In *Mesolithic Europe*, edited by G. Bailey and P. Spikens, pp. 158–181. Cambridge University Press, Cambridge.

Veth, P. M.
1989 Islands in the interior: A model for the colonisation of Australia's arid zone. *Archaeology in Oceania* 24(3):81–92.
2000 Origins of the Western Desert language: Convergence in linguistic and archaeological space and time models. *Archaeology in Oceania* 35(1):11–19.
2005a Cycles of aridity and human mobility: Risk minimisation among late Pleistocene foragers of the Western Desert, Australia. In *Desert Peoples: Archaeological Perspectives*, edited by P. Veth, M. Smith, and P. Hiscock, pp. 100–115. Blackwell Publishing, Oxford.
2005b Between the desert and the sea: Archaeologies of the Western Desert and Pilbara Region, Australia. In *23° S: Archaeology and Environmental History of the Southern Deserts*, edited by M. Smith and P. Hesse. National Museum of Australia Press, Canberra.
2006 Social dynamism in the archaeology of the Western Desert. In *The Social Archaeology of Indigenous Societies*, edited by B. David, I. J. McNiven, and B. Barker, pp. 242–253. Australian Aboriginal Studies Press, Canberra.

Veth, P. M., J. J. McDonald, and E. White
2008 Dating of Bush Turkey Rockshelter 3 in the Calvert Ranges establishes Early Holocene occupation of the Little Sandy Desert, Western Australia. *Australian Archaeology* 66:34–44.

Veth, P. M., M. Smith, and A. M. Haley
2001 Kaalpi: The archaeology of a sandstone outlier in the Western Desert. *Australian Archaeology* 52:9–17.
Veth, P. M., M. A. Smith, J. Bowler, K. Fitzsimmons, A. Williams, and P. Hiscock
2009 Excavations at Parnkupirti, Lake Gregory, Great Sandy Desert: OSL ages for occupation before the Last Glacial Maximum. *Australian Archaeology* 69: 1–10.
Veth, P., M. A. Smith, and P. Hiscock (eds.)
2005 *Desert Peoples: Archaeological Perspectives*. Blackwell Publishing, Oxford.
Vierich, H. I. D.
1981 The Kua of the Southeastern Kalahari: A Study in the Socio-ecology of Dependency. Ph.D. dissertation, University of Toronto.
Villard, M. A.
2002 Habitat fragmentation: Major conservation issue or intellectual attractor? *Ecological Applications* 12:319–320.
Voegelin, E. W.
1938 *Tübatulabal Ethnography*. University of California Publications in Anthropological Records, Vol. II, 1938–1940, pp. 1–90. University of California Press, Berkeley and Los Angeles.
von Bertalanffy, L.
1968 *General System Theory: Foundations, Development, Applications*. George Braziller, New York.
Voris, H. K.
2000 Maps of Pleistocene sea levels in South East Asia: Shorelines, river systems, time durations. *Journal of Biogeography* 27:1153–1167.
Wadley, L.
2001 What is cultural modernity? A general view and a South African perspective from Rose Cottage Cave. *Cambridge Archaeological Journal* 11: 201–221.
Walker, R., K. Hill, H. Kaplan, and G. McMillan
2002 Age-dependency in hunting ability among the Ache of eastern Paraguay. *Journal of Human Evolution* 42:639–657.
Walsh, G. L.
1988 *Australia's Greatest Rock Art*. E.J. Brill/Robert Brown & Associates, Bathurst, Australia.
1994 *Bradshaws and the Ancient Rock Art of North-West Australia*. Bradshaw Foundation, Santa Fe.
2000 *Bradshaw Art of the Kimberley*. Takarakka Nowan Kas Publications, Toowong (Queensland).
Walsh, G. L. and M. J. Morwood
1999 Spear and spearthrower evolution in the Kimberley region, NW Australia: Evidence from rock art. *Archaeology in Oceania* 34: 45–58.
Watchman, A.
1992 Doubtful dates for Karolta engravings. *Journal of the Australian Institute of Aboriginal and Torres Strait Islander Studies* (1):51–55.
1993 Evidence of a 25,000-year-old pictograph in Northern Australia. *Geoarchaeology* 8:465–473.

2001 Wargata Mina to Gunbilmurrung: The direct dating of Australian rock art. In *Histories of Old Ages. Essays in Honours of Rhys Jones*, edited by A. Anderson, I. Lilley, and S. O'Connor, pp. 313–325. Pandanus Books, Canberra.

Webb, S.
1989 *The Willandra Lakes Hominids*. Department of Prehistory, Research School of Pacific Studies, Australian National University, Canberra.

Whallon, R.
1989 Elements of cultural change in the later Paleolithic. In *The Human Revolution: Behavioural and Biological Perspectives on the Origins of Modern Humans*, edited by P. Mellars and C. B. Stringer, pp. 433–454. Edinburgh University Press, Edinburgh.
2000 Anthropological archaeology in theory and practice. *Rivista di Antropologia* (Roma) 78:75–90.
2006 Social networks and information: Non-"utilitarian" mobility among hunter-gatherers. *Journal of Anthropological Archaeology* 25:259–270.

White, J. P., K. A. W. Crook, and B. P. Ruxton
1970 Kosipe: A late Pleistocene site in the Papuan highlands. *Proceedings of the Prehistoric Society* 36:152–170.

Wiessner, P.
1977 Hxaro: A Regional System for Reducing Risk among the !Kung San. Ph.D. dissertation, University of Michigan, Ann Arbor.
1982 Risk, reciprocity and social influences on !Kung San economics. In *Politics and History in Band Societies*, edited by E. Leacock and R. Lee, pp. 61–84. Cambridge University Press, Cambridge.
1983 Style and social information in Kalahari San projectile points. *American Antiquity* 48:253–276.
1984 Reconsidering the behavioral basis for style: A case study among the Kalahari San. *Journal of Anthropological Archaeology* 3:190–234.
1989 Style and changing relations between individual and society. In *The Meanings of Things: Material Culture and Symbolic Expression*, edited by I. Hodder, pp. 56–63. Unwin Hyman, London.
1990 Is there a unity to style? In *The Uses of Style in Archaeology*, edited by M. Conkey and C. Hastorf, pp. 105–112. Cambridge University Press, Cambridge.
2002 Hunting, healing, and Hxaro exchange: A long-term perspective on !Kung (Ju/'hoansi) large game hunting. *Evolution and Human Behavior* 23:407–436.
2009 Experimental games and games of life among the Ju/'hoan Bushmen. *Current Anthropology* 16:115–145.

Wiget, A, and Balalaeva, O.
1997 Black snow, oil and the Khanty of West Siberia. *Cultural Survival Quarterly* 20:13–15.

Williams, M., E. Cook, S. van der Kaars, T. Barrows, J. Shulmeister, and P. Kershaw
2009 Glacial and deglacial climatic patterns in Australia and surrounding regions from 35,000 to 10,000 years ago reconstructed from terrestrial and near-shore proxy data. *Quaternary Science Reviews* 28:2398–2419.

Wilmsen, E. N.
1989a Pastoro-foragers to "Bushmen": Transformations in Kalahari relations of property, production, and labor. In *Herders, Warriors, and Traders: Pastoralism in Africa*, edited by J. G. Galaty and P. Bonte, pp. 248–263. Westview Press, Boulder.
1989b *Land Filled with Flies: A Political Economy of the Kalahari*. University of Chicago Press, Chicago.

Wilson, M. C.
1995 The household as a portable mnemonic landscape: Archaeological implications for plain stone circle sites. In *Beyond Subsistence: Plains Archaeology and the Postprocessual Critique*, edited by P. Duke and M. C. Wilson, pp. 169–192. University of Alabama Press, Tuscaloosa.

Wobst, H. M.
1974 Boundary conditions for Paleolithic social systems: A simulation approach. *American Antiquity* 39(2):147–178.
1976 Locational relationships in Palaeolithic society. *Journal of Human Evolution* 5:48–58.
1977 Stylistic behavior and information exchange. In *For the Director: Research Essays in Honor of James B. Griffin*, edited by C. E. Cleland, pp. 317–342. Anthropology Papers 61. Museum of Anthropology, University of Michigan, Ann Arbor.
1999 Style in archaeology or archaeologists in style. In *Material Meanings: Critical Approaches to the Interpretation of Material Culture*, edited by E. S. Chilton, pp. 118–132. University of Utah Press, Salt Lake City.
2000 Agency in (spite of) material culture. In *Agency in Archaeology*, edited by M.-A. Dobres and J. Robb, pp. 40–50. Routledge, London.
2005 Power to the (indigenous) past of present, or the theory and method behind archaeological theory and method. In *Indigenous Archaeologies: Decolonizing Theory and Practice*, edited by C. Smith and H. M. Wobst, pp. 17–32. Routledge, London.
2006 Artifacts as social interference: The politics of spatial scale. In *Confronting Scale in Archaeology: Issues of Theory and Practice*, edited by G. Lock and B. Molyneaux, pp. 55–64. Springer Verlag, New York.

Woodman, P. C.
1978 The chronology and economy of the Irish Mesolithic: Some working hypotheses. In *The Early Postglacial Settlement of Northern Europe*, edited by P. Mellers, pp. 333–370. Duckworth, London.
1987 The impact of resource availability on lithic industrial traditions in prehistoric Ireland. In *Mesolithic Northwest Europe: Recent Trends*, edited by P. Rowley-Conwy, M. Zvelebil, and H. P. Blankholm, pp. 138–146. Charlesworth & Co., Huddersfield.

Woods, J.
2009 Thinking outside the vessel: Variability in native ceramics of the Northeast. Paper presented at the 74th Annual Meeting of the Society for American Archaeology, Atlanta.

Worms, E. A.
1954 Prehistoric petroglyphs of the upper Yule River, north-western Australia. *Anthropos* 49:1067–1088.
Wright, B. J.
1968 *Rock Art of the Pilbara Region, North-west Australia*. Occasional Papers in Aboriginal Studies No. 11. Prehistory & Material Culture Series No. 2. Australian Institute of Aboriginal Studies, Canberra.
1977 Schematisation in the rock engravings of north-western Australia. In *Form in Indigenous Art: Schematisation in the Art of Aboriginal and Prehistoric Europe*, edited by P. J. Ucko, pp. 110–116. Australian Institute of Aboriginal Studies, Canberra.
Yamaura, K.
1998 The sea mammal hunting cultures of the Okhotsk Sea with special reference to Hokkaido prehistory. *Arctic Anthropology* 35(1):321–334.
Yamaura, K. and H. Ushiro
1999 Prehistoric Hokkaido and Ainu origins. In *Ainu: Spirit of a Northern People*, edited by W. W. Fitzhugh and C. O. Dubreuil, pp. 39–46. Smithsonian Institution Press, Washington, DC.
Yasuoka, H.
2004 Subsistence of the Baka hunter-gatherers in northwestern Congo Basin: An example of pure foraging life in tropical rain forests. *Asian and African Area Studies* 4(1):36–85 (Japanese).
2006 Long-term foraging expeditions (*molongo*) among the Baka hunter-gatherers in the northwestern Congo Basin, with special reference to the "wild yam question." *Human Ecology* 34:275–296.
Yellen, J. E.
1977 *Archaeological Approaches to the Present: Models for Reconstructing the Past*. Academic Press, New York.
Yellen, J., and H. Harpending
1972 Hunter-gatherer populations and archaeological inference. *World Archaeology* 4(2):244–253.
Zagorska, I.
2009 People and places in the Latvian Mesolithic: A case study from the Zvejnieki archaeological complex. In *Mesolithic Horizons* (Vol. I), edited by S. B. McCartan, R. Schulting, G. Warren, and P. Woodman, pp. 255–260. Oxbow Books, Oxford.
Zagorskis, F.
1987 [2004] *Zvejnnieki, Northern Latvia—Stone Age Cemetery*. British Archaeological Reports, International Series S1292. Archaeopress, Oxford.
Zaitseva, D. I., S. G. Popov, A. P. Krylov, Y. V. Knorozov, and A. B. Spevakovskiy
1993 Radiocarbon chronology of archaeological sites of the Kurile Islands. *Radiocarbon* 35:507–510.
Zhilin, M.
2003 Early Mesolithic communication networks in the East European forest zone. In *Mesolithic on the Move*, edited by L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund, pp. 688–693. Oxbow Books, Oxford.

Zigmond, M. L.
1981 *Kawaiisu Ethnobotany*. University of Utah Press, Salt Lake City.
Zilhão, J.
2007 The emergence of ornaments and art: An archaeological perspective on the origins of behavioral "modernity." *Journal of Archaeological Research* 15: 1–54.
Zvelebil, M.
1981 *From Forager to Farmer in the Boreal Zone*. British Archaeological Reports, International Series 115. Archaeopress, Oxford.
1993 Concepts of time and "presencing" the Mesolithic. *Archaeological Review from Cambridge* 12(2):51–70.
1994 Plant use in the Mesolithic and the implications for the transition to farming. *Proceedings of the Prehistoric Society* 60:35–74.
1997 Hunter-gatherer ritual landscapes: Spatial organization, social structure and ideology among hunter-gatherers of Northern Europe and Western Siberia. *Analecta Praehistorica Leidensia* 29:33–50.
2002 Indo-European dispersals and the agricultural transition in northern Europe: Culture, genes and language. In *The Roots of Peoples and Languages of Northern Eurasia IV*, edited by K. Julku, pp. 318–343. Societas Historiae Fenno-Ugricae, Oulu.
2003 Enculturation of Mesolithic landscapes. In *Mesolithic on the Move*, edited by L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler, and A. Åkerlund, pp. 65–73. Oxbow Books, Oxford.
2006 Mobility, contact and exchange in the Baltic Sea Basin 6000–2000 B.C. *Journal of Anthropological Archaeology* 25:178–192.
2008 Innovating hunter-gatherers. The Mesolithic in the Baltic. In *Mesolithic Europe*, edited by G. Bailey and P. Spikins, pp. 18–60. Cambridge University Press, Cambridge.
Zvelebil, M., and Jordan, P.
1999 Hunter fisher gatherer ritual landscapes. In *Rock Art as Social Representation*, edited by J. Goldhahn, pp. 101–128. British Archaeological Reports, International Series 794. Archaeopress, Oxford.

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Information and Its Role in Hunter-Gatherer Bands

Edited by

Robert Whallon, William A. Lovis, and Robert K. Hitchcock

Information and Its Role in Hunter-Gatherer Bands brings new and expanded insights into the essential and critical place of information in small-scale foraging societies. The contributors to this volume use examples from ethnography, archaeology, and linguistic anthropology to explore how such societies acquire, maintain, transmit, and utilize information. Among some of the many issues addressed are the differential distribution of information by age and sex/gender, its contextual activation, its symbolic and material manifestations, and the variable scales of time and space within which information networks operate. The degree of commonality that crosscuts the various approaches and analyses is noteworthy and allows the work as a whole to make significant advances toward defining a theoretical understanding of the multiple roles of information in band societies. Such definition, at the same time, allows us to isolate some of the major gaps remaining in our knowledge of this subject and to pinpoint those areas where further research will be most productive and important.

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