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The map is a primary tool in geographic research, and the discipline of geography has experienced a significant methodological transformation during the last three decades with the development and now near ubiquity of geographic information systems (GIS) technology. The introduction of this technology into Indian country has spurred a debate over the appropriateness and effectiveness of using GIS for Native mapping purposes. In this article, I review issues concerning the use of GIS in Native communities and present a case study of one particular tribe's implementation of the technology.

GIS are computer systems designed to store, manipulate, and portray spatial data, theoretically making analysis of such data easier, faster, and more powerful. However, many in the geographic community view GIS as a "contradictory technology that can both empower and marginalize people and communities."[1] At the same time that broader debates about the social impacts of GIS, public-participation or community-based GIS, and GIS and society developed in urban geographic research, so did a more focused debate centered around GIS and Indigenous peoples.[2]

INDIGENOUS GEOGRAPHY AND GIS

Major concerns that have been raised about the uncritical use of GIS in Native communities include perpetuation of established power relations through use of the technology, incompatibility between Native geographical knowledge systems and Western cartographic techniques inherent to GIS, and risks associated with storing Indigenous knowledge in digital form. Other concerns are more methodological in nature and include issues of cost and accessibility.

First, in the United States, the Bureau of Indian Affairs (BIA) has been instrumental in introducing GIS technology to many reservations. As Rundstrom, Deur, Berry, and Winchell point out, some tribes have curtailed BIA access to their databases because of a deep-seated suspicion of the agency

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and its historically assimilationist tendencies.[3] Even in "inclusive" projects designed to give voice to local knowledge, GIS can serve to reinforce historical power relations and the political status quo if applied uncritically.[4]

A second fundamental concern about the use of GIS in Native communities is whether such a Western system of gathering and using geographic information can be made compatible with the diverse geographical knowledge systems and forms of spatial representation of Indigenous peoples. In contrasting the two, Rundstrom typifies Western knowledge as striving for empirical objectivity and typifies Indigenous knowledge as often using other sources of information about the world such as dreams, visions, and information communicated from nonhuman elements that Westerners deem subjective.[5] The attempted translation of Indigenous knowledge into GIS can result in misrepresentation of Indigenous understandings as well as the loss of context.[6]

As an example of another type of misunderstanding of Native geography, Cole claims that the BIA's *Indian Land Areas* map has vast potential for corrupting the "untutored map reader's cognitive cartography."[7] Because most non-Indian North Americans do not understand the complex history of reservations or the multiple variations in the status of Indian lands, the simple caveat in the legend that warns map readers about the complexities of land ownership within the boundaries of reservations is not sufficient to prevent misinterpretation of the map. Additionally, Cole points out that tribal names were seldom used to designate reservation lands on this map, which resulted in even less communication between cultures.

Third, when Indigenous knowledge is stored within a GIS, the potential exists for that information to become accessible beyond its original intent.[8] For example, in mapping the locations of sacred places or sites of cultural significance to protect them from development, these locations may become known to outsiders who might use such information destructively or for exploitative purposes. Complicated issues of privacy and control of information can ensue from the use of GIS.

Finally, other significant concerns about the use of GIS in Native communities include methodological issues of cost, training, and accessibility. Most GIS software is costly, with a steep learning curve and rapidly changing versions and technological innovations; existing data to incorporate into a GIS also often come with a cost or are not useful without significant modification.[9] Because of the training and education needed to use GIS, its implementation in Indian country has often been through the use of "outside experts."[10] Chambers, Corbett, Keller, and Wood argue that "the norm appears to be for Indigenous communities to be dependent on external technical experts and support for the implementation and maintenance of specific GIS projects, and this dependency appears to remain through time."[11] Besides the cost and logistical challenges of such a situation, Johnson, Louis, and Pramono argue that when cartographic expertise remains with the outside expert, Indigenous communities are denied the ability to become agents in their own mapping projects. As part of their call for Indigenous communities to build what they term "critical cartographic literacy," Johnson, Louis, and Pramono encourage

Native community members to develop Western cartographic skills so that they may act as advocates as well as technicians for their communities.[12] In some cases, helping to develop critical cartographic literacy may necessitate that researchers working with Native communities adopt what Linda Tuhiwai Smith describes as "partnership research" or a research agenda driven more by the needs of the community than their own research needs.[13]

NATIVE USE OF GIS

Despite the aforementioned concerns, many Native communities have benefited from the implementation of GIS in a variety of settings. In Canada, negotiation and settlement of Native land claims entails the identification of settlement lands and their uses through the mapping of Indigenous knowledge; such maps have proven influential in land-dispute cases.[14] The documentation in GIS of Indigenous knowledge, including place names and sacred sites, can also assist in the preservation and renewal of Native language and culture.[15] Duerden and Kuhn describe the intent of the Gwich'in tribal council to preserve traditional knowledge by recording toponymy in an audiovisual GIS; places are linked to recordings of community elders who pronounce place names in the traditional language and detail other cultural information.[16]

The most common use of GIS in Native communities is likely for land- and resource-management purposes. Numerous issues are encompassed by this category, such as land-use planning, economic development, forestry and other natural resource management, infrastructure and road improvements, land (re)acquisition, property taxation, zoning, and jurisdictional issues. By using GIS in these types of activities, some Native communities hope to strengthen their position within intergovernmental relationships and to achieve greater self-determination. In a strategic plan document for the BIA's Indian Integrated Resource Inventory Program (IIRIP), the transfer of GIS technology to tribes is described as a "clear example of tribal sovereignty and support of tribal self-determination."[17] In short, many Native communities hope that the use of GIS in their activities will provide for empowerment inside their community and advocacy outside their community. To assist in the implementation of GIS by Native communities, initiatives such as the Indigenous Mapping Network and Canada's Aboriginal Mapping Network have been formed to provide GIS support and other mapping resources to interested communities.

In their discussion of the debate regarding Indigenous geography and GIS, Chambers, Corbett, Keller, and Wood call for documentation of the "middle ground" through case studies and critical review of how Indigenous peoples implement and learn to work with GIS.[18] In the remainder of this article, I describe the implementation of GIS in the land-management activities of the Bois Forte Band of Chippewa in northern Minnesota, as well as evaluate the effectiveness of such implementation in helping to achieve self-determination. In particular, I examine two issues that surround Indigenous geography and GIS—incorporation and protection of Indigenous information

and the use of outside experts—in the context of the Bois Forte land-use planning process. As a former employee of the Bois Forte Reservation tribal council (RTC) planning department, I also reflect on my personal experience as a non-Indian researcher working in and for Indian country.

GIS ON THE BOIS FORTE RESERVATION

The Bois Forte Reservation (*Bois Forte* means "strong wood" in French) is located in northern Minnesota, about fifty miles south of the Canadian border. The reservation consists of three different land areas: Nett Lake, Lake Vermilion, and Deer Creek (fig. 1). The Nett Lake and Deer Creek portions of the reservation were established by treaty with the US government in 1866; the Lake Vermilion Reservation was established by executive order in 1881. Nett Lake is the largest reservation land base (just more than one hundred thousand acres) and the seat of tribal government (fig. 2) as well as the location of the elementary school and other social services. Sixty miles to the east the Lake Vermilion Reservation (about two thousand acres) is home to the band's Fortune Bay Resort Casino and The Wilderness golf course developments. No tribal members live at Deer Creek (about twenty-three thousand acres); nearly all the land is in private ownership. Out of close to 2,700 currently enrolled tribal members, about 650 live on the Nett Lake Reservation and 150 live at Lake Vermilion. An additional eighty or so band members live at Indian Point and Sugar Bush, which are small areas of trust lands (about one hundred fifty acres total) that are located twenty miles to the east of Nett Lake on Pelican Lake.

The Bois Forte Reservation typifies the northern Minnesota boreal forest landscape of woodland and wetland; the reservation is comprised of wetlands and second- and third-growth forest (for example, aspen, pine, and spruce). Nett Lake covers 7,300 acres with an average depth of just a few feet and is an extremely productive wild rice lake, capable of producing more than one million pounds of wild rice annually.[19] Wild rice serves as an economic and cultural mainstay for the band; a portion of the wild rice harvest is kept for consumption and for ceremonial use, and the remainder is sold. Due to the reservation's remote location, Bois Forte members still earned much of their livelihood from the forests as late as the 1940s—in a seasonal pattern of collecting maple syrup, berry picking, harvesting wild rice, and hunting, guiding, and fur trading.[20] The isolation of the reservation and the lack of a diversified economy have made employment opportunities scarce; a historic unemployment rate of between 56 and 70 percent decreased to the 30 to 36 percent range in the late 1990s with increasing government and tribal business employment.[21] Currently, the economy of Bois Forte consists primarily of tribal government and logging and forest-related activities, as well as revenue generated from Fortune Bay Resort Casino.[22]

Bois Forte is one of the six member bands of the Minnesota Chippewa Tribe (which is organized under a single constitution), but it operates independently in governing its lands and community. The Bois Forte RTC entered into a self-governance compact with the BIA in 1995 and with the Indian
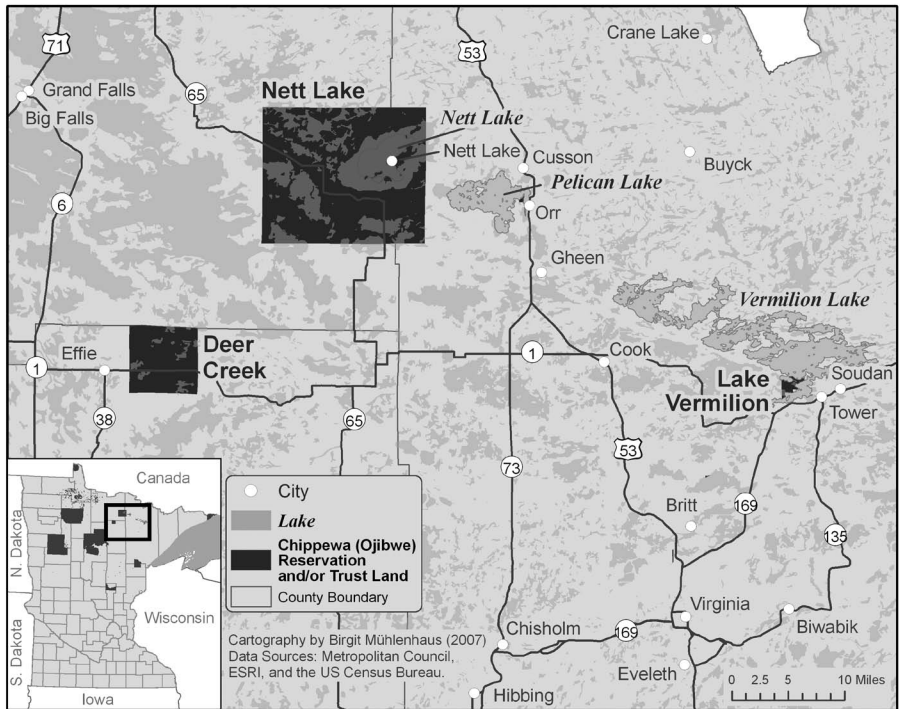
FIGURE 1. *Location of the Bois Forte Reservation. Map by Birgit Mühlenhaus.*

FIGURE 2. *Nett Lake Village, Bois Forte Reservation. Photo by William Whiteman.*

Health Service (IHS) in 1998 and locally administers most functions of these two federal agencies.[23] As is typical of all the member bands of the Minnesota Chippewa Tribe, the allotment of reservation lands after the Nelson Act of 1889 resulted in a "checkerboard" pattern of ownership and a drastic loss of Indian-owned land from within reservation boundaries. Almost half of the Nett Lake Reservation lands were transferred to the US government as "surplus" lands after the allotment process was completed.[24] Currently, about 40 percent of the lands of Nett Lake Reservation are in trust (either tribal or allotted) and the rest is in non-Indian ownership, with the majority owned by timber companies (42 percent) and state or county government (16 percent).[25]

Just as many other tribal governments have done, the Bois Forte RTC has proclaimed reacquisition of trust lands within the reservation a priority in order to restore and maintain the tribal land base as well as provide more housing opportunities for band members to return to live on the reservation. This is one area in which the implementation of GIS can prove quite beneficial to tribes. Of all potential tribal uses of GIS, Tim Krohn, the GIS specialist at Fond du Lac Reservation (near the city of Duluth, about one hundred miles southeast of Nett Lake), describes tracking and managing land ownership as the one that most "turns the crank" of the tribal council.[26] In his GIS work with tribal land records, Krohn has identified forty acres of land that were returned to the tribe because of surveying mistakes, and another three thousand acres within reservation boundaries of questionable ownership.

At Bois Forte, the primary use of GIS has been in the land-use planning process at both the Nett Lake and Lake Vermilion portions of the reservation; it has also been employed in development of a wild rice recovery plan, through the mapping of rice beds and features such as water depth, temperature, and plant density. In a preface to the wild rice plan, Tribal Chairman Gary W. Donald acknowledges the role that GIS can play:

> Over the years there have been many changes in land use, community development, and population at Bois Forte. Through all these changes, the "old ways" have remained very much alive here, and we promote these through our Elders. But we also recognize that there are advantages in applying new technologies to help sustain our land, our waters and our rice.
>
> Our Council believes that, just like the natural balance that exists between the resources, there is a balance between old ways and new ways of managing our resources. We must respect and carefully integrate all that is good from both perspectives. If we can do this, we know that we will continue to be graced with the extensive rice beds, the massive duck migrations, clean waters, and good land. This is our legacy to our young people into the twenty-first century.[27]

GIS first came to the Bois Forte Reservation in the mid-1990s through a grant made by the Administration for Native Americans (ANA) to fund a comprehensive land-use plan for the reservation.

THE BOIS FORTE RESERVATION LAND-USE PLAN

In 2001, the Bois Forte RTC adopted a revised land-use plan for the Lake Vermilion Reservation and, in 2006, adopted the plan for the Nett Lake Reservation. Because of the different characteristics of the two land bases (in physical and economic terms), the plans reflect different priorities. The plan for Lake Vermilion focuses on development associated with Fortune Bay Resort Casino and other commercial development, whereas the Nett Lake plan focuses on natural resource protection and residential development. In a survey of 167 band members for the Nett Lake plan, respondents ranked twelve items in order of importance; the two economic development items ranked of least importance, while the top-ranking items all concerned natural resources and the environment (for example, protection of the health and safety of persons on the reservation, protection of water quality, and assurance of safe and efficient waste disposal).

The stated goals of both Bois Forte plans include not only protection of the natural environment and resources and provision of housing and economic development but also preservation of the culture and traditional values of the band and of self-determination. The need for a comprehensive plan is described as especially important given the unique situation of the band as both governing body and major landowner within the reservation, and its function as both government and economic entrepreneur, as well as protector of Indian culture.[28] In the ANA grant application, the band describes the land-use plan as more than a product simply to "take up shelf space" and expresses a desire to use the computerized data library and GIS mapping capabilities to guide land-use and development decisions into the future.[29]

The foremost recommendation of both plans was to adopt proposed land-use districts as defined on accompanying maps, such as those districts shown for the Village of Nett Lake in figure 3. As an employee of the band's planning department in 1996, my duties included setting up the first GIS at Nett Lake, compiling a digital database for the reservation, and creating maps of existing and proposed reservation land uses.[30] At the start, much of my time was spent in contact with the BIA as well as state and local non-Indian governments and departments trying to acquire existing data for the reservation on forestry cover types, wetlands, lakes and streams, roads, section lines, and reservation and county boundaries. Fieldwork and community input, through the form of public meetings and personal interviews, were essential to identifying and defining districts for some of the ten different land-use categories outlined by the plan. The ten categories include commercial, community and recreational, cultural and historic, gravesite and cemetery protection, headwaters protection, light industrial, natural resource protection, public works and utilities, residential, and shoreland management. The purpose of the cultural and historic sites category is to protect such areas from any use or activity that would threaten the integrity of the site; the same applies to gravesite and cemetery protection areas. For such categories, it would have been impossible to delineate such districts, as well as to define what constitutes cultural or historic significance, without Indigenous knowledge of the land.
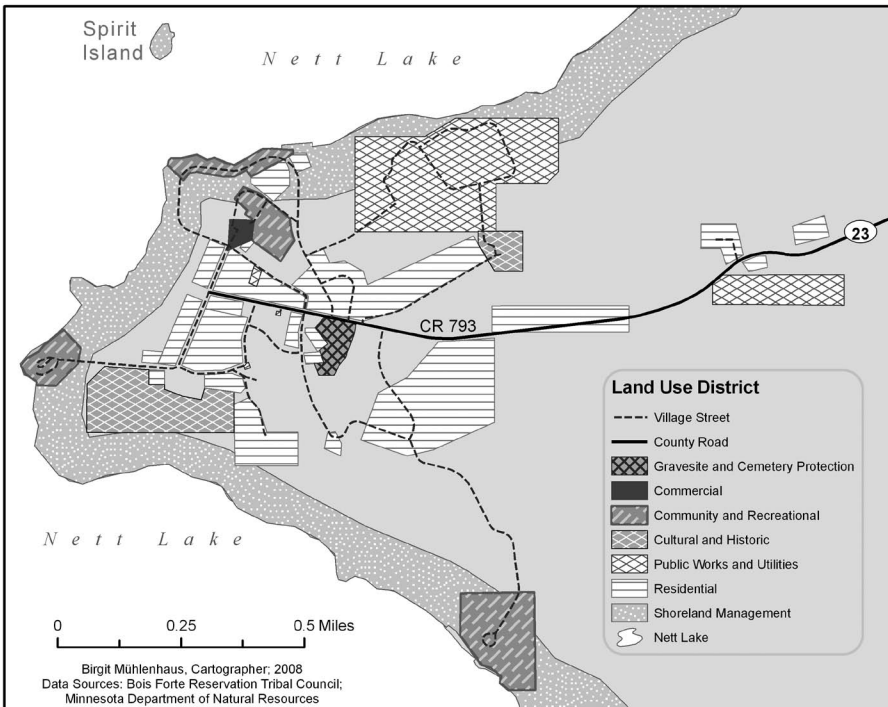
FIGURE 3. *Land-use districts within the Village of Nett Lake. Map by Birgit Mühlenhaus.*

Incorporation and Protection of Indigenous Knowledge

Of major concern in the implementation of GIS in Native communities is the degree to which Indigenous knowledge can be incorporated and the subsequent protection of such information. In the effort to incorporate Indigenous knowledge in land-use planning activities, one problem identified by Duerden and Kuhn is the solicitation of information from Native community members by predetermined themes.[31] Whether predetermined by Native or non-Native officials, the concern is that only a small range of Indigenous knowledge is used, and its removal from the broader context provides an incomplete picture of the environment. In the Bois Forte planning process, land-use categories were predetermined by the planning department (consisting of tribal members and non-Indians); however, community members helped to define what types of sites should be included in such categories as cultural and historic sites (for example, maple sugaring areas, berry-picking and medicinal plant-gathering areas, and osprey nests) or community and recreational districts (for example, picnic areas and lake access points).

Even with solicitation of community input, mapping of the cultural and historic districts proved a challenge for numerous reasons and remains incomplete. One common concern is a fear of exploitation of the sites (by Indian and non-Indian persons alike) if they are made public. An interesting

subset of this concern is worry over competition for certain types of sites, such as berry-picking areas, by other band members. Another significant and unexpected reason given by William Whiteman, comprehensive planner and band member, for individuals not sharing their knowledge of cultural and historic locations was a lack of confidence. If an individual learned of another site that he or she was not previously aware of, Whiteman said the individual sometimes felt "unqualified" to discuss the sites he or she did have knowledge of.[32] Another issue that occurred at Bois Forte was disagreement among community members about the location of some sites.[33] Finally, the Bois Forte planning department struggled with low attendance at community meetings during the planning process and had to shift its approach to conducting individual interviews to solicit Indigenous knowledge; Fond du Lac Reservation has experienced a similar situation in its zoning activities.

Once any kind of Indigenous knowledge is incorporated into a GIS, the next issue becomes protection of that information from unintended and/or immoral uses. As Andrew Datko, current CEO of the Bois Forte Development Corporation and former tribal planner, acknowledged, it is harder to keep information confidential once in digital form.[34] However, even though the planning department has perceived some community concern about making cultural information publicly accessible, there has been no tribal discussion of strategies to protect or privatize the maps or the historic and cultural site data. Whiteman hypothesizes that this may have to do with the isolation and remoteness of Bois Forte Reservation and the lack of perception of any imminent threat to reservation areas by outsiders, which may differ from other reservations across the United States. At Fond du Lac Reservation as well, there has been no discussion of privacy policies at the council level; in making GIS data available in an interactive map on the Fond du Lac tribal Web site, the decision was made at the staff level that certain information such as leases be hidden from public view and available only to authorized users and that the scale of the maps be small enough so that specific sites would be unidentifiable within the mapped cultural preservation zones.[35]

EFFECTIVENESS OF GIS AT BOIS FORTE RESERVATION

As the primary application of GIS at Bois Forte, land-use planning on the reservation has been a success in that tribal policy makers understand the need for a plan and for continued GIS use in land- and resource-management activities. Beyond the land-use maps, GIS has been used to identify areas for new residential development on the reservation and opportunities for land reacquisition. When asked directly about whether the use of GIS has contributed at all to tribal self-determination, Whiteman responded that it has been especially important in strengthening the tribe's position in intergovernmental relationships. Fulfillment of outside requests, such as a roads inventory for the BIA or a map of available medical services in the region for IHS, is made much easier, whereas in the past such requests may have gone unfulfilled. Further, Whiteman states that having a tribal GIS makes intergovernmental communication with state and county agencies such as

the Minnesota Department of Transportation or the St. Louis County Land Department more productive.

More challenging to the effective use of GIS at Bois Forte Reservation than a lack of awareness of the capabilities of the technology or a lack of potential applications, are issues of training, technical support, and personnel. When I left the planning department, I had mentored a young colleague in the use of GIS, but he soon transferred to a different position in the human resources department of the RTC and eventually relocated to Fond du Lac Reservation. Currently, Whiteman holds the position of comprehensive planner and is the sole user of GIS in the RTC; there is no dedicated GIS position in the tribal government. Therefore, the "comprehensive" aspect of his job description is appropriate because he responds to mapping requests for all tribal departments. Even so, he estimates that he is only able to spend about 20 percent of his time on GIS activities. Whiteman has essentially taught himself to use GIS software over time, and the lack of technical support in-house and off site can be extremely frustrating.[36] Whiteman believes the biggest challenge to effective use of GIS on the Bois Forte Reservation is personnel; the possibilities are "way beyond what one person can do." For example, the tribal roads and forestry departments would benefit greatly from GIS management of their resources, but there is neither the funding nor the personnel to support the creation and update of such digital databases.

CONCLUSIONS AND REFLECTIONS

Similar to what Duerden and Kuhn found among First Nations in northern Canada, I found the biggest challenges to effective implementation of GIS at Bois Forte Reservation to be methodological in nature. Lack of technological training and of personnel continuity are significant barriers in many Native communities. Duerden and Kuhn also make a distinction between realizing the full potential of GIS for decision support versus using the technology simply as a cartographic tool; one of the reasons given for unrealized potential was the system's relatively recent acquisition.[37] More than a decade after the acquisition of GIS at Bois Forte, the band has not used the technology for much more than simple cartographic representation, again primarily because of training and personnel issues.

In situations such as at Bois Forte Reservation, where it seems unlikely that methodological challenges will be overcome, one might ask whether the implementation of GIS through "outside experts" can still prove effective in tribal self-determination activities. This means that the second path proposed by Johnson, Louis, and Pramono for developing "critical cartographic literacy" within Indigenous communities—community members who act as both advocates and technicians—is not realized, making the first path—in which outside experts problematize the mapping process and attempt to learn, understand, and incorporate Indigenous cartographies into the process—all the more important.[38] As a non-Indian employee of the Bois Forte planning department and a GIS "outside expert," it was important for me to listen first and to let the tribal community guide the mapping process

and define what their Indigenous knowledge entails. Also it is important for me to sustain a relationship with the tribe and continue to assist whenever possible, even if that simply means providing or locating technical support. In some cases, especially intergovernmental requests for data, I believe that being the "outside expert" rather than a band member actually facilitated requests made on behalf of the tribe, as relationships among Indian and non-Indian communities in northern Minnesota can be quite contentious. Whether engaging with Indian country as community members or as "outside experts," my hope is that geographers can provide Native communities with the opportunity to employ GIS effectively in achieving self-determination and, ultimately, the opportunity to preserve culture and epistemology through such self-determination.

Acknowledgments

NOTES

1. Robert Rundstrom, Douglas Deur, Kate Berry, and Dick Winchell, "Recent Geographical Research on Indians and Inuit in the United States and Canada," *American Indian Culture and Research Journal* 24, no. 2 (2000): 85–110.

2. In the GIS and society debate, see, e.g., Sarah Elwood and Helga Leitner, "GIS and Community-Based Planning: Exploring the Diversity of Neighborhood Perspectives and Needs," *Cartography and Geographic Information Systems* 25, no. 2 (1998): 77–88; Trevor Harris and Daniel Weiner, "Empowerment, Marginalization, and 'Community-Integrated' GIS," *Cartography and Geographic Information Systems* 25, no. 2 (1998): 67–76; Nancy J. Obermeyer, "The Evolution of Public Participation GIS," *Cartography and Geographic Information Systems* 25, no. 2 (1998): 65–66. For GIS and Indigenous peoples, see Robert A. Rundstrom, "GIS, Indigenous Peoples, and Epistemological Diversity," *Cartography and Geographic Information Systems* 22, no. 1 (1995): 45–57; Frank Duerden and Richard G. Kuhn, "The Application of Geographic Information Systems by First Nations and Government in Northern Canada," *Cartographica* 33, no. 2 (1996): 49–62.

3. Rundstrom et al., "Recent Geographical Research," 97.

4. Daniel Weiner, Timothy A. Warner, Trevor M. Harris, and Richard M. Levin, "Apartheid Representations in a Digital Landscape: GIS, Remote Sensing, and Local Knowledge in Kiepersol, South Africa," *Cartography and Geographic Information Systems* 22, no. 1 (1995): 30–44.

5. Rundstrom, "GIS, Indigenous Peoples," 48; see also Duerden and Kuhn, "Application of Geographic Information Systems," 61.

6. Jay T. Johnson, Renee Pualani Louis, and Albertus Hadi Pramono, "Facing the Future: Encouraging Critical Cartographic Literacies in Indigenous Communities," *ACME: An International E-Journal for Critical Geographies* 4, no. 1 (2006): 80–98; Renee Pualani Louis, "Indigenous Hawaiian Cartographer: In Search of Common Ground,"

Cartographic Perspectives 48 (Spring 2004): 7–23; Robert A. Rundstrom, "The Role of Ethics, Mapping, and the Meaning of Place in Relations between Indians and Whites in the United States," *Cartographica* 30, no. 1 (1993): 21–28; G. Malcolm Lewis, "Metrics, Geometries, Signs, and Language: Sources of Cartographic Miscommunication between Native and Euro-American Cultures in North America," *Cartographica* 30, no. 1 (1993): 98–106.

      7. Daniel G. Cole, "One Cartographic View of American Indian Land Areas," *Cartographica* 30, no. 1 (1993): 47.

      8. Johnson et al., "Facing the Future," 89; Rundstrom, "GIS, Indigenous Peoples," 52–53.

      9. Duerden and Kuhn, "Application of Geographic Information Systems," 60.

      10. Kimberlee J. Chambers, Jonathan Corbett, C. Peter Keller, and Colin J. B. Wood, "Indigenous Knowledge, Mapping, and GIS: A Diffusion of Innovation Perspective," *Cartographica* 39, no. 3 (2004): 19–31; Johnson et al., "Facing the Future," 87.

      11. Chambers et al., "Indigenous Knowledge," 24.

      12. Johnson et al., "Facing the Future," 88, 90.

      13. Linda Tuhiwai Smith, *Decolonizing Methodologies: Research and Indigenous Peoples* (London: Zed Books, 1999), 178.

      14. Duerden and Kuhn, "Application of Geographic Information Systems," 54; Matthew Sparke, "A Map that Roared and an Original Atlas: Canada, Cartography, and the Narration of a Nation," *Annals of the Association of American Geographers* 88, no. 3 (1998): 463–95.

      15. Chambers et al., "Indigenous Knowledge," 21; T. J. Ferguson and E. Richard Hart, *A Zuni Atlas* (Norman: University of Oklahoma Press, 1985).

      16. Duerden and Kuhn, "Application of Geographic Information Systems," 58.

      17. Carl Hardzinski, Chuck Meyer, and Jeff Besougloff, "GIS in Indian Country," *GIS/LIS News* 13 (Summer 1996): 12.

      18. Chambers et al., "Indigenous Knowledge," 20, 29.

      19. Bois Forte Department of Natural Resources, "Bois Forte Nett Lake Restoration Project, Phase I," http://www.boisfortednr.com/COF/restoration/restoration.html (accessed 12 February 2007).

      20. Bois Forte Reservation Planning Department, *Bois Forte Reservation Vermilion Lake Community Land Use and Development Plan* (2001), 6.

      21. Bois Forte Reservation Planning Department, *Bois Forte Indian Reservation Land Use Plan* (2005), 22.

      22. Bois Forte Reservation, *Bois Forte Indian Reservation Land Use Plan* (2005), 21.

      23. Bois Forte Reservation, "Bois Forte Reservation Tribal Council," http://www.boisforte.com (accessed 15 October 2003).

      24. Bois Forte Reservation Department of Natural Resources, *Wild Rice Management at Bois Forte Indian Reservation: History and Current Perspectives* (2001), 14.

      25. Bois Forte Reservation, *Bois Forte Indian Reservation Land Use Plan* (2005), 18.

      26. Tim Krohn, Fond du Lac Reservation Resource Management, interview by author, 20 November 2007.

      27. Gary W. Donald, preface to *Wild Rice Management at Bois Forte Indian Reservation*, by Bois Forte Reservation.

28. Bois Forte Reservation, *Bois Forte Indian Reservation Land Use Plan* (2005), 8, 5, 7.

29. Bois Forte Reservation Tribal Council, *Application for Funding to the Administration for Native Americans* (1995), 19.

30. The initial GIS at Nett Lake consisted of ArcView GIS software (upgraded from version 2.1 to 3.0 during the first year) from Environmental Systems Research Institute (ESRI) and a basic 36 × 48 inch digitizer board to allow for the conversion of data from existing paper maps to digital form.

31. Duerden and Kuhn, "Application of Geographic Information Systems," 57.

32. William Whiteman, Bois Forte Reservation Planning Department, interview by author, Nett Lake, MN, 13 November 2007.

33. Bois Forte Reservation, *Bois Forte Indian Reservation Land Use Plan* (2005), 20.

34. Andrew Datko, Bois Forte Development Corporation, interview by author, Tower, MN, 13 November 2007.

35. Krohn, interview.

36. The difficulties Whiteman had in contacting the BIA Data Service Centers in Minneapolis and Colorado after the litigation over individual Indian trust monies resulted in a court-ordered shutdown of BIA e-mail and Internet systems were especially frustrating.

37. Duerden and Kuhn, "Application of Geographic Information Systems," 58.

38. Johnson et al., "Facing the Future," 90.