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FIRE AND THE CREATION OF LANDSCAPE REGIMES: WILDNESS AND INTERCONNECTIONS IN WEST AUSTRALIAN FORESTS

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Abstract

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Fire and the creation of landscape regimes: Wildness and interconnections in West Australian Forests

This dissertation tells a story about environmental change beginning with a group of people who try to maintain close and systematic connections with the landscape, connections they may be gradually losing. Fire managers in the southwest forest region of Western Australia have been systematically burning the region's eucalyptus forests with planned and mostly low intensity burns for many decades. Through these practices they have intertwined themselves in bodily, affective, and systematic ways with the landscape. Now, they are dealing with two major processes of change: climate change, which among other things comes as a long and ongoing drying trend and a tendency for bushfires to be more frequent and more severe; and a transition away from being a region shaped by an extractive industry, namely the timber industry.

Heterogeneity and ambiguity are central elements of fire managers' modes of engaging with the landscape in this period of change. In the practices of fire managers ambiguity is something quite specific: to be drawn to recognize in the forest simultaneous opposite possibilities, for instance both the possibility of resilience and collapse. Heterogeneity comes in a variety of forms in the practices of fire managers, many of which are oriented around what has burned and what hasn't. The most

important figures of heterogeneity for fire managers are future oriented, emergent and heterogeneities they regard to be something they can create or attain. Through figures of heterogeneity—most importantly a 'whole-of-forest mosaic' of burnt and unburnt areas, 'within-burn patchiness', and what I call 'favorable adjacency', fire managers try to maintain "a regime." When these forms of heterogeneity are all in the process of being actualized in the landscape this can result in an emergent state—the regime—where the landscape itself projects certain futures.

Further, I ask what happens when the systematic and bodily ties weaken and when the regime may be about to be lost? I argue that apprehensions of weakening ties occur through expectations that become more elastic, by the past becoming a more tenuous precedent for the future, by a changing affective pull of the landscape, and through being a system that may no longer be to bring about the outcomes it used to. Ultimately, this gives a story of environmental change different from those that dominate discourses both within and outside of academia—a story not of catastrophic newness that confounds people's attempts at containment and control, but of a landscape that appears to slowly and subtly recede from people's grasp even while they try to maintain their connections to it.

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Introduction

It was quite a feeling to throw my first matches onto the dry leaves on the forest floor and see that they "took," that low flames spread slowly in round and oval shapes, to see them gradually grow, seizing on the vegetation, transforming the landscape. I could hear the crackle of yellow flames curling and crunching long spiky leaves and elongated greyish leaves and turning them into black, white, and grey ash. I could feel the mild exhilaration of doing something that would usually be illegal, a slight sense of being transgressive, even though I knew that, effectively, it was as part of the West Australian state I was setting the forest on fire. And I was struck by the kind of fire my matches produced: small shapes in the leaf litter that sometimes joined up, sometimes grew bigger, but most of the time crept along the ground, behaving in ways that made me appreciate why many people use water metaphors for fire, such as fires that "trickle." It felt strangely effortless as we transformed shrubby bush into a forest almost free of understorey. With some casual matches here and there, the fire consumed what was dry enough to burn, and left a landscape of green and black.

My first prescribed burn was a burn called the Barton burn. It was one of the first burns that the Department of Parks and Wildlife did in the 2016-17 season in the southwest forest region of Western Australia. Around 4200 hectares of jarrah (*Eucalyptus marginata*) forest near the town of Mundaring in the Perth Hills—Barton forest block—was to be burned and on the second day I got to sit in with Jeremy[1] and

[1] The names of all my informants have been changed, with the exception of those that are public figures.

observe and ask questions. We spent the day on dirt tracks amidst the grey-brown furrow-stemmed jarrah trees, between spiky grasstrees (*Xanthorroea sp.*), the characteristic banksia trees with their zig-zag leaves and large cones; on a carpet of dry leaves, or on open, black and grey, recently burned soil. Most of the burn had been completed the previous day, when an airplane had dropped many small incendiary capsules in a grid pattern across the area and fire crews had manually burned the edges and patrolled to ensure that the burn stayed within the boundaries. On the second day, Jeremy and I drove around in a 4wd ute[2] to search for "pockets" that hadn't been burned, and "fill in" where Jeremy thought it necessary. For a burn this early in the season, he didn't want to leave too many unburnt patches that could flare up again when it got hotter in summer. Filling in pockets took most of the day, and close to dusk where two dirt roads met at the edge of the forest block, Jeremy and I caught up with the others who worked on the burn. The guys teased me because my work clothes still looked fairly clean and then they talked among themselves about tomorrow and the coming few days. They had several more burns coming up, granted the weather stayed the same.

This was one of the season's first burns, and in the following 9 months or so, at least 50 more burns of different shapes, sizes, and intensities would be lit by the Department of Parks and Wildlife across the corner of Australia called the southwest. In total, nearly 250 000 hectares would be burned that year for a trio of expressed

[2] "Ute" is short for utility vehicle, also called a tray-back. It is similar to a pickup truck. Possibly the most common ute in rural Australia is a white Toyota Hilux or LandCruiser.

purposes—lowering “fuel loads” for risk management, meeting different silvicultural objectives, and promoting biodiversity by contributing to diverse landscapes. Additionally, each year across the region farmers burn to regenerate pastures, and local volunteer bushfire brigades and private fire management companies carry out smaller burns around townsites.

Climate change, post-extraction, and an unusual management history

The southwest forest region of Western Australia is the site of an unusually large amount of fire-oriented activities and some recent collective experiences of being able to nudge the region to burn mostly in mild and manageable ways. One of my main goals in this dissertation is to figure out what happens in the confluence between this recent history of favorable involvement and climate change, which in the southwest of Western Australia involves a 40 year long and ongoing drying trend and more wildfires that are larger and more difficult to control. Notable among the most recent ones is the Waroona fire in 2016 which burned more than 70 000 hectares, destroyed one small rural town, and was so intense that it created its own fire-driven weather system. While the world seems to be burning in more dramatic ways, and massively destructive wildfires, especially in the US (see Petryna 2018), have become one of the major symbols of global environmental change, fire managers in WA persist with broadscale prescribed burns as part of their hope of maintaining the region as a place where most fires are small, mild, and manageable. But the southwest is also a place with a large amount of fire-oriented debate and controversy. The

encounter between an experience of manageability and the possibility of disastrous prospects is also an encounter tied up with socioeconomic changes, tensions and associations between scientists, foresters, and environmental activists; the persistence of settler colonial forms of thought and practice, the withdrawal of an extractive industry, and the gradual introduction of new pressures and new kinds of use. For most of the twentieth century, timber production and forestry have played a major role in shaping the southwest. More recently, the timber industry has seen a significant decline and the region is undergoing a transition that has a lot in common with a process happening many places in the world where industries are going away: it is in the midst of being a post-extraction place.

For more than 60 years, West Australian forest managers have systematically put fire into the forest, with numerous broad scale burns each composed of many little trickling fires (and occasionally ones that do more than trickle) that embody an aim to shape the forest landscape into something that is manageable and safe, as far as possible free from disastrous conflagrations. The Parks and Wildlife Service, a branch of Western Australia's Department of Biodiversity, Conservation and Attractions is the agency in charge of managing most of the publicly owned lands in WA, commonly called the CALM estate, consisting of lands vested in the Conservation Commission under the Conservation and Land Management Act (1984). Across the southwest, this includes about 2.5 million hectares of National Parks, State Forests, and various reserves, comprising the vast majority of the southwest forests. Fire

management and prescribed burning is one of the most important aspects of managing these lands.

The engagement with fire in the southwest stands out from most other places in the world. It forms a very stark contrast to other Mediterranean climate regions, as well as other settler colonial societies, where the dominant practices in the 20th century have been fire exclusion and suppression. Systematic fire *use* is according to fire historian Stephen Pyne what sets Western Australia apart from other places (Pyne 1991). The most clear contrast may be to large parts of the US, where staunch fire exclusion policies have been in place for most of the 20th century (see e.g. Carle 2002; Pyne 2004) and where burning is often practically constrained by other kinds of legislation (such as a clean air act the drastically limits days when burning is allowed and liability laws that can make it prohibitively risky for private land owners to burn), even in cases where it has been officially supported. The focus in the US, moreover, has been on avoiding ignition, and Smokey Bear has been instrumental in internalizing in the individual a responsibility for wildfire (see e.g. Kosek 2006). In Western Australia, efforts to avoid bushfire has long been focused on managing "fuel loads" across the forest rather than simply avoiding ignitions, and bushfires have generally been regarded as part of the responsibilities of the state. Prescribed burning has for many decades consistently had institutional and political support.

But the history of fire and fire management in the southwest also has important parallels to what has happened elsewhere. Just like on the West Coast of the US burning by the indigenous people in the Australian southwest was forced to end, and

in both cases, the landscapes that settlers arrived to were not some untouched wilderness but landscapes that had been shaped and tended by the indigenous inhabitants. As in many other places, foresters and the timber industry have been the ones shaping and managing the forests in the southwest for most of the 20th century. The southwest also has in common with other places lengthy conflicts between proponents of the timber industry and environmental activists. Finally, the different Mediterranean climate regions around the world are experiencing climate change in broadly similar ways, with longer periods of drought, less rain, and more extreme wildfire events in places already understood to be fire prone and fire adapted.

The systematic development and application of prescribed burning which makes the southwest a unique case started in the 1930s and took on something quite close to its contemporary form in the 60s and 70s. Today's burning practices developed mainly in the post-war decades. Before that, burning revolved around creating strips with low fuel loads as buffers around forest blocks where logging had taken place and which were then to be protected from bushfires in the early stages of regrowth, as well as similar buffers around towns and settlements in the forest. But only limited parts of the region would be managed in this way; most of the region had not yet been brought into the fire management regime, and the forest blocks themselves would not be burned.

A shift in the approach to fire came gradually, but became more official and systematic in the early 1950s. Some I spoke to date the shift to 1954 when Allan Harris took over as conservator of forests, the top position in what was then the

Forests Department.[3] Unlike his predecessor Theodore Stoate, Harris was an avid supporter of broad scale prescribed burning to lower fuel loads as the key to managing wildfire. Others would point to the Dwellingup fire in 1961, a monumental event in the region, as a decisive factor causing the Forests Department to turn to broadscale prescribed burning. The Dwellingup fire was a very intense summer bushfire that burned more than 150 000 hectares.[4] After the fire, a Royal Commission report (Rodger 1961) emphasized the need for more prescribed burning, concluding that part of the cause for the severity of the fire was that there had been little burning in certain areas in the years leading up to the fire (Rodger 1961: 51).

The report thereby supported the approaches that foresters had introduced in the 50s, and it laid the ground for the 60s to become a decade when much of the Forests Department's efforts were directed towards fire management. The report also helped cement a trust in the Forests Department as agents of fire management. From forest managers' point of view, the 60s and 70s represented a systematic endeavor to hone their capabilities in fire management and it resulted in a gradual removal of constraints of earlier years. They would have seen such constraints as being related to inadequate technology, inadequate resources, imperfect knowledge, and situations that were made difficult by the lingering effects of earlier kinds of management. All of these factors were gradually mitigated by research into fuel dynamics and fire

[3] Some have pointed out that many forest managers were convinced much earlier about the necessity of prescribed burning for fire management purposes but that various processes—such as wartime shortages and lack of resources—stood in the way (Underwood 2015a).
[4] The report estimates that fires during the 1960-61 fire season burned a total of 348 000 hectares.

behavior, by state and departmental prioritization of active fire management after 1961, and by the development of aerial burning from the mid-60s onwards. It all led to a period spanning a couple of decades when a significant proportion of the forest region was "on rotation," meaning that patches were burned more or less regularly every 6-8 years or so in order for the majority of the forest at any one time to have low levels of leaf litter, what fire managers refer to as "fuel."

The Forests Department took advantage of some of the features of the southwest that likely has made it lend itself more easily to fire management than comparable Mediterranean climate regions. Nearly all of the forest region is publicly owned and managed by one single agency. Most of the region also has a favorable topography, mostly ranging from flat to undulating with only scattered areas of steep terrain. These are both factors that made it easier for the Forests Department in the 60s to expand their network of fire roads. In this period, they established numerous dirt roads that still crisscross the region and play a crucial role as boundary roads in prescribed burns and as access roads in bushfires. The gentle topography and simple land ownership structure were also enabling factors for the development of aerial burning, which many would take to be the most important technological advancement and the factor most crucial to remove earlier constraints. The jarrah forest, writes Roger Underwood, a retired fire manager of many years, was "'made for' aerial burning, with its gentle topography, uniform forest and fuel types, [and] lovely spring weather with day after day of perfect conditions" (Underwood 2015a: 111). With aerial burning fire managers could burn much larger areas without a great increase in

manpower and could therefore take better advantage of the good days for burning when they occurred. After the first aerial burn in 1965 things happened fast and already the following year, nearly 80 000 hectares were burned using aerial ignition (Underwood 2015a: 63). Very soon the vast majority of burns in the region would follow the same pattern: to first burn the downwind edges by hand and then to ignite the core of the burn area with capsules dropped in a grid pattern from a plane, and then finally to "tie up" the burn by lighting up the remaining edges. Each of the burns would result in a within-burn patchiness which would be dependent on the weather, vegetation, and moisture conditions, and many such burns together would give a landscape "mosaic" of different fuel ages, or times since last burn.

The region is still burned in this way. Those who burn the forests are part of a management body that seeks to manage landscape through forms of heterogeneity—such as landscape mosaics and patchiness—rather than by simplification. This is something that makes them stand out from how social scientists have often conceived of management entities and governing bodies (see e.g. Scott 1998). It is the heterogeneous landscapes created by many burns that above all helped create what for many is a sense of a possibility of control. And it is the landscape in this state that now, with a changing climate and a changing region, is becoming more difficult for fire managers to maintain.

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Several processes of change began in the post-war decades. For one thing, more and more people and groups started to make claims on the southwest forest region. The environmental movement started gaining traction and influence, slowly in the 60s and 70s and with more force in the 80s, 90s, and 2000s (see Chapman 2008; Hutton and Connors 1999). Their main campaign over these years was to end logging of old growth forest in the southwest. In the 90s especially, the tall charismatic karri forests were the site of many tree-sits, forest occupations, and tense standoffs between activists and people from the timber industry. Meanwhile, the case against logging of old growth forest gained momentum politically and among the public and when the Labor party won the state election in 2001 they officially put an end to logging of all forest defined as old growth. The region also started gradually to see the influx and growth of new industries and new kinds of livelihood, such as winegrowing and tourism. None of the new industries have completely supplanted the timber industry, but they have been an addition of new sets of voices, alternatives, lifestyles, and preferences for what the region should be.

Along with pressures from the environmental movement and new industries came a decline in the timber industry and forestry activities. The amount of timber taken from the region's forests and the number of sawmills have both gone down significantly, especially with policy changes in the 90s and early 2000s. In the same period, large areas of the southwest have been redefined from being state forests, which were available for logging, to national parks and other kinds of conservation areas that are managed for other purposes than production of timber. The

environmental movement has also consistently been critical of prescribed burning, though not with the same fervor as they have opposed logging. And whereas logging and forestry are possibly on their last legs in the southwest, the region is still being burned a lot, almost as much today as in the 70s and 80s.

In the same decades, the region also started seeing a marked trend towards a drier climate. Since the 1970s, many places in the southwest have recorded more than a 15 percent decline in annual average rainfall. There is also a trend towards warmer weather, especially related to warm and dry weather extending further into autumn. Fire managers often expressed to me the sense that their burning seasons, in both spring and fall, were shrinking. Since the early 2000s there has also been a marked trend in the southwest towards more large and damaging bushfires. Fire managers, as we shall see in later chapters, have a slowly growing sense that more fires and burns these days are behaving in unexpected and erratic ways.

Climate change comes, of course, not alone, but in combination with many other contemporary pressures. A more encompassing notion of environmental change (such as the Anthropocene), would also in the case of Western Australia point us towards the effect of pathogens, especially *Phytophthora cinnamomi*, bauxite mining, post-war economic development and new openings to global markets, damming of rivers and groundwater abstraction, higher populations, and more intensive kinds of use. In the southwest, one of the forms that climate change takes is that of a forest region burning more frequently and more intensely. And this trend arrives along with post-

war development, greater involvement of different people and groups, post-extraction changes, and the uncertain combination of all of these processes of change.

In short, in the southwest of Western Australia two major global processes of change—climate change and post-extraction—enfold in a place with a unique history of environmental management and a recent experience of being favorably intertwined, perhaps even a sense of being nearly in control. Fire managers today manage forests in more unstable times. They more often and more acutely have to confront the wildness of fire in the landscape, even as they try to maintain the close and systematic interconnections they have with the forest through burning. The southwest might tell us something about a near future in which fire will be common in more places around the world, a future where more and more people have to confront landscapes that burn. And it might tell us something about a present where people's landscape ties are weakening.

Pyro-landscapes

The jarrah tree *(Eucalyptus marginata)* has rough fibrous bark, grey-reddish-brown where it hasn't been burned, black after fire; green, slender and slightly curved leaves that fall to the ground and become "fuel." They come in many shapes and sizes—from poles as tall as 40 meters in what foresters call "high quality sites," to a small shrubby multi-stemmed tree in sites with low rainfall, high evaporation rates, and shallow soils lacking in nutrients. The karri tree *(Eucalyptus diversicolor)* is the other major forest-defining tree in the southwest. Majestic and magnificent are words often

used to describe karri trees with their tall stems with patchy white, yellow, and brown bark and their wide crowns that fan out up to 50-60 meters above the forest floor. Karri occurs in forests where it is the only overstorey tree or in mixed forests along with either jarrah or marri (*Corymbia calophylla),* mainly in a belt of relatively high rainfall and deep loamy soils in the Warren bioregion roughly between Nannup in the east and Walpole in the southwest. Marri, a bloodwood, so called because of its red gum, resembles jarrah from a distance and is distinguished most easily by its boxy bark. Marri is found throughout most of the southwest, in association with both jarrah and karri. Other notable tree species in the southwest are the tall "tingles" (*E. jacksonii, E. guilfoleyi, E. brevistylis*) found in a small area near Walpole on the south coast; the white-barked Wandoo *(E. wandoo),* occurring in open forests and woodlands on the eastern fringes of the jarrah forest; tuart *(E. gomphocephala)* in a patch near Busselton on the west coast; and bullich *(E. megacarpa),* flooded gum *(E. rudis),* blackbutt *(E. patens),* peppermint *(Agonis flexuosa),* and paperbarks (*Melaluca* sp.) on various wetter sites. Banksias (e.g. *Banksia grandis),* sheoaks (*Allocasuarina fraseriana* and *Allocasuarina decussata*.), snottygobbles (e.g. *Persoonia longifolia*), and acacias are some of the most common midstorey trees throughout much of the region. Heathland and banksia woodlands are found along the coast.

Fire managers know these trees, plants, and ecosystems, among other things, by how they burn. They know the jarrah, for instance, by how its leaves accumulate and dry up on the forest floor becoming more flammable over spring and summer, by its thick

fire-resistant bark, and by characteristic ways of growing back after fire from underground lignotubers and from new shoots along their stems and in their canopies. They know the karri forest through long flammable bark strands that peel off from their stems; through the dense, tall, and sometimes wall-like understorey; and through a landscape that is fairly wet for large parts of the year, but that can still burn ferociously when it dries up in summer. Gradually I learned to know these forests in some of the same ways.

The landscapes of the Australian southwest are ***pyro-landscapes***, landscapes that are both shaped and understood by how they burn. We can think of pyro-landscapes as places where shared memories condense in the landscape (cf. Schama 1995, Basso 1996) specifically around instances or traces of fire, where place names evoke shared stories of fire, and where landscapes are filled with memories of flames. We can think of them as landscapes where people have a tendency to project politics, perspectives, and ideologies onto the ways in which the landscape burns, and where inequalities may be mapped onto who is and is not allowed to burn and who are most vulnerable to fire (cf. for instance Kosek 2006). We can also think of pyro-landscapes as places that are materially shaped by traces of fire, where fire is an important recurring pattern of motion—a "refrain" (Ogden 2011, Deleuze and Guattari 1980)—and where burning is a key part of the "task scape," the interrelated array of activities that take place there (cf. Ingold 2000). The southwest has long been a pyro-landscape in all of these ways. And many other places around the world are now going through processes of pyro-landscape formation.

This is not to suggest, of course, that we should necessarily expect places that come to burn more often to become like the southwest of Western Australia. Instead, let me emphasize again how unusual the southwest's history of landscape scale burning and other fire practices is, compared to other modern western nation states. It is quite unusual nowadays for people to have these close and experiential ties with fire in the landscape. This is something people in many places of the world used to have, but these days, most of us are drastically alienated from fire[5]. Landscape fire is one of the environmental processes where a transition from widespread common use—for instance by farmers and pastoralists—to complete absence of use has been the most dramatic in the past couple of centuries. Many things we used to do in the environment have gone through similar transitions from being common to being obscure, irrelevant, or illegal[6]. But few so completely as fire practices. Very few people, especially in the western world and the global north, have any experience *at all* with wildfire or with landscape scale fire of any kind. Not a lot of people engage with fire this way, and even fewer engage with fire across thousands of hectares of land. Extremely few of us in today's world know and experience fire *as a landscape-shaping tool*.

[5] A fire-centered history of modernity might tell of a transition from landscape burning to internal combustion (see e.g. Clark and Yusoff 2014). Through a "supplanting of free-range combustion" (Clark and Yusoff 2014: 210) every day by "some 400 trillion tiny explosions" (204) "burning ancient biomass in tightly sealed compartments" (212) we seem to have imprisoned fire.

[6] We can think for instance of food practices that are untied from seasonality, or the fact that to mingle with microbes such as lactobacilli in order to preserve food has become an uncommon preoccupation of artisans or those with a special interest in returning to traditional ways or going 'back to nature'

Land managers and fire fighters in Western Australia, however, do interact closely with fire on a regular basis. And though it should be noted that this close interaction with fire arose not from some long-maintained tradition, but from settler forms of management that regarded themselves as modern and scientific and that were involved in breaking the bonds that aboriginal people in the region had with fire and the landscape, they are close and experiential ties nonetheless[7]. Most fire managers are up close and personal with dozens of fires every year, many wildfires and many planned burns. The latter, the fires they use to shape the landscape, are fires that are not completely tamed or controlled, but also not wildfires. They are fires that afford them ontological possibilities, giving them powers of transformations that span across many scales. Such fire involves both wildness and interconnections.

In my time with fire managers, then, I've gotten to experience something that few people get close to. I learned about burning and fire at a week-long fire crew member training course and at several different pre-season training sessions. But much more importantly, I also learned to burn out in the forest where I participated in prescribed burns with fire managers and crews from Parks and Wildlife. For some of my burns I followed field officers, those who organize and run the burn on the ground. For other burns I was part of a fire crew. I learned different things about fire and burning from these experiences. The field officers oversee operations on the ground, they direct the crews where and when to go light up, in what patterns, and where to patrol and put

[7] Suffice it to say that close and experiential doesn't necessarily entail virtuous and good.

out fires. Fire crews are typically the ones closest to the fire itself. Most often, they are the ones handling drip-torches and hoses. They do the legwork. I learned to see a burn as a whole, and I learned to see it in its smallest details.

Over time, I got more accustomed to the habits of fire in the southwest forests. I experienced how the forest responded to our actions and how we could respond to its actions. I learned that some trees and bushes tend to burn in rapid hot flashes, while others burn more slowly, at least at first. Some types of vegetation usually burn gradually, while others seem to burn with threshold dynamics—very slowly until there's enough heat and then very rapidly. I learned what kind of vegetation to put a spot in to ensure that it would catch and in what sort of places it might start slower or even not start at all. I learned to pay attention to slopes (fires burn much quicker up-hill), aspect (in the southern hemisphere slopes with a northerly aspect will usually be drier), and perhaps above all to wind. Fire managers see the wind in forecasts and on maps, but they also see the wind as it moves the landscape; in leaves in the tree crowns, and in the flames themselves. Few things can change a burn or a fire so drastically as a change in the wind. A stronger wind from a different direction can turn a small docile burn into a big blaze. But fire also has dynamics of its own. I experienced what fire fronts do when they meet—in the "junction zone" where they feed into each other and grow—and I saw how fire can "pulse," climb up in the canopy, then come back down again as it loses touch with ground fuels, then build back up again, and so on. Fire is dependent on, feeds off, synthesizes its surroundings, but is not reducible to them. I also learned what happened after fire. I

saw numerous examples of the different ways that plants sprout, flower, and grow back. I learned gradually to see the landscape as a place that has burned and a place that will burn again.

Burning gave me an appreciation for the transformative potential of fire, both locally and in the way that many burns can be used to create patterns across the forest. And I gained an aesthetic appreciation for fire[8]. I came to experience the joy of having a sense that fire was playing along. Most of the work done on a prescribed burn is not actually lighting up. Typically, one would light up for an hour or two and then patrol and "mop up"[9] for a day or two. When mopping up—hosing down hotspots, smoldering roots, hollow logs, and the like—I would sometimes get a sense that I was struggling *against* a landscape that seemed to stubbornly want to stay alight. I experienced on several occasions believing that I had put something out, only to find it smoking again when we passed by the same spot a while later. When lighting up, on the other hand, my feeling was more often one of gently nudging the forest to burn, of working *with* the vegetation. It was a sense of doing the right thing at the right time—like picking ripe fruit. Just like fire "trickles" even while it is clearly not

[8] Saito argues that there is a paradox in aesthetic appreciation of dangerous things, because the danger they pose keeps us at a distance, and "too much distance will deprive us of the opportunity to have a fully engaging aesthetic appreciation of them" (Saito 1998: 107). But since dangerous things tell us stories, there may be good reason for us to try to appreciate them aesthetically. Of course, I cannot say how we might have looked at fire if it hadn't been dangerous, but we did appreciate the beauty of fire and of things that had burned.

[9] Mopping up involves putting out what is still burning on the edges after the fire has gone through. This is especially important near roads that are used by the public to lower the risk of trees falling across the roads. The other main reason to do mop-up is to make sure there is as little risk as possible that something flares up again and ignites forest outside the burn area. In most cases, mopping up progresses by first putting out "hots and highs," spots still burning and spots up high in trees, then by putting out everything that's still smoking at least two tree-heights in from the road.

water, fire is also not a creature, but it sometimes inspires us to think of it as creature-like, as something that lives, and that has urges and wants. Of course, there are many times when the fire doesn't do what we want it to do, and as we shall see in the coming chapters (especially chapter 7), such moments are experienced to come more frequently than they used to. But in learning to burn, I clearly experienced the sensation of using fire with ease.

It is the meeting between these close and embodied experiences of fire as a landscape shaping tool—that is, fire as both something to use to manage landscapes at a region-wide level and something one feels and knows up close with the whole body— and contemporary processes through which fire in the southwest is becoming more frequent, more intense, and more uncertain that my focus lies. If more places around the world, as they burn more often and with more dramatic consequences, are now going through processes of pyro-landscape *formation*, through which they are increasingly becoming places that must be understood and engaged with as places that burn, in the southwest, we instead see what can be thought of as pyro-landscape *exacerbation*. What was already pyro-landscapes are becoming even more fiery, even more characterized by how they burn.

In the southwest, two major processes of change that are characteristic of our times intersect with an unusual recent history of involvement. Pyro-landscape exacerbation happens and is deeply felt. But at the same time, the people who burn the southwest still retain a sense that it may be possible for wildfire to be managed through their ongoing involvement. They insist on trying to maintain the ongoing patterns of

interaction with the landscape—oriented around prescribed burning—that they have kept up for more than half a century. What's so fascinating about this is that it is a situation where it's very clear that the question of whether we are facing something that is out of our control or something that is still manageable is very much unsettled. Have we lost control or can we still manage? This is one of the great existential questions of our time. In the southwest, a kind of wildness that is simultaneously new and familiar meets interconnections that are both bodily and systematic. As such, fire in the southwest forests may prompt us to tell a particular kind of climate change story: one that highlights both peoples' ongoing efforts to keep themselves connected with landscapes in good ways, and the gradual and subtle ways that they experience the landscape to be escaping their grasp.

Ambiguity and heterogeneity

You don't have to hang out with fire managers for very long before noticing how much they talk about patchiness, mosaics, and diversity. In offices, meeting rooms, and on the fire ground, there is often talk of soft-edge mosaics, fine grained patchiness, small-grained mosaics, mosaics of fuel ages, mosaics of burnt and unburnt patches, mosaics of intensities, and more. They talk about patch sizes, patchy ignitions, and burns that gave a patchy result. About unburnt patches, patches of leaf litter, of burns that were too patchy and burns that were not patchy enough. They also talk about connectivity of patches, about avoiding uniformity, about diversity of fuel ages, diversity of seasons when burns occur, diversity of habitats types, and diversity

of fire intensity. Another thing I noticed a little later on, as I got closer access to fire managers, as it were, "backstage," was that they were often strikingly reticent to pronounce with certainty what was going on in the landscape and strikingly comfortable with situations that seemed to suggest or embody opposite simultaneous possibilities; for instance, the possibility of the forest being both resilient and near collapse. In fire managers, I encountered a group of people who seemed almost obsessed with forms of patchiness and mosaics, and who thought carefully and frequently about opposite possibilities for what might be going on in the forest. I have encountered people who, in confronting climate change and post-extraction changes, do so through forms of thought and practice that are aptly gathered by the terms heterogeneity and ambiguity. These are ways of thinking through which fire managers make sense of the present southwest forest and their role in its future. In the southwest, I will argue, the response of fire managers encountering drier and more fiery conditions with a recent experience of control is crystalized in a peculiar mode of engagement and form of knowledge. They confront this situation still with a degree of faith in their practices, but also with a notable appreciation for *forest ambiguity* and *landscape heterogeneity*. Mixedness and connections are at stake for fire managers. In ambiguity and heterogeneity we can find both their efforts to keep themselves intertwined and their apprehensions of losing grasp.

In environmental anthropology and other fields concerned with human-environment relations, heterogeneity, ambiguity and related concepts have lately been useful in one particular way: to help us refute dualisms. The anthropological literature on

human-non-human relations has developed through fairly distinct stages in the last few decades. From being concerned mainly with the non-human world as it is involved in human affairs as either "sustenance or symbol" (Shanklin 1985), scholars began not long ago to take actual human-non-human interaction seriously in its own right[10]. Non-humans, environments, and landscapes were then no longer merely a backdrop, a resource, or a canvas onto which humans project their concerns.[11] In this recent period, a main driver of inquiries for many has been to transcend or break down dualisms, such as the dualism between nature and culture or human and non-human. Heterogeneity, ambiguity and several related concepts have been central to many of these interventions. Scholars have been pointing out how the human and the natural intertwine, they have made arguments with hybrids, naturecultures, cyborgs, the post-human and the more-than-human, and several other figures of mixedness. For social scientists and humanities scholars, thinking with hybridity, natureculture, and the like, have been ways to allow them to avoid seeing worlds made out of something natural on the one hand and something human, cultural, or social on the other. These concepts have helped us be critics and counterweights to "moderns," to purifiers, and to those that impose hierarchies and order and then call it "natural." They have let us tell stories about mixedness and complexity in a time when

[10] Indeed, to "take seriously" is a trope from this period.

[11] Kirksey and Helmreich wrote in 2012: "Creatures previously appearing on the margins of anthropology—as part of the landscape, as food for humans, as symbols—have been pressed into the foreground in recent ethnographies" (545).

governments and publics seem increasingly infatuated with simple quantitative thinness (cf. Porter 2010).

Refuting dualism has been useful for long and useful for a lot. Now, I think its time to ask ourselves if it hasn't become constraining. Inquiries driven by this motivation tend to reproduce similar stories and analyses, analyses that find mixedness where people supposedly thought there were distinct and separate elements. Stories of this kind are extremely prevalent in Science and Technology Studies (STS), where analyses have very often proceeded by finding uncertainty, complexity, intimacy, and tinkering—and heterogeneity and ambiguity—in what on the surface may appear to be hard and unambiguous facts reached by a simple following of rational scientific procedures.[12] They have argued that things are much messier (cf. Law 2004) and more complex (Law and Mol 2002) behind the image of thinness that science sometimes presents, or that (perhaps more often) society pushes science towards (cf. Porter 2012). This kind of stories are also very widespread in the literature on human-environment relations where many have argued that if we look closely, we will find tentative "care"- and uncertainty-oriented practices—where process, attentiveness,

[12] Latour, for instance, in *Science in Action* (1987), argues that behind the public image of a confident and knowing "ready-made science" there's always a more uncertain "science in the making." Mialet (2012) finds that there is an extensive, complicated, and shifting network that enables Stephen Hawking to outwardly be portrayed as a disembodied genius. Traweek (1988) finds that scientists who regard themselves to be the product of a natural potential that can be revealed are actually made in long and complicated social processes. Hustak and Myers (2012) argue that there are urges towards a non-masculine, non-dualist, union-oriented "erotic" kind of science behind neo-Darwinian chemical ecologists' presentation of themselves as rational, logical, masculine, and neutral. And there are numerous other examples of analyses that proceed in structurally similar ways by finding something like a thick world behind thin descriptions (Porter 2012), hybridity behind purification (Latour 1993), uncertainty behind facts (Fleck 1935, Rekdal 2014), fluidity where things appeared to be solid (de Laet and Mol 2000), and cyborgs and networks behind knowing subjects (e.g. Latour 1988).

and attunement are central aspects (cf. Mol 2008)—in what may at first appear like domination, ordering, or scientific distance.[13] Or similarly, that if we slow down and pay more careful attention we find that humans are not alone in their actions, but perform them as part of heterogeneous working groups (Bennett 2009) composed of both humans and non-humans; that behind a human that may appear to be an independent actor are myriad co-species collaborators; that a human is not just a human, but rather a portmanteau (cf. Crosby 1986). A drive to refute dualisms also has a tendency to produce a particular kind of climate change narrative, one where nature's hybrids return to violently confound the moderns attempts at control. In this story, hybrids demonstrate that "we have never been modern" (Latour 1993), and climate change demonstrates that the world could never be contained and controlled.

My concern is that certain heterogeneity- and ambiguity-concepts come to take too much of their shape from what they are defined in opposition to, and that the stories we tell of environmental change come to take too much of their shape from the dualisms we are driven to refute. STS and the more-than-human literature teach us to see heterogeneity as that which mixes nature and culture and ambiguity as that which overflows purification processes or confounds simplification. However, we might thereby miss some of the patterns that can be constructed from empirical specificity.

[13] Scholars have found such practices in veterinary practice (Law 2010), among anglers (Bear and Eden 2011), in agriculture (Singleton 2012) and aquaculture (Lien 2015), in hunting practices (Ogden 2011), and in many different research settings (Candea 2010, Despret 2004, Myers 2015a), to take just a few examples. In many cases, the argument is that distance only comes by way of practices that involve intimacy and care (e.g. Candea 2010), i.e. that some semblance of dualism is *made through* entanglements.

In my encounter with fire managers—who incessantly think and act with heterogeneity and ambiguity—I have come to realize that a drive to refute dualisms can make it difficult to ask other interesting and important questions. Questions about how elements of engagements with environmental change arise from the ground up. Questions such as: what can a world look like in which the most crucial and most salient parameters for apprehension, understanding, and intervention is the way things burn and the way things grow? Questions not about how the world violently resists and exceeds modern attempts to order it, but about how it can still slowly escape the grasp that people have had on it through close and practical diversity-oriented projects in other ways. And questions open to take seriously imperfect binaries that are not assumed to be an elaboration of the dichotomy of nature and culture. These may be things we miss if we primarily have the means and methods to recognize and articular climate change as a sudden and dramatic confounding of peoples' efforts to order and dominate. We must look closely and systematically at what happens with peoples' ties, what happens to their efforts to muddle and connect, and not just what happens with peoples' efforts to purify.

In my case, both ambiguity and heterogeneity involve a pull towards dualities. Ambiguity often involves being drawn in opposing directions, and some of the forms of heterogeneity that are important for fire managers involve a binary between burnt and not burnt, fire and not fire. These are imperfect binaries, but they are meaningful *as binaries.* Especially these days, in times of landscape transformations and widespread contests around knowledge, we may want to be open to telling new kinds

of stories of scientific practice and of human-environment interactions. And it's important that we're able to tell a variety of climate change stories. As such, I'd like to take our insights beyond just confronting dualism, in order to build our concepts of heterogeneity and ambiguity from the empirical ground up.

I start from the point of view that we should not be too surprised to find people who tolerate ambiguity and embrace heterogeneity. How unusual is a tolerance of ambiguity and heterogeneity really? Perhaps not very. We can look to classics in the anthropological literature to find people who were highly attentive to the diverse and ambiguous features and habits of for instance cattle (Evans-Pritchard 1940), gardens (Malinowski 1922), and pigs (Rappaport 1968). But I also argue that we shouldn't simply take complexities for granted, as something out there for people to confront, know, and order in various ways. In these classic accounts, a diverse and ambiguous world is usually implicitly present, a worldly chaos for culture and social structures to order, utilize, and sometimes appreciate. In STS these phenomena have also been taken for granted in a way, as that which will always escape or overflow modern attempts at purification. For anthropology the objects of concern have been culture and social structure; for STS they have been moderns and modernity. Heterogeneity and ambiguity have performed a background role in both cases, and have rarely been systematically conceptualized in either of these fields.

Another point worth making is that there are certain imaginaries that can make us think of ambiguity and heterogeneity as more unusual than it is. We can regard them as circulating narratives that instill in us expectations against which we come to see

people who tolerate ambiguity and embrace heterogeneity as strange. One of these imaginaries comes through stories we tell about domestication and civilization; another in stories about climate change.

Firstly, there are conceptions of humans gaining control over environments that once were wild built into the conventional domestication narrative. Too often, according to Lien et al. (2018), this is a linear progression narrative involving species that are transformed from wild to domesticated by way of humans' intentional actions upon them, and humans progressing from being at the mercy of a wild world to being in control. This is a story that is both simplistic and harmful, downplaying that domestication more often than not is gradual, mutual, multispecies, not unidirectional, and involving unintentional effects (Lien et al. 2018). So, when I refer to fire managers' experience of having been almost in control, this should not be taken to refer to a state without ambiguity, complexity, liveliness, and even mess. It should not be taken to be an accomplished state at all. Likewise, wildness should not be understood as that which is yet to be brought under control. Instead, I intend wildness to point to something that lies in relations between people and fire, that lies in real ties based on experiences with a liveliness that can sometimes be dangerous to them.

Secondly, conceptions of loss of a control we once had are built into often-told climate change stories. In such stories we encounter dramatic newness and collapse, an unambiguous break with the past, and an end of nature as we used to know it.[14] As

[14] The end of nature has become a well-worn trope both within and outside of academia (see e.g. McKibben 1989, Wapner 2010, Purdy 2015, Dunlap and Cohen 2016).

I will argue in following chapters, to lose a complicated kind of control can be a gradual, subtle, and ambiguous process. Control in domestication was never so smooth (Swanson et al. 2018); loss of control in contemporary environmental change is rarely a clean break—partly because control was never so simple, but partly also because losing grasp can happen in many different ways.

Perhaps we shouldn't expect there not to be ambiguity in these situations; perhaps we shouldn't expect people not to appreciate heterogeneity. And perhaps this—to expect there to be heterogeneity and ambiguity in some form, but not to take them for granted—should be no more than a starting point, a point from which we can construct more specific versions of heterogeneity and ambiguity, and a wide variety of carefully told climate change stories.

It is no great insight nowadays merely to point out that there is heterogeneity and ambiguity in our fieldsites. And so, when I argue that fire managers see the forest as heterogenous and ambiguous, I intend something quite specific. It is not just saying 'they think and act in complex ways', or 'they appreciate complexity in the forest'. It is true that modernity—which many associate with projects of ordering, simplification and disambiguation—also contains other kinds of thought and practice. But this doesn't need to be more than a starting point. Both heterogeneity and ambiguity come into their own specific forms beyond their mere capacity to refute binaries. I will argue that ambiguity, for fire managers, is to be pulled by both their knowledge frameworks and by details in the forest to recognize *simultaneous opposite possibilities*. More specifically, to see in details in the landscape at once the

possibility of resilience and the possibility of imminent collapse. Heterogeneity, in turn, comes in various forms in fire managers' practices and thought styles. The forest managers various kinds of "patchiness" and "mosaics" are heterogeneities made of elements that burn and don't burn, and that burn in different ways. These are various forms of mixedness that we start out assuming simply to have mixedness in common (rather than having in common a mixing of something nature and something culture). From there, we shall see they are mostly future-oriented forms of mixedness, heterogeneities that lie not just in the way a landscape displays a mixedness in the present, but more importantly how that mixedness projects heterogeneity into the future. And most of them are heterogeneities that can be produced or swayed (rather than discovered and protected). They are also heterogenous forms that can combine with each other to produce an emergent state, a "fire regime," through which fire managers seek to maintain a forest that promotes and constrains different futures.

Both of these sensibilities or thought tendencies have a history. A current openness to ambiguity is a tendency that forest managers have been nudged into by experiences over the past century and by precedents from recent history in Western Australia and elsewhere: several different moments when the forest has been thought to be nearly on the verge of collapse, without yet collapsing. These precedents are part of what makes it meaningful for forest managers today to look at the forest and see a landscape that is at the same time resilient and possibly on the verge of collapse. A tendency to think and act with forms of heterogeneity in current fire management practices has West Australian forestry as an important influence. Forestry, as I will

argue in chapter 5, is characterized by a way of thinking about the forest as a place where one can produce heterogeneous patterns. It is also a future-oriented way of thinking, where any present landscape is considered above all for the future forms it enables. Today's fire managers have inherited from the past century's foresters a particular way of thinking about time and heterogeneity.

The thought styles crystalized in the confluence between two processes of change and an unusual history of management are historically shaped. But they are also—and have been throughout their history—affected, impinged on, and shaped by the forest itself. Ambiguity and heterogeneity are knowledge formations, but they are also elements of the landscape itself. If we no longer need to so forcefully refute dualism, this assertion can be a freeing starting point, neither a paradox, nor an argument in itself, but an opening to new ways of inquiry and new forms of description. I'd like to convince you in the course of these chapters that we can write about knowledge as something that is not representational, and that this doesn't mean we cannot still write about knowledge. And we can write about the forest as something that's not a completely external reality, and this doesn't mean we aren't still writing about forests. Heterogeneity and ambiguity—if we can untie these concepts from the bonds of dualism and non-dualism—will help me describe forest and forest knowledge at the same time.

Strong description

The world consists of people who describe forests and people who describe representations of forests. And many of them police the lines of separation. I aim to develop careful and systematic ways of doing both at the same time. Discussions around global environmental change is an area where this seems especially needed. Debates about the forests in the southwest are ripe with people claiming to describe (or "speak for") the forest and then being accused of merely revealing their biases. Environmentalists say they describe the forest and advocates of timber production and more prescribed burning hear only values, interpretation, and ideology. And vice versa. The same dynamic saturates debates about global environmental change nearly everywhere in the world. The concept of "strong description" is my call to embrace doing both.

The term strong description is inspired by Sandra Harding's (1992; 1995) notion of "strong objectivity," a feminist intervention into debates around truth and politics in science. Harding and others argued that the way to strengthen objectivity is not to purge scientific methods of their cultural, social, and historical situatedness, but rather to lay bare these conditions. Objectivity gets stronger the more it knows about its own conditions of possibility and how they could be otherwise. Like Harding, I call for a double refusal. Harding's strong objectivity is a refusal to let standpoint theory mean that we have to let go of objectivity[15]. Mine is a refusal to let go of knowledge, and a refusal to let go of the forest itself. And it is a refusal to let the liveliness of both

[15] "Where the 'old objectivity question' asked, 'objectivity or relativism: which side are you on?', the new one refuses this choice…" (Harding 1995: 331).

disappear into mixedness. The realization that our descriptions come through practical ties embodied in knowledge frameworks does not mean that we cannot describe forests, or that it isn't forests that we are describing. But this is also not to fall back on correspondence theory and the idea that with the right methods we can achieve correspondence between knowledge and the world. To insist on the active role of the forest is not to suggest we *only* need to look at the forest. Knowledge too is lively and surprising in its own ways.

Strong description, moreover, can also be a way to reconcile two desires that are currently prevalent in studies of human-environment relations—an urge to think about knowledge as/about something non-dualistic, but also as something collaborative with a world that is lively in its own ways. Put different, on the one hand there's a felt need to recognize *wildness* in what we used to call the 'natural world' (e.g. Clark 2011)[16,17], and on the other a desire to keep a strong focus on *interconnections* and entanglements. By wildness here I mean a sense of the world being lively, but also potentially lively in ways that people may experience to be erratic and sometimes violent. The idea of the Anthropocene instills a need for systematic and imaginative ways to capture both wildness and interconnections—to focus on both without one overshadowing the other. The southwest of Western

[16] Fire has indeed been one figure through which scholars have pointed to a wildness that is now very conspicuous (Petryna 2018). Petryna also describes wildfire with words like "monstrous" and "rogue."
[17] A wildness that is not the "wilderness" many have criticized (e.g. Cronon 1996, Kosek 2006). And a wildness that is also not just that which cannot be contained by modernity. Many prefer other terms than "wild" and "nature" as these can evoke unwanted connotations. As such, Clark, for instance, prefers using other terms, such as the "volatility" of "worlds beyond us" (Clark 2011).

Australia is full of landscapes that are lively, often in dramatic ways. Wildfires in recent years have burned in ways that are defying expectations. But in the company of forest managers, the southwest is also very notable as a site of interconnections. Fire managers in the southwest are both systematically and bodily intertwined with the landscape through fire. Wildness and interconnections capture a central part of my leading question about what happens in the meeting between climate change and a place with a strong history of involvement and control. To develop ways to capture both is needed in this situation, it is motivated by my experiences with fire managers in the southwest forests, in situations where both wildness and interconnections demand our attention.

Harding's strong objectivity followed debates on epistemology and power. Strong description comes at a time when anthropology has recently dealt with an *ontological* turn. What difference does this make? My intervention is not primarily to locate knowledge more strongly in history, like strong objectivity does, but to locate knowledge in the forest and locate the forest in knowledge. This is not to say that knowledge isn't historical, but that the past forest knowledge that influences present forest knowledge was also affected by the forest itself. In the past too, the forest moved people and impinged on their conceptions of it. In the past too, people conceived of the forest's actions through their own knowledge frameworks, which also played into how they allowed themselves to be swayed.

People with different standpoints and knowledge frameworks conceptualize the world differently: "for standpoint theories, the grounds for knowledge are fully saturated

with history and social life" (Harding 1992: 445). For those who engage with forests, knowledge is saturated with history and social life, but it is also saturated with leaves, soil, bark, and fire: with different standpoints and different practical knowledge frameworks people are also open to the world in different ways. We let the world in and close ourselves off in different ways. I want to point not just to a relation between what one sees and knows and where one is situated, but a relation between knowledge, standpoint, and a world that is lively in its own ways, and whose liveliness affects our ways of knowing.

With strong description I want to express an aim to describe at the same time the forest and "the forest," along with the practices and processes that connect them. I aim to describe at the same time the forest and the framework that allows (/constrains) someone to apprehend and describe the forest (as forest). Strong description of climate change would involve a simultaneous attention to details and features in the landscape and the knowledge frameworks and practices that allow us to see them as climate change. It's a refusal to let either one stand on their own, and a refusal to let both be flattened into mixedness.

I suggest, somewhat simplified, that we can look at strong description in three ways—starting from the forest, starting from knowledge, or starting in between. We may regard these as three strategies for strong description. The first way is a view of the forest *through* the knowledge and practices of, in my case, fire managers. This involves asking what goes on for these people that allows this or that way of describing things. It involves describing the forest—an actual, but partial forest—as it

appears through a particular framework of knowledge. Descriptions here are strong because they show you where they are weak. They are strong because they know they are imperfect, strong because they presume the existence of alteration and alternatives. This is a description of the forest that is also a description of the knowledge frameworks that make it possible to see the forest as such.

The second way is a view of knowledge *through* the ways in which the forest impinges on, affects, intrudes, forces itself on, sways, stirs, moves, and nudges what fire managers do and think.[18] This is a view of forest knowledge through its affective and material ties with the forest. There is something that impinges on our knowledge and ways of thinking, which never fits precisely with what we are able to apprehend as "the forest," but nevertheless nudges and sways the frameworks of knowledge and practice that makes it possible for us to call it a "forest."

Both of these approaches aim for not just knowledge on its own, and not just forests on their own—but still knowledge, and still forests. I aim to describe knowledge forms that the forest has an active role in, and forests that knowledge forms have an active role in. But strong description doesn't have to start from one side or the other. We can think of it that way, but it may also be that the more we get accustomed to ways of thinking that are neither dualist nor non-dualist, the less we have to start from one side or the other. A third way is to start out not from one or the other end, but with something that *must* point to both the forest and the knowledge frameworks that

[18] These are all verbs to convey kinds of influence as far from 'determine' as from an 'arbitrary relation'.

make it possible to see the forest as such. This is what I attempt to do with 'ambiguity' and 'heterogeneity', as well as with the notion of pyro-landscape. When writing about "forest ambiguity," for instance, I intend for the question of whether ambiguity lies in knowledge or in the forest itself *not* to be one we can or should answer or resolve. Instead I want concepts such as "forest ambiguity" to invite us to think about both at the same time. When, in the following chapters, the reader encounters statements and stories about the forest or forest knowledge, I encourage you to resist the urge to settle for yourself whether these *really* or *only* concern the landscape or representations of it.

Chapter overview

All the chapters in this dissertation work on a few different levels. Firstly, they are all together a story about forest- and fire management in the southwest of Western Australia. This story is an example of larger processes, but it's not only that. I maintain that to tell this story is valuable for its own sake as well. Secondly, and at a more general level, they are an inquiry into what happens in a meeting between two contemporary processes of change—climate change and post-extraction—and an unusual history of involvement and management. Or, in other words, how people encounter wildness with a history of close and systematic interconnections. In a sense, this dissertation is a story of climate change. It is an attempt to craft a careful and systematic account of changes in ties between people, forests, and fire—changes that are not so much a dramatic newness confronted by moderns that have

disconnected themselves from the world, but gradual changes that happen to people who have a history of being consciously and closely intertwined with the landscape. Thirdly, the dissertation is an analysis of and argument about pyro-landscapes, ambiguity, and heterogeneity. On this level I aim to highlight some of the processes and frictions that can be involved when a place is created and reiterated as a pyro-landscape, and to analyze how heterogeneity and ambiguity can be characteristics of changing landscapes and the way that people deal with them. These three are concepts through which I address the question of wildness and interconnections, but they are also part of an argument about what these three concepts/phenomena are in themselves. Finally, and this especially the case for the chapters in part 2 and 3, this dissertation consists of experiments in strong description.

The dissertation is divided into three parts organized according to the concepts of pyro-landscape formation, ambiguity, and heterogeneity. Part 1, "Figures and frictions of pyro-landscape formation," consists of two chapters that tackle the fraught issues that fire practices are tied into, such as conflicts around timber production and rural development, and the place of aboriginal people in both land management and in the popular Australian imaginary. Processes by which a region comes to be a pyro-landscape—a place that is shaped and understood by how it burns—happen through patterns and figures, and happen in non-smooth ways. Specifically, in the two chapters of part 1, we will see that the southwest, as it goes through processes of pyro-landscape formation and exacerbation, is tied into and looped through figures such as the fire-prone region, the 'transitioning town', the controversial Forests

Department, the ‘traditional bushman’, and ‘aboriginal fire management’. The latter is explored in a chapter of its own, chapter 2, where I argue that fire managers and others mobilize figures of “aboriginal burning” and “indigenous fire management” to understand the southwest forests, and in the process, they place actual aboriginal people at a distance. Processes through which the southwest comes to be understood as a pyro-landscape can also be processes by which aboriginal people continue to be excluded.

In Part 2, “Ambiguity,” I delve into forest ambiguity through both knowledge frameworks and active and changing landscapes. Chapter 3 is a story of three periods in the last century where forest managers and other people concerned with the southwest forests have experienced dramatic change. With logging and fire in the early 20th century, with *phytophthora* dieback and pressures from economic development in the 60s and 70s, and lately with the drying climate, we can recognize three long moments where the forests have been thought possibly to be on the verge of collapse. But stories of possible impending collapse coexist with stories of stability and resilience—compelling stories about forest plasticity and regrowth that are not just thought, but felt and seen in encounters with the forest. Chapter 4 goes further into forest ambiguity in the ongoing present, especially focusing on the relations between forests, fire, and the drying climate. Forest managers in the southwest see the forests both through knowledge frameworks that include precedents for stability and collapse in the past century and through their own embodied experiences in the forest.

Together these inspire them, make it meaningful for them, even sometimes compel them, to see ambiguity in the forest.

Part 3, "Heterogeneity," consists of three chapters that all explore landscape heterogeneity as something that involves both knowledge formations and features and patterns of the landscape itself. In chapter 5 I tell a story of forest policies over the last decades and forestry practices today. In this chapter I ask: what happens to forest management when it is no longer driven by the timber industry and forestry? I argue that the answer is to be found in changing and enduring forms of landscape heterogeneity and ways of thinking about time. Forest heterogeneity is thought, created, and impinged on by the forest, and for foresters and forest managers, it is usually oriented towards what the forest can be in the future.

In chapter 6 I follow burns through the long and ongoing planning process. In this process, which involves both engagements with the forest and with visions of what can and should be achieved, fire managers attempt to realize in the landscape a combination of certain forms of heterogeneity—a whole-of-forest mosaic, a within-burn patchiness, and what I call favorable adjacency. When these are all together in the process of being actualized, a "fire regime" can be the resulting state. Finally, in Chapter 7 I look more closely at what it means for fire managers to be in a "regime," and what it means for the regime to slip from their grasp. Maintaining the regime, and its forms of heterogeneity, involves both bodily and systematic interconnections. With the drying climate in recent years, the forest seems to indicate to fire managers in subtle ways that the regime may be about to be lost. I argue that this is felt through

expectations that are prompted to be more elastic, by the past turning from a model for the future into a more tenuous precedent, and through a weakening of the emergent embodied ties that exist between fire managers and the forest.

I conclude with a reflection on what it means to "manage" fire and other situations in which people have been closely intertwined with landscapes for some time and now grapple with environmental change. I propose that the case of fire managers in the Australian southwest gives a different kind of climate change story than what we are used to: a slower process of gradually losing grasp of a landscape regime, where changes are found not in sudden catastrophic newness, but in subtle shifts in bodily expectations, and gradual apprehensions of being part of systems that may no longer be able to affect the same outcomes as they used to. This gives a story not of how nature returns with force against people who have tried to subdue it, but of a forest that may be slowly slipping away from people that are intently trying to maintain connections.

Part 1 — Figures and frictions of pyro-landscape formation

Fig. 1. A public noticeboard in the town of Greenbushes asks, “are you bushfire ready?” and encourages people to “prepare, act, survive.”

Chapter 1—Encountering the Southwest

On most autumn days, you can find your way on to emergency.wa.gov.au and see the south west corner of Western Australia dotted with dozens of little blue and black triangular flame icons. They signify burns and fires, the blue ones for fires and the black ones for burn-offs, and for most of April and May, as the long dry summer is increasingly punctuated by showers and rainy days, the flame icons are scattered throughout the region. After prohibited burning periods close, typically in the latter part of March, the black dots start to crowd out the blue ones, indicating farmers burning firebreaks and windrows, burning to clear land, or to stimulate their crops—these are the fires that used to be referred to as "settler's burns."[19] But bushfires still occur, often into May, some years even into June.

A similar map can be found on the website of Parks and Wildlife, where flame icons in yellow, red, and blue point to the prescribed burns that are currently active. The yellow icons signify the burns planned for lighting on the given day, the red for previous days' burns where more ignitions are planned, and the blue for burns that are still active but where there are no planned ignitions for the day. If you live in the more rural parts of the southwest, you're likely to wake up many mornings to the sweet, slightly fragrant smell of eucalyptus smoke, and sometimes a light white veil that softens the morning sun. If you live in Perth, such smoky days are less common,

[19] The term "settler's burns" was used in annual report until the early 70s, when it was replaced by other terms such as "escapes from private property."

and often worthy of a news segment, where a meteorologist may talk about the atmospheric conditions that have allowed smoke to accumulate over the city, and a spokesperson for Parks and Wildlife may apologize for the inconvenience caused to those suffering from respiratory problems, but ask for understanding as the burns are crucial to prevent large and damaging summer bushfires.

Over a large part of any year, the south west is on fire in a variety of different ways. Some are burn-offs on private property; others are burns lit by the Department of Parks and Wildlife according to a prescription; others again are wildfires. Some fires scorch, flare up, run, kill, devastate and defoliate; others "trickle," "clean up," stimulate, and release. Some are started by lightning, some by a match, and some with hundreds of small incendiary capsules dropped from a low flying airplane. Some fires are useful, others are dangerous; some fires may enhance the diversity of the landscape and the vegetation, whereas others can simplify and lay waste. Some fires do exactly what people want, others don't.

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I open with glimpses of encounters with the Australian southwest. In the company of both fire fighters and environmental activists, professors and former mine workers; while holding a drip-torch in the forest or a note pad at a conference, the southwest presents itself in fragments with diffuse outlines. We will meet those that experience the southwest to be gentrifying, as well as those that urge timber and mining towns to embrace the transition to new industries and new ways of life. Sentiments concerning

the forests and fire are closely connected to the region's history of logging and forestry. We will also meet some of those on the ground who burn the southwest forests, and I will introduce you to regulators in wildfire bureaucracy and people in local government who try to instill in regular people a consciousness about fire risk. After the Waroona fire and other destructive bushfires of recent years, fire protection has increasingly become a project of preparation and readiness, systematized and abstracted in factors, levels, and ratings. At stake, both within problematically transitioning towns and in public and institutional reactions to the recent more destructive bushfires, is what kind of place the southwest is and should be, and for whom; in what ways it is appropriate to live in the region, and who should have a say. People continually understand, perform, and shape the southwest as a pyro-landscape, and they often do so through fraught figures: the figure of the timber town and the transitioning region, the traditional bushman, the controversial department, and the faraway urban government; and not least, the risky and fire-prone landscape.

Grimwade

It wasn't difficult to see that Grimwade had been settled. But when Ben, the regional manager in the South Coast district of Parks and Wildlife told me that he had worked there in the late 70s as a field officer for the forests department, the small forestry settlement whose only remaining signs of that time are a few concrete foundations, some remnants of stone walls, a small network of dirt roads, and a smattering of exotic kinds of trees suddenly seemed very different. Some of the traces may be as

much as a hundred years old, from when the township was called East Kirup, from when it was home to people working at one of Millars Jarrah and Karri Company's saw mills. Today, though, most of those who drive out to Grimwade, about 20 km east of Kirup, do so with RVs, caravans, or trucks loaded with tents and swags[20]*. They neither cut nor plant trees but recreate within the forest. They park by the man-made little lake or in the shade of a large conifer. Perhaps they're a family with small children, backpackers from the UK, or grey nomads. In the surrounding area, road names such as Grimwade Rd, Kirup-Grimwade Rd, Lowden-Grimwade Rd, Grimwade-Wilga Rd, and Greenbushes-Grimwade Rd are witnesses of a different time. Now a web of roads connects surrounding settlements to a ghost.*

A lifetime in the Department

In the 70s and 80s, Ben was among the people who managed the forests around Grimwade. When I met him in his office in the coastal town of Albany, he allowed me a look back at his long career as a forest manager. Ben started in the Department straight out of school. He went to high school in the south coast town of Albany and he had his mind set on working in the navy. But when someone from the forest department came around to recruit, he jumped on the opportunity and joined. He started in the Department's Cadet Program in 1976 and his first appointment was in

[20] Swag is an Australian slang term for portable sleeping gear, usually a mattress and a sleeping bag rolled together.

Walpole on the south coast. After that, he worked in Grimwade for a couple of years, which at that point was an outstation for the forests department office in Kirup.

Ben talked in circuitous ways, with digressions and reflections about amalgamation of districts, about managing at a "finer scale" back in the day, about seeing himself as more of a technical-pragmatic kind of forest manager, rather than the scientific type, and about the interesting changes afoot now that many senior people in the department were about to retire. I listened and took notes at a little round table in Ben's office in Albany.

After his stint in Grimwade, Ben was transferred to Manjimup; then after a few years, he was back to Walpole. Every two or three years he would be transferred, he told me in another digression. The way they saw it, the managers back then, was that people being trained needed experience in different places. It was "an excellent synergy," Ben said, between long term knowledge of particular places and the advantage of fresh perspectives coming from experiences somewhere else. We talked about how managers tend to move around, whereas crews, the guys on the ground, often stay for decades in the same town. This both requires and promotes a sense of humility among the managers. Especially when it comes to fire, Ben said, it's good to have people with a wealth of local knowledge, referring to the crews, because there are things about the local vegetation and how it burns that it can take quite a bit of time to get properly acquainted with.

Ben's next stop was in Busselton, where he was the district manager for Blackwood District. After several years there, he worked for a short while as the regional manager in the southwest region, before recently moving back to Albany to take up the position of regional manager there. He had climbed the grades in the Department and come back around. For Ben, this was kind of like coming home.

For the most part, Ben and I talked about changes. Ben mentioned that they are about to undergo an organizational change once again. The newly elected government wants to rebrand and reorganize the department. He told me about the plans, which he himself had only learned about a couple of weeks before. They were going to amalgamate the Department of Parks and Wildlife with Perth Zoo, King's Park, and Rottnest Island and make it the department of "Biodiversity, Conservation, and Attractions." The rationale for the Premier, he explained, was to have fewer departments and a simpler system. For most practical purposes, Parks and Wildlife would likely stay the same, as a distinctive branch within the larger department. Then he told me about the previous mergers and demergers. This process was nothing new. He talked about the merger of the Forests Department with fisheries and national parks that created the Department of Conservation and Land Management (CALM) in '85. Then about the labor party wishing to take the timber production side out of CALM—in part because CALM was accused of embodying a conflict of interest—and creating the Forest Products Commission in 2000. The next change after that was quite a big one, as they became the Department of Environment and Conservation, the version of the Department I myself had encountered when I did my first stint of

fieldwork in Western Australia in 2012. This restructuring involved a merger with the departments responsible for licensing and environmental regulation. All of a sudden, Ben said, they became responsible for overseeing industries, which was a very different thing than what they used to do. And the merger, "it was not because our boss woke up and thought it was a good idea," Ben said, it was something that came from the politicians. "Our reason for being was the land base," Ben said referring to the CALM people, who came from the Forests Department and went into DEC. "The other guys' reason for being was the regulations act." They became a big department with what he felt to be a too wide array of responsibilities. The change to DPAW in 2013 was a de-merger. "Our business changed for the better," he said, "it brought us back to focus." As for the impending merger, he seemed cautiously optimistic that not too much would actually change.

Another big change, Ben continued, was what he referred to as "the gentrification of the southwest." When he was at Grimwade in the late 70s, for instance, the district was dominated by what Ben called "traditional farming," and back then, the forests department was in the process of buying up farms to establish pine plantations. And now, when you drive past towns in the same area, he said, "there's boutique, wineries, people seeking retreat from the city." And with that, he continued, "comes a change in the level of expectations." It's a much more diverse and engaged community, Ben said. People have moved in from elsewhere, and people have started questioning land management.

Restructurings of the Department were driven not just by economic and political considerations, but by more and more people losing faith that foresters could manage the region in a good way. In a way, the trend towards a more involved community culminated in episodes of civil disobedience during the forest protests in the 90s. Ben understands that it is an emotional issue, he said while telling a story about protesters who had come in and occupied his office, sitting on the floor and in his chair until the police arrived. And they still get a lot of criticism, even if it's not quite as confrontational these days. "It is practically a sport in Australia to have a go at a government department," Ben said and in a curious way managed to convey a situation in which both himself as a government employee and the people criticizing his work seemed to be underdogs.[21] But in the end, it is the community's land, he said, and his job is to manage it on their behalf. In the end, "the broader community and the politicians needed to resolve that debate." And after him and his colleagues had been the people out there doing the harvesting when they were the Forests Department, they were also the people whose job it was to roll out the new policies after they had been put in place—"sometimes you have to be a bit schizophrenic."

Pemberton

[21] The underdog position is clearly a highly regarded position for many Australians, as can be seen for instance in the figure of the "Aussie Battler." It also comes through in the tall poppy syndrome, and in a widespread Australian anti-authoritarian sentiment. The Australian underdog is often up against the government in a kind of David and Goliath story that is played and replayed in Australian popular culture. A couple of examples include the classic 1997 comedy "The Castle" and the 2006 mockumentary "Kenny."

One of the most popular films playing in theaters in Western Australia in 2017 was "Jasper Jones," a coming of age thriller-drama with commentaries on racial tensions in rural Australia set in a West Australian town in the 1960s. The scenes showing the fictional town Corrigan were all shot in Pemberton, a small town three and a half hours' drive south of Perth. There, some hoped that the film would bring more visitors, but also that it would contribute to enticing people to move down from Perth in favor of the quiet former mill town nestled amidst the towering karri trees. Within the property market, some thought Pemberton would become the new Margaret River[22], referring to the southwest's most popular tourist destination. Meanwhile the shire president estimated the film to potentially be worth millions for businesses in the shire[23].

In Pemberton, the saw mill closed in late 2016. It had been in operation for just over 100 years. In addition to weathered old blokes with cabbage tree hats and dinged up utes, the streets of Pemberton now make room for those who come to visit wineries, for backpackers and week-end tourists, for people who walk the Bibbilmun track and ride mountain bikes on the Munda-biddi, and for visitors to the national parks. Some former millworkers' cottages have been turned into a hostel. Having been to Pemberton periodically over the course of nearly three years, I could almost convince myself that I could feel a change. Weren't there more hip little cafes than last year?

[22] https://www.domain.com.au/news/starring-role-in-new-movie-jasper-jones-shines-spotlight-on-tiny-wa-town-of-pemberton-20170320-gusny8/
[23] https://thewest.com.au/news/australia/pemberton-falls-under-spell-of-jasper-jones-film-ng-ya-132040

Weren't there more people with backpacks, mountain bikes, or rented RVs? Couldn't I overhear more foreign languages spoken at the local restaurant and bar? Wasn't it even sunnier?

Cartoons, a window to the public mood

One of Daniel's favorites depicted a fighter jet upside down and plummeting, with black smoke coming out the back. On the side, it had the words "forest policy" written, out of the plane a caricatured version of Richard Court, premier in Western Australia in the 90s, was being shot with an ejection seat, while Cheryl Edwardes, the environment minister at the time, hovered in the background in her own seat suspended by parachutes, having ejected herself out moments earlier. Forest policy was going down, and the politicians in charge were trying to get away, evidently, with varying luck.

Daniel, an ecologist at Murdoch University in Perth, had saved cut outs of political cartoons from the forest conflicts in the 90s and early 2000s. Most of them satirized the process surrounding the highly contentious Regional Forests Agreement (RFA) [24] and the conflicts around logging of old growth forest in the southwest. The cartoons reference, among other things, the forest occupations in the southern forests, the

[24] Regional Forests Agreements are agreements between Australian states and the Commonwealth of Australia that are supposed to serve as overall frameworks for forest management. The RFA for Western Australia aimed explicitly to balance concerns about stability in the forest products industries with reservation of forests for environmental protection (Commonwealth of Australian and the State of Western Australia 1999). The Comprehensive, Adequate, and Representative reserve system (CAR) and Ecologically Sustainable Forest Management (ESFM) were both concepts that became institutionally formalized in the RFA's.

involvement of urban Liberals and celebrities in the forest debate, popular opinion that the Department of Conservation and Land Management were much too closely aligned with the interests of the timber industry[25], and a premier stuck between the loud and unrelenting demands of jobs, on the one hand, and the environment on the other.

The cartoons were stored in a beige folder on one of Daniel's book shelves, and he told me, as he pulled them out, that cartoons like these can be a particularly good historical source as they reveal something about the public mood at the time. Another one of his favorites showed Richard Court and John Howard, premier and prime minister, with karri forest in the background running hand in hand with childlike expressions and short shorts towards a cabin made of candy with a sign saying "RFA" over the door; Wilson Tuckey, who was the federal minister for Forestry and Conservation and an outspoken advocate for the forest industries, was standing in the doorway in a suit with a devious look on his face. The subtitle for the cartoon was "Hansel and Gretel … A modern fairy tale." John Howard was leading Richard Court—a reference to the Commonwealth's role in the RFA process, Daniel explained—towards something that looked good, but was in fact akin to a trap. The message seemed to be: A willing prime minister and a naïve premier beguiled by a timber-enthusiastic minister for forestry who was really the one in charge.

[25] One cartoon indicated that the Department of Conservation and Land Management's acronym CALM would more appropriately stand for "Cutting and Logging, Mate."

In between the cartoons, Daniel and I talked about how, over the years, several people from within forestry had voiced a concern that the timber industry was allowed to cut at a rate that wouldn't be sustainable. In fact, there had been voices like this ever since the late nineteenth century. But, Daniel pointed out, sustainability was always something that was pushed ahead, envisioned to be more achievable ten years or so into the future. It was never a state foresters would be able to bring about at the current moment, but rather something they planned to achieve in about ten years' time. Foresters in the southwest, it seemed, had several times been in a position in which they were not able to manage the forests as they would like. Daniel noted, in reference to the depression years, that it seems to have been in periods when production collapsed in the timber industry that foresters could do forestry the way they wanted to.

Another cartoon, with the title "RFA old-growth reserves explained," showed disgruntled protesters with flowers in their hair standing next to a rubbish tip, the Mt. Barker tip, and notes and arrows pointing to stuff on the tip such as "Old growth smells," "old growth flies," "old growth mould on dumped oranges," and "old growth rust on bike wheels." As we stood in the copy room making copies of a selection of the cartoons, Daniel told me about the context for this particular one. The story was that at one point a map of the old growth forest to be reserved from logging under the Regional Forests Agreement was found to include a rubbish tip and a gravel pit. Many took it as a sign that the Department of Conservation and Land Management were untrustworthy. Some assumed they were consciously trying to deceive.

One of the last cartoons I asked to get a copy of showed Syd Shea, CALM's general manager at the time, with an axe under his arm standing in from of a clear-felled patch—a large field of stumps cut close to the ground—explaining to two journalists that "Luckily, we were able to catch these before the dieback set in." The little smile and nod Daniel gave me when I handed him the cartoon to copy indicated to me that this was one that resonated with him. That it reflected for Daniel, however exaggeratedly, a situation in which CALM logged more than they should and acted brashly in response to the threat from *phytophthora* dieback, seemed clear enough not to warrant further discussion.

Daniel was interested in the cartoons for what they indicated about a period when forests and forestry was a major political issue in WA, and *the* major environmental issue. Logging of "old growth" forest officially ended in 2001 after the Labor Party won the state election. Today, forest management has a much less prominent place in politics. But the tensions and animosities of the forest conflicts still linger in the southwest. They affect among other things how people conceive of Parks and Wildlife and their fire management practices, as well as how Parks and Wildlife's crews and managers see themselves. They persist through the ways in which the region comes to be understood as fire-prone.

Augusta

I noticed an increase in the number of RVs, campers, and 4wds with canoes on top as I got closer to Augusta. But Augusta itself set the tone properly with the strangest

sight right on the edge of town. There, a huge lawn bowls court full of elderly people, every single one dressed in all white shirt and trousers, made it seem like some kind of West Australian Pleasantville. I had read that Augusta, for most of the 20th century, had been a place where people had summer houses, a place to retreat to from the sweltering Perth summer heat. Even earlier, in the late 19th century, the town had been a timber town. Now, Augusta appeared like a combination of weekend or summer getaway for people from Perth and Bunbury, a haven for retirees, and a backpacker town. I had now travelled into a different part of the southwest from where I spent most of my time. This was the Augusta/Margaret River region, the most strongly developed area for tourism in the southwest. Compared to many other places, where the mining and timber heritage is still strong, Augusta seemed far less rough around the edges, and much more dominated by those who don't live and work there.

On the moderately bustling main street, the billboard listing properties for sale seemed to be drawing the biggest crowd. Out towards the now museum-ized Cape Leeuwin Lighthouse, people drove slowly to take in the view. On my evening walk, I shared the streets with some French backpackers with dreadlocks and bare feet. And north of Augusta, the famously picturesque Caves Road twists and turns and culminates in the spectacular Boranup forest where I joined both Australian and

Japanese tourists on a viewing platform to take pictures of the 60-meter-tall karri trees[26].

Collie

Wayne, who was one of my main contacts in Parks and Wildlife and who had helped me make arrangements with some of the different districts, talked about Collie as a place that would be interesting for me as an anthropologist. Collie was a coalmining town. Collie was rough, and clearly shaped by its many workers passing through. It might be exotic for me, Wayne said—it would surely be different from Perth.

Collie had about as many bars as Pemberton had cafes. Some of them were lit with fluorescent lights and had dog races on the TVs, others served pub meals and had cheap workers' accommodation upstairs, and several of them had "skimpies" a couple of nights a week—scantily dressed young women who tended the bar and gradually took off more clothes as the night wore on and as their tip jars filled up. Some of those I met in Collie talked about their town with both pride and contempt. They were proud of not being like the city folk up in Perth, but they also talked about Collie as something of a shithole. Lee, a Collie local and Parks and Wildlife crew member, liked it in Collie, even as he talked about it as a dump. He loved his dogs, he liked to go out pig hunting on the weekends, and he would never want to live in an

[26] Boranup forest was logged in the 1890s, probably burned more than once in the following years, and has since regenerated on its own and become one the most famous, and most visited, forest areas in the southwest. It is spectacular and frequently touted for it. Occasionally, Boranup is used by some to argue that logging is not as bad as people think it is.

apartment up in the city. Chris, one of Parks and Wildlife's field officers, who lived in Bunbury and drove the 40 minutes up the hill every morning, intimated that people in Collie were bogans[27], arsonists, and vandals. Too many people in Australia just "fuck around" in the bush making a mess and wrecking things, he told me, and there were especially many of those in Collie. Another from Parks and Wildlife, a machine operator, told me that when he needed to leave his bulldozer out in the forest overnight, he would always try to hide it a bit, otherwise someone might come by and siphon the fuel out of the tank. It had happened to him several times. Especially around the Collie area. It would be easy, and no doubt too simple, to find in Collie people who had made preferences out of what they were condemned to.

Fire lighters and fire fighters—who burns the southwest forests?

When the mill closed at Deanmill, Nate got a job in one of Parks and Wildlife's fire crews in the Warren region. He told me about it over smoko[28] one day in the forest east of Manjimup. Most of the burn we were working on was completed, and we had spent the morning mopping up and lighting up a few remaining bits and pieces and were looking forward to an earlier than usual 4 pm knock off. The breaks were always relaxing and enjoyable the times I was out with Charlie's crew. This time, we

[27] The bogan is a stereotype of a particular kind of Australian person. Bogans are usually presented as working class, culturally unrefined, associated with suburban living and markers such as hard rock music (for instance AC/DC), customized cars, mullets, and ugg boots (see e.g. Gibson 2013). Many people also take pride in being bogan.

[28] Even though few people actually smoked, "smoko" is still a widely used Australian term for a short break from work. It can also refer to the food that you would eat during such a break.

had set up camping chairs alongside the trucks on the far end of the sector we were working on. Nate shared fruit leftover from lunch. Charlie and Brett had tea.

"You can put a big question mark on everything that has to do with the timber industry," Nate said after I had brought up the mills closing recently at Deanmill and Pemberton. At Deanmill, where Nate still lives, the company that used to operate the mill[29] (Auswest Timbers), still owns all the houses, and they aren't putting them out for rent. They would only rent to people who worked at the mill, he told me, and now that the mill has closed, they are not opening to others. He continued, telling me that Auswest was the sub-company of a big eastern states brick making company called Brickworks Limited, and that their sawmills were clearly the lower priority. From his perspective, Nate said, it seemed like Deanmill was just a place where they could write off the company's losses.

Nate was far from the only one I met who had come to the fire crews after saw mills had closed. In Collie, for instance, where I spent a couple of weeks in February 2017 as part of a crew, I met at least four guys in the crews who used to work at mills nearby. Another handful of blokes had come to the crews from the coal mine. A third major grouping seemed to be those that had a background as "tradies" (Australian slang from tradesmen). But in the crews I also met a mix of many kinds of people.

[29] The sawmill around which the township of Deanmill was built was originally the State Sawmill no 1, opened in 1914. Since then, it has changed hands several times, having been owned by Bunnings, Wesfarmers, Gunns, and finally Auswest Timbers, a subsidiary of Brickworks Limited. The trend is not just from state to private ownership, but also away from ownership by West Australian companies (Bunnings and Wesfarmers) to companies from other Australian states (Gunns from Tasmania and Brickworks Limited from New South Wales).

Alex had a farm on the side, Brett had sheep, and Tess ran a wildlife sanctuary where she took care of injured kangaroos. Some had been in the crews for decades, and some were fresh just this season. A portion of the crew members, some of them young blokes, were seasonals, employed from around the start of the burning season in spring, through the fire season, and until the end of autumn. Among the seasonals, I met Colin, who had studied art history at a university in Perth and was enjoying the freedom he got from a relatively well paid seasonal job; Jacob, Eric, and Jarrod who were local Manjimup lads straight out of high school; and Spencer, who used to be a sparky (slang for electrician) and was now hoping to get a full-time job with the crews.

Fig. 2. Smoko with the crew, Giblett forest block near Pemberton

A fire-fighter's mind set

We were in no hurry at all, our overseer Joel had mentioned several times over the course of that overcast February morning. We were picking up old tires, oil drums, and other rubbish that someone had left out in the forest near Collie. It was our job for the day, and we'd better make it last. An outsider might have construed it as laziness, a sign of poor work ethic, or even as foot dragging, but, as I was learning, the slow pace was part of a conscious and deliberate approach to being a fire fighter, known and valued at every level of the organization. The guys in the crews were not like the urban fire fighters (the "pole dancers" in their "shiny red trucks") they would point out—they are also land managers, and when there aren't any fires or burns, they take care of the state forests and national parks. Fires, however, always do come first.

When no fires are burning in the district, and it's outside of prescribed burning season, the crews spend their days doing "works." Sometimes, this involves updating signage in the national parks, sometimes felling hazardous trees around recreation sites, sometimes oiling decks and railings at camp sites, fixing roofs, spraying invasive weeds, or producing bait for the feral cat and fox control programs. And sometimes it involves picking up rubbish that someone has dumped in the bush. It was February, and Wellington District had had 31 fires so far that year, which makes for a very quiet season. A few of the guys had been dropping comments over the last couple of days suggesting that they were keen for a few more fires. Some of them

seemed frustrated. Some of them were both visibly and audibly bored. They were fire fighters without any fires to fight.

One of the things that caused frustration was funding. There are different sources of money for fires and for "works," the latter coming from allocations for parks maintenance and other programs. When there are a lot of fires, the money available for works can contribute to giving the seasonals a few more weeks of work in autumn. But when there are few fires, the money available for works can run out. Right now, they had been asked to bring in their own water bottles, and rumor had it that one of the other districts had run out of matches. Joel told me that he had experienced being up in Perth Hills late in the season one time when they basically had to tell the blokes to go out with a ute and rake around some recreation sites, and make sure not to damage the rakes because they wouldn't have the money to fix them.

On our way out to pick up the rubbish, I listened to Joel and Spencer talk about what it means to be a fire fighter. Spencer was new this season and Joel appeared to have taken him under his wing. Joel was giving him advice on how to make himself a strong candidate for getting a permanent position in the fire crews. Spencer's background as an electrician could help him out, Joel said, but he had to start thinking like a fire fighter. For the purposes of this little educational talk, Joel used Dean, another one in the crews, as an example. Dean didn't have the right mind set, said Joel. Dean used to be a tradie, he knew a lot of different skills and was good at the

jobs he did. But he put too much into them. “In the end, we’re fire fighters,” Joel emphasized. “The deck that needs oiling doesn’t matter, it’s not important.” It’s a job we do, he continued, but it’s much more important to be ready to respond. “We’re fire fighters waiting for a fire,” and the most sensible thing to do with these kinds of jobs is to do them in small portions and let them be something you do while waiting for a fire. Joel and Spencer talked about “smashing out a job,” an attitude common among tradies, which is not necessarily a good thing when you’re a fire fighter. When you’re “first on,”[30] you should always be ready to drop whatever you’re doing and head over to where the fire is. And it is also not necessarily a good thing to get jobs done quickly, since the jobs are essentially less important than whether or not you are ready to take off to a fire while doing them. So a lot of people become good at doing little things, keeping themselves occupied throughout the day while they wait to be called out. And if you get called out at 4:30 in the afternoon, you don’t want to be tired because you put too much energy into smashing out the job you had for the day. You might be in for many hours on the fireline even when you’re called out at the end of the day. It takes a different mindset than being a tradie. Spencer agreed.

We kept on waiting for a fire throughout the day, making several trips to pick up tires and rubbish, and giving ourselves generous time for breaks. We kept listened for the spotter plane on the radio, and Joel seemed excited when we heard a scratchy sound

[30] The different crews are on rotation, being first or second to be called out.

that he said sounded like the noise the radio makes when there's a lighting strike. But there were no fires that day.

Crews and officers

The crews I briefly was part of each consisted of two trucks and the people to fill them—one "gang truck" with up to four people and one "heavy duty" with two[31]. Both types of trucks are relatively nimble four-wheel drives with high ground clearance, a large water tank on the back, packed with two live reels, several hoses, rake-hoes, nozzles, drip torches and more. Each crew has an overseer who leads the crew, typically drives one of the trucks, and does most of the communication with the field officers. In Collie, there were two crews, and together with the crews in the nearby town Harvey, they made up Parks and Wildlife's fire crews for Wellington District. The Southwest region in turn, consisted of Wellington District and the adjacent Blackwood District, which had a similar number of crews located in Busselton, Kirup, and Nannup. Other regions, districts, and towns are nested in a similar way. What I have referred to so far as the southwest forests consists of three land management regions: from north to south, Swan region, Southwest region, and Warren region.

In addition to the crews, a prescribed burn involves sector commanders, an operations officer (OPS), a duty officer back in the office, and often an air crew and one or two

[31] What is today called a crew is similar to what used to be called a gang, or forestry gang. A heavy duty contrasts with light unit, which commonly refers to a ute with a smaller water tank and pump on the tray.

machines (either front end loaders or bulldozers). Field officers and managers rotate in the roles of sector commander, OPS officer, and duty officer, though most of those who fill the role of sector commander rarely act as duty officer and those that are duty officers rarely perform as sector commanders. The OPS, the role of operations officer, is for the person in charge of running the burn as a whole out in the field. This role is given to experienced field officers. It is sometimes even taken on by district and regional fire coordinators. Each burn is composed of several sectors, each with a sector commander, who is allocated one or more crews. Both crews and field officers are shifted around according to need, for instance as edging is completed on a sector, or mop-up is required somewhere else.

During the burn season, to the mild annoyance of some, just about everyone in Parks and Wildlife has to contribute. “Everyone has to do fire,” I was told, even if they work with something quite different for the rest of the year. Hence, I met sector commanders who otherwise worked with anything from visitor services, to animal tracking, to flora conservation projects. Ideally, if a burn involved particularly important biodiversity values, the prescription would be written by someone from the science and conservation division, who would also, if possible, perform the role of OPS officer or be one of the sector commanders on the day of the burn. Or, similarly, if the burn had silvicultural objectives, it could be prescribed and led by someone from the Forest Management division of Parks and Wildlife.

Like Ben, several in Parks and Wildlife have been with the Department through mergers and demergers, thereby contributing to a sense of continuity and a notion that Parks and Wildlife, in a sense, *is* the Forests Department in its current form. In many contexts, people would talk about "the Department" or "us" and clearly refer to something which has remained continuous across the Forests Department, the Department of Conservation and Land Management (CALM), the Department of Environment and Conservation, the Department of Parks and Wildlife (DPAW) and the Parks and Wildlife service within the Department of Biodiversity, Conservation, and Attractions (DBCA). When someone would tell me that they'd been with the Department for 40 years, for instance, the Forests Department, CALM, DEC, DPAW, and Parks and Wildlife would be expressed as instantiations of the same. But that does not mean that people in the department are not a differentiated group or they have not changed in the last few decades. With a few exceptions, crews and officers are somewhat different kind of people. Very few of those who are field officers or who hold management positions, for instance, have come up from the crews (I only met one). Managers and officers are more likely to have a university degree in environmental science or a background from land management from another state than to have come from working at the mill or at a mine.[32] Among officers and managers, the gender distribution is also somewhat more even. This is not because

[32] Some of the senior forest managers and retired foresters I spoke to were critical of the disappearance of forestry programs at Australian Universities. One reason why more young field officers and forest managers today will have degrees in environmental science than in forestry is that the former kinds of degrees are more widely available today.

there is a particularly high number of women who are field officers or managers—it is certainly still a majority of men—but more so because there are very few women in the crews.

The managers of tomorrow are less likely to see themselves as foresters. They are less likely to be lads straight out of school who spend a lifetime in the department, and they are less likely to have degrees in forestry. But there is no doubt that they will enter into an organization that continues to reiterate strong and often proud connections to the Forests Department and the timber heritage of the southwest. And for a while still, they will be confronted with others in the southwest who continue to regard Parks and Wildlife with skepticism because of their predecessors Departments' ties to timber, forestry, and years of forest conflicts.

Greenbushes

For one of my visits to Parks and Wildlife in the Blackwood District, I decided to stay in Greenbushes, a small town with a long history of mining and logging. There are still active mines and an active mill nearby, but not many people still live in town. I booked a room at the hotel, a rundown place with creaky floors, dirty wall-to-wall carpets, and locals who came in to drink at the bar after work. As far as I could tell, I was the only guest. On my first night, I went for a walk through town. First, up towards the lithium mine and the lookout by the 300-meter-deep Cornwall Pit, then down the main street, past the service station, a bakery, a handful of abandoned storefronts, and the visitor's center. The main street had plaques with black and white

pictures and stories about what Greenbushes used to be like back in the day, back when it was a vibrant mill and mining town with several times the population that it has today. But there were no tourists here. There were hardly any people at all. The only signs of activity that evening came from one of the pubs, where a woman in the door loudly implored a bloke in a white ute to fuck off.

What was striking about Greenbushes was not that it was small—I had been to many Australian towns where you don't have to specify which hotel—nor how quiet it was. What struck me most was the main street lined with plaques without any visitors there to read them. A change from timber and mining town to tourism seemed troublesome for Greenbushes, to say the least.

Jarrahdale

When you drive into Jarrahdale, you will pass the centenary log, a huge section of a jarrah tree with a plaque commemorating 100 years of logging. When I passed the centenary log for the first time, I was on my way to the annual Jarrahdale Log Chop and Country Fair. The oval encircled by jarrah forest was crowded, so crowded that I concluded that unless Jarrahdale (a town of roughly 1000 people) was inhabited almost exclusively by families with young children, many must have driven in from elsewhere. Here were all kinds of country-looking folk, with 4wds, work boots, and scruffy beards. But there were also plenty of more urban looking families with strollers, and a lot of the fair was catering to the kids. There were stands with candy and toys, small merry-go-rounds, snakes you could hold and pet, and even camel

rides. Some stands had locally made pickles and preserves. At yet another stand the local volunteer bushfire brigade was selling sausages and bacon and egg rolls. The fair had plenty of elements which had that distinctive kind of small town oddness to them—like an old bloke singing karaoke to hardly a single listener. Other things, like a coffee cart serving espresso drinks, were catering to more cosmopolitan tastes.

The most interesting thing though, was the log chop competition. In the corner of the big field there was a competition for chopping through a jarrah log the fastest. There were five or six logs lined up, held securely in place so that the axeman could either stand on top of it and chop through, or, if it was set up vertically, he could chop, starting on one side and then on the other until it broke in two. The competitors were a motley bunch, all men, but of all ages and shapes. They ranged from athletic young men, to older guys who could very well be the older generation of loggers, to burly looking beer bellied fellas, to teenage boys who were having a crack at it. The judge, an older, spry-looking man with a cabbage tree hat and a long white beard, spoke through a creaky PA system set up on the back of a ute. He looked the part of a typical bushman, I would imagine, like they did a hundred years ago. A sizeable crowd followed the heats, and they consistently clapped much louder for the last one to finish his log than for the winner.

Transitioning towns

"Protecting WA's environment is protecting WA's future" was the name of an event jointly arranged by a number of environmental groups in the state. The Wilderness

Society, WWF, the Conservation Council WA, and Birdlife WA were the main groups arranging, while other smaller ones such as the WA Forest Alliance were also among the participants. It was held at the Perth Town Hall, an old stately building in stone and timber. When I walked up the main staircase to a large hall, I was met by a room full of people, some stands that different groups had set up along the rear wall, and the event's title on a projector screen up front on the main stage. Around the room, I noticed people with slogans on their shirts reading things such as "Flouride free WA, drink water, not waste," "I support a frack free future," and "Renewable WA." On posters I could read that the Conservation Council WA was "a voice for the environment," and the Urban Bushland Council "a voice for the bush."

The forum was occasioned by the state election, which was only a week away. On every chair set out in the hall there was a little "scorecard" assessing the different parties' policies on a list of issues. The green party, for instance, received a nice long line of blue globe icons indicating "excellent policies" on everything from "cancel freight link and protect Beeliar wetlands" to "protect our wildlife and biodiversity." Pauline Hanson's One Nation, in contrast, got almost all red globes, and only one in yellow. The red globes, according to a key in the bottom right corner of the scorecard, stood for "damaging policies," and the yellow ones for "inadequate policies." The Liberal Party also got mostly red globes, except for two that were split in half—part yellow and part red. They were also awarded one single positive blue globe, on the issue of "Kimberley coastal protection." WA Labor had a good mix of yellow and blue globes. They were assessed to be doing well on "Preventing uranium mining,"

on “Kimberley coastal protection,” and on the issue of “Transparent and accountable government,” but were regarded to be somewhat inadequate on issues such as “Protect water and communities from fracking,” “Protect our wildlife and biodiversity,” and “Protect the Helena Aurora Range and the Great Western Woodlands.” Neither fire nor forests management specifically were among the issues on which the parties were assessed.

The evening’s chair was a charismatic man who had a past as a radio host. He started by introducing a young Aboriginal man to give a Welcome to Country. The young man was the stand-in this evening for his grandmother, who wasn’t feeling too well. But he was also WA’s Young Person of the Year. In a jovial speech, he said he came from a long line of so-called “aboriginal troublemakers,” which drew laughs from the audience. He talked about “connection,” that this is what aboriginal people are so good at; “connecting to the country.” He also said some things in language[33], which he explained afterwards. In addition to celebrating the country, and looking after the country, and honoring the people who were here before us, he also asked for bad spirits to leave, and for good spirits to stay.

In two more introductory statements I would hear a prominent environmentalist insist that “we can no longer afford to treat our environment as eternally resilient,” and the chair asking rhetorically “how can this not be the most important subject in the

[33] It is common in Australia to use the phrase “in language” to mean in the indigenous language in question.

election?" There were two politicians attending the forum, Lynn McLaren from the Greens, and Chris Tallentire, the Labor Party's shadow environment minister. The first panel was centered around "sustainable cities and regions," and featured six other experts of different kinds, in addition to the two politicians. The panel discussed the biodiversity act, and the question of an environmental court. The Labor Party's representative pledged that threatened species protection is of utmost importance to them. One of the experts, a former Chair of the Conservation Commission, opined that environmental offsets should be banned and that an environmental court is needed "because history has taught us that nothing else is working."

For the second panel, some of the experts were replaced by other experts and the discussion went on. By way of an uncompromising question about fracking, the conversation was steered towards renewable energy, and after that towards a question about the coal mining industry in Collie. The region needs to transition away from coal, the consensus seemed to be, and it needs an alternative source of jobs. The shadow minister laid out the plans the labor party had for Collie, which included among other things a biomass plant (he emphasized "with no logging of native timber, let's be very clear about that, only plantation timber").

The chair then brought up a question about whether people are "aware" and "on board." Are they aware of the fact that Collie needs to move away from fossil energy and on board with the notion of transitioning to a sustainable future? A significant part of Collie's identity is as a coal mining town, so there is likely to be some

resistance. But transitioning can be done, the shadow minister said, and mentioned a couple of examples. There were precedents from Albany, which had transitioned from being a whaling town, as well as from Manjimup. There was a feeling in Manjimup back when they (the environmental movement) were campaigning to stop old growth logging in the 90s and early 2000s, the shadow minister said, that this would kill the town. But as it turned out, it didn't, and they have transitioned in a good way, he emphasized. The panel talked about a challenge being that many people in Collie see themselves as coal miners. It's part of their identity, just as people in Manjimup saw themselves as timber people, and Manjimup as a forestry town. How to reactivate the town, they wondered. How to *make Collie transition*?

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In the town hall in Perth, logging and forestry is part of an old order of things. Along with coal mining, it is no longer appropriate, it is unquestionably passé. The issue is not whether Collie should still produce coal or Manjimup should still produce timber, but rather how to make such communities embrace a transition to other kinds of livelihood—not simply how to change towns, but how to change the people who live there. The transition seems almost inevitable, an imperative of our times, but it also needs help from outside. Collie, it seems, will transition or fade away.

Pemberton, Grimwade, Greenbushes, Augusta, Collie, Deanmill, Jarrahdale and other towns in the southwest all display different patterns of transition, and different ways in which ties to timber and mining persist or fade away, either within actual practices

or in peoples' view of themselves and the values they attach to the past. Some timber towns, such as Grimwade, almost completely vanish; others, such as Augusta, transition so completely that their timber past is scarcely noticeable. Most towns hold on to their ties to timber and mining in some way in situations where it is uncertain what will come in the future.

Parks and Wildlife's enduring connections to forestry, and their troublesome ties to the forest conflicts of the 90s and early 2000s, reverberate through most of my encounters with the southwest. They reverberate through the southwest's processes of pyro-landscape formation. For many in the region, certain burners, burns, and fires evoke in one way or another ties to a troublesome recent past. The Department, as Ben exemplified in the beginning of this chapter, tend still to understand themselves as a rural agency—they often see themselves not as part of what Ben understood to be processes of gentrification, but as part of the southwest that either withstands or fades away when towns are gentrified or when towns transition. Talking to retired foresters, I once or twice played with the thought that I was doing a kind of salvage ethnography. I could imagine—quite inappropriately in a sense!—that I was talking to the last remaining elders of a tribe, the few who were still unspoiled by a certain kind of modernity (here appearing in the shape of big city politics, environmental science, and the tourist industry), the ones who could still remember the myths, who still held the traditional beliefs, and who could still recall how they would perform the rituals back in the day.

On the other hand, for some, Parks and Wildlife are easily lumped into the part of the southwest that needs to be transitioned. Parks and Wildlife's collective understanding of themselves, their explicit or implicit reiteration of themselves as continuous with the Forests Department, and their many crew members who have ties to the mills, mines, or at least to mill and mining towns, contribute to a sense that the agency might be part of the old order of things. Support of forestry cannot always be separated from support of foresters and forest towns, and support of burning cannot always be separated from support of a certain type of government agency and a certain kind of person who burns.

Forest management was barely mentioned in the Green Groups' forum. Fire didn't come up at all. This is not because these are resolved issues in the eyes of most environmental activists in Western Australia. Certain issues move in and out of focus for environmentalists and people concerned with the environment, nothing else is to be expected. But issues can also wax and wane in the extent to which they are enacted as environmental matters more broadly. Following shortly after the Waroona fire, bushfire and prescribed burning were bigger issues this election than they had been in a long time. But they were not presented as environmental issues. Rather, in the public discourse and in the Western Australian state election in 2017, fire management was overwhelmingly a matter of risk, hazards, and the safety of lives and property.

A pendulum and a region in pink

After our interview, Murray Carter, head of the Western Australian Office of Bushfire Risk Management (OBRM, pronounced "obram") walked me through the main statewide control center for emergencies. He opened sliding glass doors with his key card and we entered a large open room with desks and chairs set up in little groups in front of a big projector screen. Murray lowered his voice as he told me that this is where the major emergency operations are run from if they are level 3 incidents, the highest level for emergencies. Weather data was being projected on the screen and Murray noted casually that there was some lightning around up north at the moment. All the chairs had high visibility vests hanging on the back, and the desk spaces had signs that specified who they were allotted to, for instance the Bureau of Meteorology, the Department of Fire and Emergency Services, or Parks and Wildlife. Most of the chairs were empty today. It was September and the bushfire season was still a couple of months away. But, Murray assured me, "when there's an incident this will be a lot busier."

Murray came to OBRM from DEC where he had been a high-level fire officer for several years. The office of bushfire risk management came out of the process following the Margaret River bushfire in 2011, a prescribed burn that escaped and destroyed about 40 homes. In the months following the fire, DEC was subject to a lot of public scrutiny, and new requirements for burning were set in place after a formal inquiry. One of OBRM's main objectives was to oversee that DEC and later DPAW conducted their operations in line with international standards for risk management, the ISO 31000.

Before our little tour of the emergency center, as we sat in a small glass-enclosed office designated for the people working in OBRM, Murray described prescribed burning as a double-edged sword. On the one hand it is about mitigating risk. But prescribed burning is also something that has its own inherent risks. OBRM are concerned with both of those two areas of risk, he said, both the risk of bushfire, which can be mitigated principally through the use of prescribed burning, and the risk involved in doing prescribed burning itself, which they deal with through officially specified standards of operation. In practice, he said, they "won't tell DPAW how to do their work." Instead, they oversee and endorse the "whole package," everything from doctrine, to plans, procedures, and implementation. In this sense, OBRM also works as a mechanism to help Parks and Wildlife manage their "reputational risk" (cf. Power et al. 2009).

Murray used another image, a pendulum, to talk about the state of prescribed burning and bushfire in the southwest. With active use of his arms he explained how one side of the pendulum's swing would represent a situation where bushfire risk is under control and everything is managed for bushfire risk. But now, WA is well on the way to swinging to the other side, where things are less managed and there are more big bushfires. And, he said, "we'll never get back to the right end of the pendulum." But they are trying to get closer, and at least prevent the pendulum from swinging all the way over to the wrong side. And a lot of the world is way over on the wrong side, he added, and we segued to talking briefly about the situation on the west coast of the U.S.

One of the reasons, according to Murray, why they may never be able to get back to the right side of the pendulum's swing, is the development of settlements, that is, more and more people living in "bushfire prone areas." It is directly in connection to this issue that OBRM are developing a statewide map of what areas are considered to be bushfire prone. It acts kind of like "a trigger for assessment," Murray said. It doesn't tell anyone categorically that they cannot build in an area, but they will be subject to more standards and more strict building codes. From the assessment triggered by the map, the prospective builder will get a "bushfire attack level." If you want to build in an area with a high bushfire attack level you can, Murray said, "but you'd have to build a concrete bunker basically." Murray made sure to emphasize that the map itself completely leaves out the *level* of risk. It shows risk or no risk. On the online map, bushfire risk is shown by a pink colored overlay. You might have somewhere far inland that would burn about once every hundred years, and you might have the jarrah forest, Murray explained; as far as the map goes, these are both bushfire prone areas. This means, he continued, that about 90 % of Western Australia comes out as fire prone. To a developer, the southwest forest region is pretty much completely pink.

"Do you own a property in the shire?"

"Bring the family!" urged the Facebook event for the Bushfire Expo in the Perth Hills town of Kalamunda. It was held on a sunny Saturday at the Performing Arts Centre in town. It was early September, and the bushfire season was getting closer. Close

enough to be on people's minds, but still not so close that residents wouldn't have time to make preparations. Outside of the venue, a large fire truck and a few smaller ones fully equipped with all sorts of gear were parked alongside some stands and a few guys in fire fighting gear who were talking to people. I followed the sign that said "entry" into a hall with exhibition stands set up in a circle along the walls. There was a stand for Kalamunda Bushfire Services, the Department of Fire and Emergency Services had a stand, as did State Emergency Services and the Shire of Kalamunda. But the majority of stands seemed to be for companies providing products or services. One stand offered a "bushfire ready kit" for 69 dollars. Another one sold self-cleaning gutters, and another promoted garden plants and landscaping strategies that promised to give a less hazardous property.

When I walked up to the Shire's stall a stocky man with a mustache introduced himself as Terry and asked "do you own a property in the shire?" I had to disappoint him, I was not the ideal target of his efforts at raising awareness. Terry told me that one of the things he does in his job with the Shire is to encourage people who live here to take action to make their properties less prone to bushfire. They can do this for instance by pruning, he explained, or by raking together leaves. Before he talked to me, I had overheard him explaining to a man with his little daughter on his arm about eucalyptus leaves that don't decompose but accumulate as more and more litter from year to year. Terry mentioned to me that they are seeing a "changing bushfire landscape," which was also the name of a recent campaign they ran, in which they offered free one-hour info sessions about bushfire risk to members of the community.

I asked if this was related to a drying climate, and he said that it was more about the landscape in the area now being more densely vegetated than it used to be. Pruning and thinning, he said, were the main ways that property owners can deal with this. When I asked about prescribed burning, he said he can only *encourage* property owners to burn, he cannot *make* anyone burn on their property. As I sensed Terry's attention veering, I grabbed a pamphlet and said thanks, allowing Terry to hurry on to the next person approaching the stall—perhaps a property owner.

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"Fire prone" has its own institutional existence. It is a concept that contributes to defining places in the southwest, and it has consequences for builders and developers. But fire safety doesn't end once a house is built. Through expos, pamphlets, and community events, fire safety becomes an ongoing project of preparation, protection, and readiness. Property owners are often the relevant performers of bushfire safety. In such instances, bushfire is something that concerns your family and your house. For people working in the Shire or in the Bushfire Brigades, it's a matter they feel they must continually impress on people, the importance of which they must continually bring to peoples' consciousness.

"Less afraid than they need to be!"

Parks and Wildlife are by far the group who does the most burning in the southwest, but they are not the only ones who burn. In recent years, a small number of private

fire management companies have popped up in the region. There were three of them while I did my fieldwork: Working on Fire, EntireFire, and Fire Mitigation Services. All of them were relatively small, but trends seemed to point towards a growing market.

I met Sheryl from Fire Mitigation Services at a café at Murdoch University. She had a PhD in biochemistry, had been a post-doc at a major American university, but eventually grown tired of academia, and recently gotten the job in FMS through a friend. Now, she was taking a few post-grad courses in environmental science so as to be better prepared to work with fire management and before we met, she had just had an exam.

A lot of my conversation with Sheryl revolved around how FMS and the other private fire management companies differed from Parks and Wildlife. There were certain obvious connections—several in the private companies had a background from Parks and Wildlife or their predecessors. I had heard some of them referred to as disgruntled ex-forest managers. The private companies also used the same method for writing burn prescriptions and calculating fire spread as Parks and Wildlife, the method from the so called "Red Book," a pamphlet written by Forest Department researchers in the 80s. An obvious but crucial difference was that the private groups didn't decide where to burn or when an area needed a burn, they had clients who engaged them, clients who had somewhere they wanted burned. For FMS and the other private groups, burning was also overwhelmingly focused on hazard

management. Whereas Parks and Wildlife conduct burns for three overarching reasons—risk management, biodiversity, and silviculture—the private groups were mostly focused on bushfire risk, because that was what motivated their clients.

Sheryl told me that the need for these groups arose from a situation in which burning on land not under Parks and Wildlife's tenure had been too dependent on the volunteers from the various local bushfire brigades. The volunteers are often less eager to do prescribed burning than fire fighting, she said. They often have another job, there's already quite a lot to do in a typical season with fire fighting, and prescribed burning doesn't feel nearly as urgent. The division of labor was also an important thing—Parks and Wildlife manage crown land and the CALM estate, including parks and state forests. Local government, shires for instance, were the ones who used to depend on the brigades, and are now one of the main types of clients for FMS.

I felt like we had a good tone as the conversation went on, and after a little while I mustered the courage to ask what I thought of as a critical question. We had just talked about the growing demand for prescribed burning from private landowners and local government areas,[34] and I thought my question would be getting at a central ambivalence for private fire management companies. I asked, wouldn't a growing sense of risk aversion be something that gives rise to the niche they are filling?

[34] A recent job they had, for instance, was a large burn at the Bindoon training area for the military, north of Perth. Later I learned that this was an area that the Forests Department used to burn, on behalf of the army.

Wouldn't they even be capitalizing on an increased feeling of fear? Sheryl nodded at first in agreement to my point that there was an increasing sense of risk aversion in the southwest in recent years, but then she disagreed completely. There was no unnecessary fear to capitalize on. In fact, it was the opposite that was the problem: "People are less afraid than they need to be!"

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It was often pointed out to me that complacency returns quickly after a big bushfire. And the general public isn't the only group whose concerns with fire are understood to have a short half-life. A long enough time without conflagrations can make even the most sensible politician (or the one with the safest seat) doubt whether they need to put money into something that doesn't appear to *produce* anything in a positive sense.

After the recent years' unusually high number of large bushfires, some express the notion that there are trends among the public towards increased risk aversion, as well as the notion that people aren't afraid enough**.** Curiously, both risk aversion and not being afraid enough can be understood to be ways to express concerns about disconnection, about people losing touch with the environment. Risks and hazards conjure up an image of distance, of people who don't really have relations with the forest, but with abstract and technical concepts such as "bushfire prone areas," "fire danger ratings," and "bushfire attack levels." These appear to be people who cannot be expected to have formed close experiential ties with the landscape, but instead

must be reminded constantly that the forest is a place that is liable to burn. In lieu of local knowledge, there are self-cleaning gutters and bushfire preparedness kits. Similarly, not being afraid enough evokes an image of distance as well—perhaps of people who aren't aware, of complacency, and of passions and interests that lie altogether elsewhere. It is as if more and more people live in the southwest, but they do so without really being connected with the landscape. Meanwhile, a more "traditional bushman," one who was closer to the bush, and whose image remains in how the Department often presents itself, is also closely associated with extractive industries—he is, for example, the axe man, for better and for worse. He can be revered when he's removed from these industries, such as on the café lined streets of Pemberton and in heritage-laden log chop events in Jarrahdale, but he can also infuse those, like Parks and Wildlife, who still explicitly or implicitly evoke and embody him, with a threatening sense of anachronism. It can be complicated to live in the fire prone southwest, and it is certainly complicated to be those that are charged with managing the regions landscapes. One thing at stake here is how to be someone with close interconnections with the environment without evoking a figure that is also tied to extraction.

In practical encounters the southwest comes to be shaped and understood as a pyro-landscape through fraught figures. As the region is reiterated as a place that burns, it is looped through already existent and dynamic cultural figures such as the risky fire prone landscape, the transitioning town, the controversial Department, and the traditional bushman.

Chapter 2—Natural, ancient, and indigenous

After an unseasonably heavy spell of summer rain, by February 17th the Fire Danger Index (FDI) had again crept up to 40. This meant that according to the Department's internal standards there should be a fire truck accompanying the bulldozer upgrading a track in preparation for an upcoming burn. A dozer working against rocks can cause a spark that could light a fire. When the FDI is above 140, they just don't do any of this kind of work.

Jack, the contractor with the dozer, was working on the dirt track surrounding Lennard forest block about 45 minutes from Collie. I went out there in a truck with Nigel and Aidan and we caught up with him eventually, after some fiddling with the VHF radio. Our job was to be present as a water source, and for a couple of hours we followed him at a bit of a distance. It was fairly tedious. Nigel, a short older bloke with glasses, who had a penchant for wise cracks, and who cursed every time the gear box made a noise, was especially snarky that afternoon, though it was always the kind of snark that was never far from a smile. Now, some of it was directed towards a Wagyl, a rainbow serpent. There was a section of the track Jack had been told to avoid because it ran close to an aboriginal sacred site. Probably, Jack told us, a Wagyl. The officer in charge of the works was going to get an aboriginal representative out there one of the next days to oversee the work, but for now Jack just had to work around it. When got to the section we thought was the 'sensitive area', Jack lifted the blade and drove on by. Nigel mentioned with annoyance that

there was a track there already but we can't use it because there's a Wagyl down there, indicating that he found it to be a somewhat pointless demand. "Fucking Wagyl," he muttered, and I understood him to be deliberately misplacing the blame for comedic purposes. Nigel reckoned the aboriginals just want an easy buck, and Aidan agreed. Monti, a local elder Nigel knows, "is alright," he said, but most of them don't know much about this, they just want an easy 200 bucks. The Wagyl also came up when we sat down with camping chairs and sandwiches for lunch. Jack was a middle aged, mild mannered man. He had an inexplicably clean shirt, and he engaged me in conversation about Europe. I caught myself thinking that he seemed out of place in a bulldozer in the forest. Then, Nigel and Jack exchanged some comments about the aboriginal site. Jack said he understood and respected that they should get to have their say, but … he paused. I sensed that the rest of the sentence would be to say that it was an unnecessary inconvenience. Nigel added that when there was a bushfire everything is alright, they don't have to worry about sensitive sites then. It's a bit of a pain in ass, he concluded.

For crew members and fire managers, Wagyls are sometimes a presence in the southwest forests. But they come into view in specific ways, usually as "sacred sites," "sensitive sites," or "aboriginal cultural heritage." Indigenous *people,* however, are rarely involved in fire management activities. Instead "indigenous burning" or "aboriginal fire management" is engaged with as conceptual figurations, usually situated in the past. In the case of the Wagyl, it is concealed within into something "cultural" or something "sensitive." Indigenous burning is frequently discussed and

debated, but never given direct relevance for management decisions. Moreover, fire is a particularly strong discursive gateway to broader questions about indigeneity and the environment, nature and native, matters that haunt and trouble settler societies. In becoming a pyro-landscape, the southwest is conceptually looped into these big thorny issues.

To many of the people on the ground, such as crew members and field officers, aboriginal sites were a small inconvenience. They were also a matter that was often treated and discussed in a strikingly similar way to other considerations they had to make when burning, such as environmental considerations and measures related to risk and safety. Nigel's "Fucking Wagyl,"[35] echoed comments I had heard about frogs, orchids, possums, or the recent requirement to wear gloves on the fire ground; also with their attendant expletives. That is not to say that some did not wholeheartedly support recent risk management, environmental, and indigenous heritage considerations. But many, I believe, saw them as something that was hoist upon them from up in the city, as political points, out of touch what was happening on the ground. These things would appear more closely related to documents and meeting rooms than to drip-torches and hoses. Here and in similar situations, aboriginal issues are leveled with other things that are seen as urban and political

[35] There is a close parallel to a scene from Werner Herzog's 1984 film *Where the Green Ants Dream*. The scene, which is also used by Vincent and Neale (2017) to exemplify an oft-described dynamic between mining companies and aboriginal people in outback Australia, depicts the encounter between aboriginal protesters and a bulldozer driver who, in response to the protesters' insistence that a site should not be disturbed because it is "where the green ants dream," angrily exclaims "Ants! Fucking Ants!"

concerns. When aboriginal issues come up in fire management, it is not necessarily aboriginal people that the Department's crew members engage with, it can just as likely be "Perth." In subtle ways on that afternoon in February, we dissociated Wagyls and aboriginal people from the forest itself.

But if Wagyls and aboriginal concerns are a nuisance for those who burn, once turned into figures to think with, they can be meaningfully connected to fire manager's concerns. Fire managers' primary concern is the forest today and how it will burn in the near future. They draw "indigenous burning" into this framework. The figure of "indigenous burning" is part of the knowledge frameworks through which fire managers think and act in the landscapes of the southwest. Aboriginal burning as a conceptual formation is tied into the ways the region is understood and shaped as a fire prone place; a process which also continually casts actual aboriginal people's involvement outside of relevance for forest management today.

Stories involving indigenous burning play a role today in how fire managers think about the southwest as a fire-prone place. The conceptual figure of indigenous burning can give meaning to what fire managers and others see in the southwest forest when it burns. In this chapter I look at several processes involving both indigenous people and "indigenous burning." As the inconvenient Wagyl showed us, indigenous matters can be aligned with other "urban" political constraints or objectives. It can easily slip over into other concerns. Indigenous burning can also become a framing device for understanding the southwest, alongside "ancient fire" and "natural fire." We will also see that knowledge of aboriginal burning in the past

can be mobilized for different purposes than land management, some of which are seen as more important by members of the indigenous community. Indigenous issues can often be rendered a debate issue, and it can be relegated to what I call the research sphere—a realm of uncertainty or uncertain application. Overall, 'indigenous burning' and indigenous land management go through processes which make them not-quite-relevant for practical management. What all of the processes have in common is that they gradually come to make "indigenous burning" (as a conceptual figuration) meaningful for fire managers today, at the same time as they dissociate fire management from indigenous concerns. As fire managers tie the figure of "indigenous burning" into their own concerns, they also place actual aboriginal people at a distance from the forests and from burning.

Situating southwest fire

Open a planning document, a policy statement, or a research paper about the southwest, and you are likely to be introduced to fire as both ancient and indigenous. Many of those who write and talk about the environment in the southwest of Western Australia—forests managers, researchers, and environmentalists among others—tend to point out a set of similar things about the region's long fire history. They tend to frame their discussions, analyses, descriptions, research papers, or management plans in similar ways. I had heard it many times in conversations too, as well as at events and seminars related to the environment or land management—that the southwest was a fire prone region, a place that had experienced fire for millions of years. Often

alongside descriptions of southwest landscapes as subdued, ancient, with poor soils[36], and a high degree of floral endemism in part because of the "island-like" isolation (Hopper 1979) that the region has had due to the ocean to the west and desert to the east ever since it formed part of the ancient supercontinent Gondwana, many will point out the close association between fire and vegetation. In the management plan for Wellington National Park near the town of Collie for instance it is stated that "Evidence of frequent fires has been documented dating to 2.5 million years ago in the south-west of Western Australia indicating that fire has been a major evolutionary influence…" (Department of Environment and Conservation 2008: 57). And according to a piece from *Forest Focus,* a magazine the Forests Department published in the 70s and 80s, "The forest abounds with structures which have been developed to cope with fire" (Shea 1975: 4).

Such ways of putting fire into context are not just a feature found in vademecum science (cf. Fleck 1935) and in popularized outputs. I heard it frequently in research talks and seminars as well, employed as a framing device, a way to set the stage, or to indicate the importance of the research. It is also often pointed out in publications. Burrows (2008) for instance, between descriptions of the southwest's "ancient geological history," it's "apparent homogeneity," "lack of topographic relief," and it's "Mediterranean climate," (2394) mentions that fire "may have been a force of evolutionary significance" (2395) for at least 2.5 million years, and he characterizes

[36] Hopper and Gioia describe the region as "a flat, stable, highly weathered, nutrient-deficient landscape, with subtle soil mosaics" (2004: 644)

the region's forest ecosystems as "fire-maintained, having evolved traits that enable them to persist with, and depend upon a variety of fire regimes" (2394). Although not without their critics[37], these are framings that in the southwest are mostly uncontroversial.

Fire, as "an ancient ecosystem process," (Department of Environment and Conservation 2008: 57), "an environmental constant" (Seddon 2005), or "an intrinsic aspect of the ecology and management of SW Australian forests" (Boer et al 2009: 133), is presented, through an association cemented in evolutionary timescales, as something 'natural' and inevitable in the southwest. This comes to be a baseline of what fire managers expect. Many of the features they see in the forest—the recently defoliated trees with a fir of intensely green epicormic shoots along trunks and larger branches, the shrubby "advance growth" of the jarrah trees that will resprout from underground "lignotubers" even after high intensity fires, the grasstrees with "skirts" that are flammable on even the wettest winter day, or the so called "fire weeds," the many plants that germinate prolifically following a fire or a burn—all come into view as signs that the forest lives and thrives with fire. In a similar way, scientists will talk about serotiny, obligate seeders, sprouters, and other plant traits that characterize species that have evolved in such a way that they are able to either cope, thrive with, or depend on fire. The jarrah forest in particular has long been described as fire-resistant, hardy, and resilient (e.g. McArthur 1962; Wallace 1966; Dell et al. 1989).

[37] There are some who argue that these aren't strictly speaking adaptive traits (e.g. Bradshaw et al 2011), or that it is more likely that they are adaptations to drought than fire specifically.

Another connection is also frequently made to situate the fire-prone southwest. Right alongside ancient fire, often in the same breath, people will remark on the region's long history of aboriginal burning. In the current Forest Management Plan, a ten year overarching strategic document for the southwest forest region, it is stated that: "Noongar people have long used fire as a key tool in forest management" (Conservation Commission 2013: 48) and that "burning by Noongar people with a fire regime appropriate to seasons and forest type was used to lower the risk of bushfire, encourage the growth of bush tucker and bush medicine, and provide forage for native fauna" (ibid.). In the Department's Fire Management Strategy 2017-2021, the pyric proclivities of the region are established with reference to both natural and aboriginal fire: "Fire has been present in the Australian bush for millions of years," they write, and continuing, "Aboriginal people managed fire for millennia, creating a mosaic of burnt and unburnt vegetation that prevented vast bushfires from forming" (Department of Parks and Wildlife 2017: 2). Here, a vocabulary of "risk," "key tools," and the environment as something that can be shaped according to our needs, meshes the desires of contemporary management with aboriginal burning practices through analogy, and the southwest and its proneness to burn is established, by implication, as something manageable. At the same time, as the ancient and the aboriginal are tied together in these practices of framing, both are severed from the present, mobilized as as background and context. Indigenous fire becomes context in much the same way as the ancient fires of evolutionary time.

A handful of themes together make up the most common narrative about aboriginal burning in the southwest, the narrative told by Parks and Wildlife as well as many others. One component is the longevity of burning. In publications from the 80s, the estimate was often that aboriginal people had been living and burning in the region for 30-40 000 years (e.g. Abbott and Loneragan 1983; Underwood and Christensen 1981)—more recently as much as 60 000 years is sometimes quoted (e.g. Department of Environment and Conservation 2008). The notion of mosaic burning, or *fine-grained mosaics,* is another common feature, indicating a focus on a particular feature of aboriginal burning, namely that they did not burn uniformly, but rather in heterogeneous patches across the landscapes. The third main component concerns how often the landscape would have been burned. It is commonly said that the aboriginal fire regime relied on frequent low or moderate intensity fire (e.g. Burrows et al. 1995: 13). In conversations, especially with people in favor of more prescribed burning, I sometimes heard this relation expressed as a logical necessity—because fire intensity relies to a certain extent on litter fuels, frequent burning would keep fuel levels low and give, "mild" or "cool" low intensity fires. In an influential paper from 1966, Roy Wallace, who was conservator of forests in Western Australia between 1969 and 1973, stated regarding fire in the "pre-colonial era" that "…it is not unreasonable to assume that the forest was completely burned through every 2-4 years" (Wallace 1966: 34; see also Abbott and Loneragan 1983). Stories about being able to ride a horse and cart through the forest are also fairly common, and sometimes used to highlight that larger parts of the forest may have been more open back then

because it was more frequently burned. Others describe bushfires in the 19th and early 20th century with flame heights no higher than what one could step over, and wildfires that could be beat out with a marri sapling (e.g. Pyne 1991: 256), suggesting that these are features tied to frequent low-intensity burning.

The story about aboriginal burning often comes with a caveat or two about variability. Underwood and Christensen, for instance, in a Forest Department publication from 1981, recognize the possibility that Noongars spent more time in some areas than in others, and that burning "in the denser forest areas such as the karri forest of the south, fires appear to have been less frequent" (Underwood and Christensen 1981: 6). What effect aboriginal burning has had on flora and fauna is another topic which is treated cautiously (it is associated with some unsettled debates, see Hassell and Dodson 2003: 73-74)[38]. However, an argument you may hear quite a lot among those in favor of prescribed burning is that whatever species were present at the time of European arrival must necessarily be able to cope with frequent low-intensity mosaic burning.

People today mobilize aboriginal burning to make sense of a region that they know, and experience intimately, to be a place that burns. To draw on narratives of aboriginal fire management is one of their many means to capture what they see and feel in the southwest forests. But these stories also affect the way they then come to

[38] "One complication is that any human impact is superimposed on a long-term trend towards replacement of fire-sensitive by fire-promoting vegetation, a trend that reflects increasing aridity of the continent over several million years" (Smith 2005: 187-188). A key question, Smith continues, seems to be "whether [Aboriginal] burning complements, opposes, or amplifies the prevailing climatic trend" (188).

see the landscape. They allow fire managers more easily to see something that could be thought of as a potential regime. They allow them perhaps to think of a kind of inevitability to the burning landscape, but also to imagine that one can sway burns and fires in qualitative and patterned ways. One of the circuits through which the southwest is formed as a pyro-landscape is the figure of indigenous burning.

When mobilizing this figure, fire managers also tie themselves into larger questions that occupy Australians. The figure of indigenous burning that fire managers draw on is clearly indebted to a series of writings from the last few decades that have played an important role in challenging assumptions about aboriginal people and about the Australian environment before Europeans arrived. When framing the fire-prone southwest as a place with a long history of indigenous fire management, fire managers evoke questions of nature and native.

Nature and native

The narrative of aboriginal fire builds on a chain of oft-cited and very influential publications. This is a chain of publications that always had a dual purpose: to challenge ingrained assumptions about indigeneity and about the environment. These contributions have been just as important because of what they say about aboriginal use of the land, as for what they say about fire, challenging conceptions that aboriginal people did nothing to alter their environment, and working to dispel the myth of the primitive hunter gatherer whose impact on the land was merely accidental.

The doctrine of *terra nullius* was official policy in Australia up until the Mabo Judgment in 1992 when aboriginal land rights were recognized for the first time. Terra nullius, the idea that Australian settlers arrived to an empty land, was premised on the notion that to own land one must alter it, for instance by cultivation of crops. The idea that aboriginal burning could be seen as a type of agriculture would have been challenging and provocative in 1969 when Rhys Jones wrote his classic paper on "Fire-stick Farming." The word 'farming' was intentional, explains Petty (2012) in an introduction to a recent re-print of the paper: "It simultaneously challenged the notions that Aboriginal people were passive creatures eking out a rude existence in a wide brown land, and that fire was inherently destructive" (Petty 2012: 1). Jones, an archeologist, discussed evidence from carbon dating as well as from explorers' records to indicate the extent and longevity of aboriginal burning. "Fire was man's first extra-corporeal muscle," (Jones 2012 [1969]: 7), he wrote, and explained how the aboriginal peoples would have had a number of different reasons to burn, including signaling, clearing ground, hunting, regeneration of their food supply, to extend the habitat in which they could live, and simply "for fun" or because it was custom. This odd mix of reasons and outcomes reveals a clear functionalist bent in Jones' thinking. Hence, for Jones, aboriginal people could have been burning compulsively due to "custom," even while they were unaware of the function of their

customary activities, and that the actual cause for the customs would have been their adaptive value (p.7).[39]

Sylvia Hallam, writing only a few years after Jones, also confronted popular notions of the Australian continent as untouched at the time when it was settled by the British and the attendant conception that the aboriginal people never really altered the environment. “The land the English settled was not as God made it. It was as the Aborigines made it,” (Hallam 2014 [1975]: xi) she stated on the first page of her study of Aboriginal fire practices in the southwest of Western Australia. Hallam’s *Fire and Hearth* drew heavily on descriptions from explorers and early settlers, such as George Grey, James Stirling, Matthew Flinders, Archibald Menzies, Phillip King, Richard Dale and others. The fires that Hallam described were for the most part low intensity, patchy, widespread, and frequent—so common to the explorers that they were utterly “unremarkable” (Hallam 2014: 22). In sum, she argued, it amounted to “a country-wide burning by ‘consecutive portions’ as a deliberate, regulated activity” (Hallam 2014: 33).

With a nod to Jones, Hallam also took up the concept of farming, pointing out that aboriginal burning would satisfy several of the aspects implicitly held in European ideas about farming: hard labor, territorial confinement, and “conservation and husbanding, rather than depletion, of a product” (Hallam 2014: 13). Moreover, the

[39] “…it is in some ways as irrelevant to me whether or not the ancient Aborigines knew what they were doing as it is to paleontologists whether or not the giraffe knew why his neck was growing.” (Jones 2012 [1969]: 7).

common European form of cereal farming may be regarded as only one among several forms of farming, of deliberate and systematic modification of the environment (Hallam 2014: 111). The aboriginals as described by Hallam were efficient and systematic in their efforts to shape the land. Commenting on the rich and precise aboriginal vocabulary of environmental phenomena, she noted that "It would be fairer to say of the Swan River Aborigines that they *were* botanists and ecologists, thoroughly conversant with ecological zones, seral succession, and climax vegetation" (Hallam 2014: 38, emphasis in original). The mosaic patterns in the southwest landscapes were shaped by both the fires "incidental to camping, gathering and travel" (Hallam 2014: 76), as well as the fires that were "part of the deliberate management of plant and animal resources" (ibid.), and this ultimately presents an interesting entailment: that to burn as the aboriginal people did, one may have to plan for, or at least embrace, irregularity. That is not to say that aboriginal burning practices were haphazard, Hallam's argument is the opposite, but they were driven by objectives that are different from those of present-day land managers (Hallam 2014: 190) and involved certain elements of what we would call randomness.

Hallam's book, like Jones' paper, is an argument about the environment as well as about aboriginal people. To many of my interlocutors in the southwest, both of these publications were most interesting for what they could be made to say about landscapes as fire prone, adapted to fire in particular ways, and as places where certain types of fire are desirable. For many, Hallam's general argument that most of the southwest was burned frequently with low intensity patchy fires was one of many

sources contributing to the now dominant view of aboriginal fire in the southwest. For others, Hallam could be mobilized to challenge parts of this narrative, for instance because she indicates that the karri forests of the far south may have been burned far less frequently than the jarrah forests further north (Hallam 2014: 25-27; 55). As we shall see later in this chapter, it would seem like the argument about the landscape as shaped by frequent anthropogenic fires has been easier to accept than the one about aboriginal people as skillful and knowledgeable farmers and ecologists (even if it might seem illogical to accept one without the other).

Bill Gammage's *The Biggest Estate on Earth* (2011) is another widely read and debated book which in a similar way to Jones and Hallam makes an argument at the same time about the Australian landscape and about aboriginal people. Gammage was writing at a time when aboriginal Australians had regained rights to their country in many places, as well as a time when settler forms of land management had been under sustained critique for quite a long time. *The Biggest Estate* makes a dual argument in which the case concerning aboriginal people has necessary implications for the environment and vice versa. Almost a perfect reversal of the doctrine of terra nullius—where an untouched nature is evidence of aboriginal primitiveness and aboriginal primitiveness is evidence of an untouched nature—Gammage's notion of *templates*, landscape forms and ecological communities that aboriginal people deliberately created and maintained for particular purposes mainly by the use of fire (Gammage 2011: xix; 211ff), is a dual argument concerning an anthropogenic land—what he calls an *estate*—and a skillful group of managers with detailed technical

knowledge of the land. More than once, I found myself on bumpy dirt roads with a burn on one side engaged in a conversation with a fire manager about Gammage and *The Biggest Estate*. With fire managers, I was usually prompted to discuss the implications the book could have for our understanding of the role of burning in the Australian environment; rarely the implications it might have for our view of aboriginal people in Australia today and in the past.

Gammage, like Hallam, relies considerably on sources from early European settlers, and the part of his book likely the most easily engaged with by the Australian public is a section where he discusses early settler Australian landscape paintings and, in some cases, compares them to how the places they depict look today. All of Gammage's examples display a change, away from "park-like" grassy woodlands where trees were sparse and "country always more open than is natural" (Gammage 2011: 41) towards something that is much more overgrown and covered in scrub and trees. Or a change away from a mosaic of different adjacent landscape types towards something either more homogeneous or forcefully fragmented. But the templates, according to Gammage, were not just about creating less scrubby landscapes and promoting grasses. They were specifically planned for one or more purposes, for instance to create clearings within forests, grasslands that grew in alternating patches, or "sawtooth tongues of forest […that] bite into grassland to let hunters ambush prey" (Gammage 2011: 59).

Just like Hallam, Gammage describes aboriginal people as skilled and knowledgeable, systematically setting to work their plans for the landscape.

Templates suggest an even closer and more methodical planning, and Hallam, in her 2014 postscript is unconvinced by such a degree of "detailed deliberation" and "total planning" (Hallam 2014: 176) as well as by Gammage's contention that Australia was a single unified estate. Gammage repeatedly describes aboriginal people as "managers." Rather than farmers, he prefers to liken them to "estate managers" (Gammage 2011: 281), who "commanded no-one […] had land, sought knowledge, had much time for religion and recreation, and usually lived comfortably in parks they made" (310-311). For Hallam and Gammage both, as well as for many of those who draw on aboriginal burning as a framing device, intention is clearly a key variable. It is crucial to establish intention as well as actual physical alteration of the landscape, not coincidentally the same things that define contemporary forest management and prescribed burning—a planned set of practices that shape the forest.

These writings can be seen as part of the work that for fire managers has the effect of establishing flames in the forest potentially *as regimes*, and regimes as comparable to each other. It's as if to say: aboriginal people had fire regimes—systematic patterns of shaping the land according to their needs—and we can have them too. Aboriginal burning, including aboriginal practices and motivations, become legible for settlers, for western science, and for contemporary land managers. Fire managers read this influential series of works with a view to how it can help them know and interact with the forests.

The gap

One could perhaps draw a parallel between the fires dotting the southwest landscape today and those that were seen in the area by the first European explorers, the fires lit by the Noongar people. In that case, today's fires may be seen as forming a continuum with the fires of the past. The southwest is burned by bushfires as it has been for millions of years, and it is still burned intentionally, as it is commonly believed to have been for at least 40 000 years by the aboriginal inhabitants of the area. But these are complicated, and possibly inappropriate, parallels. Hardly any people of Noongar heritage are involved in fire management in the southwest today, and they haven't been for quite a long time. To call it a continuum would be to conceal a violent break.

According to Burrows et al. (1995), 1855 can be thought of as the point when the aboriginal fire regime ended in the jarrah forest of the southwest. This estimate make sense for Burrows et al. according to their study of stem sections and fire scars, but it also follows shortly after the 1847 Bushfire Ordinance which made it an offence for aboriginal people to light fires. In the southern forests, Crawford and Crawford cautiously estimate that aboriginal fire management "may have continued comparatively undisturbed until about the 1860s, when the pastoralists to the north began to establish homesteads and to take out leases for grazing on the coast" (Crawford and Crawford 2003: 71). This was less than three decades after Western Australia's first settlers arrived in 1826 at King George's Sound (today Albany), and later, in 1829, to establish the Swan River colony in what is now Perth. European settlement spread slowly in the earliest years in Western Australia, but fire was a

source of conflict from very early on (Green 1984; Ward 1998). There were no doubt other factors that contributed as well, in addition to legislation, including diseases brought by the Europeans. Numerous aboriginal people died from influenza, measles, cholera, and whooping cough in the decades following European arrival. There were also killings and massacres (such as the battle of Pinjarra in 1834), large numbers of aboriginals were imprisoned, and from the 1850s onwards, many of the aboriginal people who had gotten rural employment were displaced by the flow of convict laborers from Britain (Green 1984). There are also sources that say aboriginal burning persisted after this (see for instance Lloyd and Krasnostein 2005; Kelly 2000), but it is not understood then to have constituted a region-wide regime. Increasingly, the fires of the southwest came from the settlers, soon almost exclusively, and later still aboriginal fire management moved into the research sphere and into debates, and narratives emerged that could be used to set the stage for seminars and planning documents.

The time in between the aboriginal fire regime and the Forest Department's systematic prescribed burning which begun gradually from the 1930s and was extended to the entire forests region in the 1950s seems difficult to characterize in a clear way. In a sense, it appears to form an interim period in which the forests were un-managed, a messy period where some aboriginal burning, the burning done by pastoralists and stockmen[40], the settler's fires and their attempts to keep fire away

[40] In the karri forest, according to Crawford and Crawford, pastoralists would likely have burned more frequently than the aboriginal people. They write: "In the twentieth century, one stockman, Bill Ipsen,

from their homes and farms, a new lack of fire in areas where it used to be frequent, and the fires started and exacerbated by un-managed logging in the late 19th and early 20th century (see chapter 2) all combine to form a curious gap in settler memory of fire. Burrows et al. describe this "First European era" as characterized by the cessation of aboriginal burning along with various unwise settler practices, such as wasteful logging which filled the forest with flammable debris and the unplanned escapes from burns set to clear land for farming (Burrows et al. 1995: 14). In a somewhat different tone, historian Jenny Mills writes about early settlers in the southwest trying to replicate Aboriginal burning, but producing more fierce fires because they were "not so adept at burning off" (Mills 1989: 234). Much of the fire in this period seems to have lacked those crucial elements of aboriginal burning practices: intention and skill. There is very little systematic data on fire occurrence and frequency prior to the late 1930s. Compared to both the period of 'the aboriginal regime' and the period of prescribed burning, the time in between has been little analyzed in terms of fire. It appears to be conceived of as a time of haphazard anti-pattern where one regime had been disrupted, but a new one had yet to be initiated. It is a gap that may contribute to a prevalent and often tacit assumption that a regime is something which is very easily disrupted, and is very difficult to reinstate. The gap may also be a factor that allows for some ambiguity between the aboriginal regime and today's prescribed burning. The two regimes, while comparable as regimes, were,

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recalled that drovers burned frequently: 'Drop a few matches while you were there?' one drover was asked. 'Oh, I'd burn when I could'. The cattle ate the fresh vegetation that quickly followed burning" (Crawford and Crawford 2003: 72).

so to speak, never directly in contact. Because of this gap, prescribed burning, started by Foresters in the 20th century, is not taken to be what supplanted the aboriginal regime. Forest managers may be able to see themselves, then, not as those that caused a fire regime to break down, but as those who are attempting to instate and maintain a new one. And in those efforts, the indigenous regime is at a sufficient distance to be an imaginative resource.

Discursive practices involving aboriginal burning both bring it together with the present and pull it apart. Through the notion of management, and the concept of a fire regime, aboriginal burning is tied to present day management as a kind of imaginary for what might be possible to do—a precedent for low intensity fine grained mosaics. But on the other hand, by a sometimes seamless-seeming proximity to ancient fire and by a gap in historical memory—a systematically told lack of pattern—indigenous burning is placed at a distance, categorically distinct and not in actual contact. This, in part, is what lets it become a figure, a resource for understanding and imagining, but not something they have to practically deal with.

Through the gap, nature and native is held apart. But in other contexts, the thorny issues related to indigeneity and the environment bubble up more explicitly. Let me take you into the debate columns of the dispossessors to show what could otherwise have been confronted when people mobilize "indigenous burning."

Indigeneity and environment—the debate columns of the dispossessors

In the latter part of 2016, a fierce public debate raged in WA about a decision by the Fremantle city council not to provide funding for the Australia day fireworks display. Instead, they wanted to arrange an alternative celebration, a more inclusive event, to be held on a different date than January 26th, the date that marks the arrival of the First Fleet in 1788. Among modern settler states founded on violent dispossession of indigenous people, noted Fremantle councilor Sam Wainwright in the local paper in September, Australia is "the only one to hold its national day on the date that marks the beginning of that dispossession" (Fremantle Herald, September 24th, 2016). Wainwright had written a strongly worded opinion piece, in which he argued that "it takes a willful ignorance not to see why so many indigenous people find this confronting, and a stubborn racism to keep insisting that non-indigenous Australians get to decide whether or not indigenous people should have a problem with it." The aim of the city council's decision was to create a celebration that was more "culturally appropriate" (ABC news, August 25th, 2016) and more respectful of the indigenous community. The debate that followed developed in two main directions—one concerning local economy, the other about identity and principles. Many of those who spoke out against the city council's decision, argued that it would seriously disadvantage local businesses. The chamber of commerce said restaurants and retailers would lose a very important day of profiling, a day when they would otherwise expect some 50 000 visitors. This strain of the debate argued, explicitly or implicitly, that fireworks and the Australia day celebration was not about racism, colonization, or politics. In the more vitriolic contributions, the city council's decision

was accused of being an example of political correctness gone mad, a reaction to the loud voices of a handful of activists, and they were urged by some to stay out of racial politics, or even resign. But the issue of Australian identity and history was never far from the surface. During the months leading up to Australia day, I would hear arguments about genocide and reconciliation—some called for a treaty, others were "kinda ready to hear 'I forgive you' from our indigenous community"[41]—and about the conditions of Australian society today. Eventually, both state and federal politicians got involved after Fremantle city council suggested to move its citizenship ceremonies from the 26th to the alternative celebration on the 28th. The federal Turnbull government threatened to intervene and take away Fremantle's power to perform the ceremonies, arguing that they should not be political affairs (Fremantle Herald, December 3rd, 2016). Liberal WA premier Colin Barnett even called Fremantle city council "disloyal," saying that Australia day is a day when "we come together as one people, one country" (ABC news, November 27th, 2016). Some argued that there was a lot to celebrate about Australia—regardless of its history it is worth celebrating that Australia is a good country to live in today. Others, like mining magnate and philanthropist Andrew Forrest—who later in 2017 was named West Australian of the year—said he found it "phenomenally difficult to be complete proud of our country," as long as there is disparity between indigenous and non-indigenous Australians (The West Australian, January 25th, 2017).

[41] This is a quote from a facebook post by one member of the Fremantle Chamber of Commerce, it was also quoted by Sam Wainwright in the Herald.

In an opinion piece published on the day of Fremantle's alternative celebration, Paul Murray argued that the debate shows Australia as "a brittle, divided society," but perhaps also a healthy society, "one that can thrash out its differences in the open peacefully" (The West Australia, January 28th, 2017). But Murray also indicated that a reason why the conversation caused such discomfort for many Australians is that it brings to light something that is jarringly dissonant with the Australian virtues of egalitarianism and fairness. Aboriginal MP Ben Wyatt had similarly noted that the 26th is a "deeply unsettling issue for modern Australia" (Fremantle Herald, August 26th, 2016).

In the end, two celebrations took place. The "traders' oz day," as the Herald called it, was held on the 26th and had fireworks funded by local businesses. The alternative event, "One day in Freo," was held on the 28th. The latter featured concerts and a fairground with food trucks and stalls where people could try bush tucker, basketry, and indigenous dance, as well as stalls where they could talk about reconciliation or "check their privilege" on a chart.

The Australia day debate was one of two issues that must have been covered every single week that spring in Fremantle's two local papers, the *Herald* and the *Gazette*. The second issue was a conflict surrounding a project to build an extension of the Roe Highway. This was by far the most prominent environmental issue that year in WA. The Roe 8 project, as it was called, was met with massive opposition from Perth's environmental groups as well as many locals in the area, including local Noongars. The project involved clearing a section of the Beeliar wetlands, an area of remnant

bushland in the southern suburbs of Perth, and was meant to alleviate the pressure on the road network from freight traffic going into Fremantle port. The environmental groups argued that the extension of the highway would not in fact alleviate the congestion, but more importantly, the project would threaten an area of bushland with high social and ecological values, among other things as a roosting site for the endangered Carnaby's black cockatoo.

Over the course of spring and summer, as work began on clearing and construction, the conflict escalated, and many protesters camped out at the site where some engaged in direct action, for instance by chaining themselves to machinery. The conflict ended with the state election in March, when the Labor Party opposition won with a considerable margin and immediately pulled the plug on the project. Looking back at the conflict a few months later, the director of the Conservation Council WA described the project as a "shocking crime" against the environment, the community, and the "unique and ancient ecology of Coolbellup and Beeliar Boodja[42]" (Fremantle Herald, July 1, 2017). The Government in charge of the project, he likened to "teenage vandals throwing rocks through the stained-glass windows of a cathedral" (ibid.). In the months following the election, there were also petitions and rallies *in favor* of Roe 8. These emphasized that the project was "good for the state," contributing to future prosperity, economic development, and less congestion. I recall reading a letter to the editor in one of the papers sometime in May where a man in

[42] Boodja or booja is Noongar for country or land.

favor of the project calmly and confidently asserted that it was only a matter of time, with the liberals back in power in an election cycle or two, the road would be back on schedule—progress, he seemed to imply, was inevitable.

Settler societies are troubled in a distinctive way by matters concerning indigeneity and the environment, and it is telling in itself that the Australia day debate and the Roe 8 conflict were the two most controversial and contentious public issues in Fremantle in the spring and summer of 2016-17. It is not a stretch to see in these two public debates certain unresolved settler anxieties, but one could also call it a kind of settler commentary. If white Australia's treatment of aboriginal people is "an indelible stain" (Reynolds 2001) on the nation's history, then many would say the same about the way the settlers have treated Australian nature. With regards to the environment the Roe 8 conflict quickly settled into a familiar mold where developmentalism was set against conservationism and indigenous people were mobilized as naturally tied to the land—Beeliar was both Boodja and cathedral, both ancient and indigenous.

The Roe 8 debate was a site where environmentalists forged a relationship with indigenous people[43]. And in a more or less direct way, both the debates concerning Roe 8 and Australia Day are necessarily connected to questions of who should be allowed to use the land, who should be allowed a say, and on what terms. In a sense, these debates show that the concerns of most West Australians in 2017 was not forests or fire. But in another way, they concern the same tensions that are often

[43] See Vincent and Neale (2017) for a recent discussion of the complexities of the relationship between environmentalists and Aboriginal groups.

drawn into the ways people think and act towards fire and forests. Fusions and disconnections of indigeneity and the land occur in public debates such as these, just as in debates surrounding fire. Larger debates, partially overlapping with the ones that underlie the controversies surrounding Australia Day and Roe 8, are potentially involved, intentionally or not, when connections are made (or omitted) to "Aboriginal fire management." When fire managers draw on the figure of indigenous fire management to understand the southwest forest, they are also negotiating connections and disconnections between indigeneity and the environment. Often, even while they are recognizing that aboriginal people were skilled and conscious land managers, they place today's indigenous people at a distance—they construct the relevant indigenous burner as an abstract model, a precedent for management and for the regime.

As we know, there can be an insidious kind of cunning (cf. Povinelli 2002) to both recognition and reconciliation (Cowlishaw 2012; Hinkson and Altman 2007), to sovereignty and apologies (Moreton-Robinson 2007; Short 2012; Moses 2011), even to land rights (Altman and Hinkson 2010: 10)—all seemingly positive developments for indigenous people that nevertheless entrench their place within the settler state's order of things. We can also see these debates, as well as the scholarly writings on fire stick farming, indigenous fire management, and terra nullius, as being involved in governing in a different way. They order and define not just who should be allowed to use the land, but also what is considered life and non-life. According to Povinelli (2016), the figure of the animist is one ordering or governing mechanism in what she calls late liberal geontopower. Just as Foucault's biopower has its figures— "the

Malthusian couple, the hysterical woman, the perverse adult, and the masturbating child" (Povinelli 2016: 2)—geontopower is characterized by the figures of the desert, the animist, and the virus. Those that have spoken in favor of greater recognition of indigenous ways of life, both of indigenous peoples' life ways today and of indigenous burning practices in the past, have usually made dividing lines between different kinds of life and existence, and we can image that the figure of the animist would have helped them, guiding and constraining their thinking. Usually, they have held Wagyls and "management" strictly apart. Rainbow serpents and farming have been kept in different spheres of reality. As we shall see later in this chapter, indigenous people also draw on these tacit and powerful lines of separation in order to be legible to and gain traction with mainstream Australia.

Another way to approach these public debates and the ways that people mobilize fire to understand the forest is to see them as a collective struggle among white Australians to come to terms with their own history as a settler colonial society. With a few exceptions, the debates were mostly ones where settler Australians discussed aboriginal people, and in that way similar to how indigenous burning is being mobilized to contextualize or give meaning to present day fire management. Bergland finds that stories about American Indian ghosts show how native Americans have "vanished into the minds of those who have dispossessed them" (Bergland 2000: 3). In Western Australia, it might seem like indigenous Australians, along with their fire practices, are being vanished into the debate columns and prefaces of their dispossessors. Both the debate over Australia Day and the Roe 8 project display ways

in which indigenous life is contained, made into a thing and placed in categories that are meaningful for settlers. But perhaps the situation is more complicated than that.

The recent South West Native Title Settlement, which during my time in the southwest seemed well on the way to becoming implemented, appears to bring some not completely unambiguous benefits for Noongars in the region. The Southwest Settlement Agreement consists of 6 different land use agreements involving some 30 000 people. In 2017, as I participated in preparing burn prescriptions with Parks and Wildlife, I was told there was "a bit of watch this space" about indigenous involvement in land management. On the online burn prescriptions platform we left the column for actions to be taken concerning Native Title Representative Bodies with nothing but an asterisk, indicating to ourselves that we would return to it in the future, perhaps in the hope that there would be more clarity about this matter when we were to go over the prescription with the district fire coordinator. There wasn't. Things were happening, but they were happening slowly. What I mean to suggest is that an extensive practical involvement of aboriginal people in forest management in the southwest seemed rather remote in 2017.

At Parks and Wildlife, Aboriginal representatives had gotten a column, but that was also pretty much the extent of it. And an asterisk contributed to quietly displacing aboriginal people as land manager towards an unspecified point in the future. That is not to say that the native title settlement was not seen as an important step forward by many. It promises among other things to set aside up to 320 000 ha of land, it gives access to public land for "customary activities," (which does not include burning),

and it grants about 50 million AUD distributed over 12 years to a Noongar Boodja Trust. On the other hand, just like former Prime Minister Kevin Rudd's official apology to Australia's indigenous people in 2008 (see Short 2012, Moses 2011), the Southwest Native Title Settlement has been criticized for falling short of being a treaty.[44] Like so many other things in the world of aboriginal politics, these phenomena can be seen to embody aspects that may be regarded as ways of governing the indigenous population (columns can be confining)—a domination driven by what may well be good intentions. As I write this in late 2017 (and as I revise in late 2018), the native title claim is still not completely settled. In February of 2017, five of the Noongar claimants refused to sign the deal, causing it to be rejected by the federal court. Going against the majority of representatives, the five who refused to sign were displeased with the process and concerned that the settlement's land use agreements would once and for all preclude the possibility of truly realizing Noongar peoples' rights to the land[45]. Since then, the settlement has been lodged with the National Native Title Tribunal, an independent body that among other things provides assistance in negotiations. In the meantime, as the Southwest Aboriginal Land and Sea Council explain on their website[46], work on establishing the institutional frameworks for implementing the land use agreements is going ahead.

[44] https://www.theguardian.com/australia-news/2017/feb/03/noongar-native-title-deal-ruled-invalid-by-federal-court
[45] http://www.abc.net.au/news/2017-02-02/billon-dollar-noongar-native-title-deal-rejected-by-court/8235138
[46] www.noongar.org.au

One way to interpret the settlement is to see it as a method for creating closure. There is an implicit Christian European notion of time that underlies settler Australian ideas about reconciliation, argues Deborah Bird Rose (2004). It is a temporality built on ideas of disjunction and irreversible sequence—of the present as a hinge-like moment where the past can be transcended—which "enables regimes of violence to continue their work while claiming the moral ground of making a better future" (Bird Rose 2004: 15). But cunning governance does not completely determine how the aboriginal population receives and creatively responds to the settlement and what comes with it, just as modern bureaucratic definitions of space never completely determine what people make of those spaces (cf. Scott 1998). Merlan (2014) makes a similar argument regarding Welcome to Country ceremonies and other "rituals of recognitions." These are more than just "the product of neoliberal cunning" (297), rather they are understood in various complex ways by indigenous people and they can be personally significant and transformative. That contemporary fire management is not one of the sites where the unresolved tensions of nature and native is confronted—even though it clearly has the potential to be—may not be just down to fire managers. It may also be because aboriginal people consider other matters more urgent.

Ancient bread and the right kind of fire

In June 2017, I attended an event at the Perth City Library called "Agriculture or Accident." There, I helped make up the majority white audience who had come to

listen to indigenous scholar and author Bruce Pascoe and a panel of Noongar elders discuss Pascoe's recent book *Dark Emu* (2014). It was almost packed, perhaps as much as two hundred people, including a somewhat larger contingent of indigenous people than I would normally see at academic events. The panel consisted of four Noongar cultural leaders, two women and two men. The two men, Noel Nannup and Richard Walley, both had connections to academia, whereas the women, Vivienne Hanson and Dale Tilbrook, worked with traditional medicine and bush foods respectively. Bruce Pascoe had a long white beard and made jokes about Aussie-rules football. Behind him, on the projector screen, was a rainbow serpent, a wagyl.

"We need to reform education," he emphasized. We need to start teaching the truth about what aboriginal people were actually doing on the land, and the time to do so has never been better. The rainbow serpent gave way to a stone in a sharktooth shape. It has been used as a pick to till the soil, residues on the stone and the pattern of wear leaves no doubt—granted one is not convinced otherwise. He talked about having visited museums where they had cabinets full of similar stones which were labeled "unusual stones," and "stones of unknown use." The evidence of aboriginal agriculture is there in abundance, he said, but it has been systematically ignored and explained away because it doesn't fit with the European view of aboriginal people as nomadic hunter gatherers who never worked the land.[47] He went on to show etchings

[47] As he puts it in his book, "Australians make plaster figurines of aboriginal men standing on one leg waiting for the windfall kangaroo, while we have all but ignored ethnographic evidence of aboriginal engineering" (Pascoe 2014: 65-66).

of elaborate aboriginal houses that could fit dozens of people, of decorated aboriginal burial grounds, and of the Brewarrina fish traps in New South Wales, said to be the oldest human construction on earth. But the most important thing was agriculture. "We need to stop saying such things as dead heart and desert," he said emphatically. What Europeans saw, and still see, as the dry barren land of the interior was part of the aboriginal people's grain belt, where they systematically grew grains, plants, and tubers, such as the yam daisy. The explorer Charles Sturt, as he was struggling to survive on an expedition to the central dessert, was given a house to stay in, bread, and even roast duck by the local aboriginals. This is all there in Sturt's journal, Pascoe emphasized, but no one will teach it to you in school. Instead of being proud of Australia for Kylie Minogue and vegemite, he said while a picture of a gritty rustic loaf adorned the screen behind him, we should be proud because it's the country that invented bread. Moreover, what aboriginal agriculture can teach us becomes so much more important now that we're experiencing a drying climate, he added. When a dry land is becoming even drier, we need knowledge about how to see Australia as fruitful rather than barren and empty.

The discussion that followed reinforced the optimism of Pascoe's talk. The key is education, Noel Nannup said. Australia is more ready than ever to talk about the wrongs of the past, and particularly the young are eager to learn. There's no better time for this than now, said Bruce, "young people are keen to treat aboriginal people as not a charity, but as fellow citizens." And we're heading in the right direction, a

couple of the other panelists concurred, the large turnout this evening was a clear sign of it.

Later, during the Q and A, as Noel Nannup was in the middle of answering a question from a Noongar elder in the audience about whether they were not just preaching to the converted, an eager man interrupted from one of the front rows. He had a question to Bruce about fire. The eager man was Sam, a farmer and passionate but mild-mannered environmentalists I had met a few months earlier near a small town on the south coast. We had spent a day together in the forest, where he had shown me what he saw as the devastation of some recent Parks and Wildlife prescribed burns. Sam directed himself to Bruce Pascoe. He said that he was from the wet karri-tingle forest down south and that his experience after having lived there over 50 years is that some of the forest is good at looking after itself, and, moreover, that Parks and Wildlife are wrong in suggesting that they are burning like the aboriginal people used to. Noel, seemingly adept at dealing with inappropriate interruptions from white people, told Sam that Bruce could answer the question after he had finished with his, and he went on at some length, perhaps, I wondered, even demonstratively long. Then Bruce answered, in what sounded like a reluctant tone of voice. He didn't say anything specifically about the southwest forests. Instead, he emphasized that aboriginal people handled each part of the country differently. There wasn't any one plan to fit all. They cared for country and managed it in a careful way. Richard Walley took over and said that it is important to distinguish between cool and hot burns. The aboriginal people would burn cool burns, and in small patches, he said.

But Sam was reluctant to let it go, and followed up, asking whether all of the southwest really would have been burned through with frequent cool burns? Richard said that according to their knowledge, yes it was. But he also said that the southernmost part of the southwest may not have been very densely populated. Noel took over again and said that with fire you have to understand the opposite of fire. Few things travel up a hill faster than fire, and few things travel down a hill slower. On the other hand, few things travel uphill slower than water, and few things travel downhill faster than water. You've got to understand it's opposite. Aboriginal people, he said, used the natural features and weather to burn. They knew that at a certain time of the year they would have the steady wind from the southwest, the "Fremantle doctor" as people call it today, and at another time of the year the opposite wind from the northeast. "Our people burned in between those, with fingers of fire, in mosaics, and for the whole suite of the biota." And they would not burn unless there was a heavy dew, he added. Then you could light your fire in the afternoon and let it burn out to the edge. At this point, the chair cut them off. It's been quite a discussion, she said. Then she apologized to anyone who had any other "burning questions," and the crowd burst out in laughter at the apparently unintended pun.

Pascoe's book and talk are among the latest in the series of interventions working to change dominant conceptions of aboriginal land management before European invasion. In his chapter about fire, he draws heavily on Gammage, and he also cites Rhys Jones. However, whereas Jones, Hallam, and Gammage are specifically focused on burning, Pascoe's concerns are broader, and fire is only one component, one

among many examples of how the aboriginal people skillfully and carefully managed the land. There are two different things at stake in the fire debate at the Pascoe event, and they're not the same for Sam as they are for Bruce and the rest of the panelists. For Sam, aboriginal people and their burning practices are one aspect of a larger issue regarding fire management. For Bruce, fire is one component of a larger issue concerning aboriginal people and how they are seen and treated by mainstream Australia. For Bruce, fire was one example of how aboriginal people managed the land, and a component that could be used to intervene in how young Australians are educated. Bruce emphasizes elements— stones used to till the soil, grains, bread, sedentary living—that allow him to garner the momentum of dominant Western narratives of domestication[48]. Bruce is aware of what has the potential to move popular opinion. For Sam, knowledge about aboriginal fire is important mainly in so far as it gives us some indications about how to (or how not to) manage the forest today. For Bruce the image of aboriginal people was itself at stake. For Sam it was a figure to tie into the southwest as a place that burns in certain ways. Here, Sam draws on indigenous burning in the same way as fire managers do, as a figure, a resource to understand contemporary concerns with fire and burning. For Bruce, there are bigger things at stake than fire management today.

I'm confident that Sam's mind would not have been swayed by the answers he got. Even though he was told that aboriginal people burned in all parts of the southwest,

[48] See Swanson et al. (2018) for a recent critique of this narrative.

Bruce and the panelists expressed an openness or uncertainty about the extent to which aboriginal people had occupied the wet forests of the far south, and the notion that aboriginal people skillfully managed all parts of Australia, each place in a different way according to their needs and what was good for the country, would not necessarily be at odds with Sam's contention that they left certain forested areas un-burnt.

Even if it is indisputably clear that aboriginal people burned the southwest, it is also a matter associated with a fair amount of uncertainty; often enough to accommodate contradictory interpretations. What is often alluded to, yet never resolved, when aboriginal burning is invoked in writing or debates about fire, is the distance or proximity between aboriginal fire management and present-day prescribed burning, especially perhaps in frequency of burning and intensity of the fires. Very rarely is it stated explicitly that current practices or outcomes are comparable to those of the Noongars[49]. And just as rarely is it argued that we should see aboriginal burning as a model for contemporary fire management any more specifically than that we should strive to achieve planned, mostly low intensity burns. It is as though these are assertions that could never be more than just assertions. Indigenous burning can be an imaginative resource, but not quite a model.

For Bruce and the panelists' concerns about changing mainstream perceptions, aboriginal burning has a clear role to play as part of what was a deliberate and

[49] One exception is Abbott and Loneragan (1983).

intentional way of shaping the environment. Indigenous fire management can be held still so it can be used to move mainstream conceptions of aboriginal people. Concerning management of today's forests, however, ultimately, aboriginal burning is left in a limbo—where it has importance, but it is never entirely clear how or for what; where it of interest but is never directly and undeniably relevant for contemporary management. If aboriginal burners are sometimes confined to debate columns and prefaces, they are also sometimes relegated to what we may call the research sphere, a space for things that are too uncertain to have a clear practical implication, for vanguard science (cf. Fleck 1935), and for things that are esoteric, or whose ultimate impact is perceived to be directed towards an academic debate. Neither fire managers nor environmentalists are interested in keeping indigenous fire management still.

In the research sphere, uncertainties are allowed to flourish. In this case, people are uncertain partly because the sources that researchers rely on are tricky, and partly because it is unclear to them how exactly knowledge about indigenous burning should relate to fire management today. Jarrah trees rarely live longer than three to four hundred years, and low intensity burns may not even make fire scars that can be detected by stem sectioning techniques (cf. Burrows et al. 1995). Therefore, curiously, the lack of traces of fire can be a sign of frequent fire. Landscape art from the early settlement period and explorers' records is another set of finicky sources. Many researchers take them to indicate something about what the forests used to look like. Numerous explorers and early settlers described aboriginal fires. However, we

can also imagine that landscape painters would likely have modified the landscapes they depicted according to the style of the time, as well as in order to appeal to British eyes, since such paintings were often used to attract settlers to the new colony. Gammage dismisses this point of criticism, perhaps too easily, arguing that painters of the day, some of whom were also naturalists, had good reason to be accurate (Gammage 2011: 18). It's also possible, on the other hand, to argue that Gammage may underestimate the reasons painters had to be selective. Reasons that "nature [was] modified by art" (Weston 2003: 178) need not even be something the artists were wholly aware of. As many painters made "the scenery look desirable and familiar, the awfulness and fear of the unknown [were] reduced or removed entirely" (ibid.). Considerable efforts were expended in Western Australia to attract settlers from England. According to Frawley, "The early promotion of the Western Australian colony is one of the best examples of such distortion of information" (Frawley 1987: 6). Hence, a shrubby monotonous subdued landscape could have been turned into a park-like woodland, with framing trees, a distinct background/foreground separation, and overemphasized hills and tidy large trees.

These sources, moreover, also show more than just a region made of tidy parks. Along with the many references to the southwest as open and park-like, there are also a number of descriptions of landscapes that are impenetrable with dense undergrowth (see e.g. Crawford Crawford 2003: 29), especially in the southern forests, and according to Noongar environmental scientist Glen Kelly, traditional fires were also lit to encourage thick growth in some areas (Kelly 1998). It has also been pointed out

that early descriptions of fire intensity in sources such as explorers' journals would partly reflect their European preconceived notions of what an intense fire is. There is plenty of evidence and knowledge about how aboriginal people burned and still burn in other parts of Australia, such as the Western Dessert (e.g. Bird et al. 2005) and the Northern Territory (e.g. Lewis 1994; Russell Smith et al. 2009), but this isn't assumed to necessarily be transferrable to the southwest forests. In the southwest, both historical and archeological data are limited (Dortch 2005; Gill and Moore 1995). Knowledge about such things as patch size or ignition pattern in aboriginal burning don't seem to be understood to be within grasp.

My point is not whether or not landscape artists and early settlers made accurate depictions of the southwest landscapes. Debates around landscape art all too easily pull us in two opposite directions. As discussions revolve around the question: are these paintings accurate representations of the world? they seem to pull the paintings towards being either representations of the forest or of the painters' knowledge frameworks and biases, and never both. Instead, I believe landscape painters would have seen landscapes from a particular position, but they would also have been nudged and pulled by the landscapes' liveliness and peculiarity. More important for my concerns in this chapter, however, is that these depictions allow the figure of indigenous burning to be tied into present day concerns in various different ways. While the research sphere and the debate column place buffers of uncertainty and contestation between indigenous people and the environment, they also allow for

indigenous fire management as a figure to be sufficiently open, so that it can speak to a variety of concerns. It is allowed it to be a flexible imaginative resource.

The gap in history has a similar effect to the research sphere and the uncertainty of sources. The gap is represented by a mismatch between different kinds of fire history, where one regime is known by policy documents and foresters' records of when and where fires and burns occurred, another regime known by extrapolating from the documentations of explorers and artists who were mainly preoccupied with something else than recording fire, and a period in between in which fire is barely known at all. Compared to the frontier period gap, both the aboriginal regime and the foresters' regime take on an air of completeness, connectable or disconnectable to each other as regimes precisely because they never touched directly. As a figure, indigenous burning can be mobilized by critics of today's fire management practices, such as Sam, as something that embodied deep insights that they believe are lacking today; and it can be mobilized by people in Parks and Wildlife as a means to contextualize the contemporary forest, placing today's landscapes in a deep history of being fire-prone and fire-adapted, and to give a precedent for management and manageability. In these ways actual aboriginal involvement is often placed outside of relevance, even while, and in part because, "indigenous burning" contributes to the knowledge frameworks that both fire managers and their critics approach the forest with.

A final reason why indigenous issues can fall outside of relevance, and for "indigenous burning" to become a framing device, is that it might just be the case that the forests and the region have changed too much. The forests that burn might not be

the same forests. As we will see in the next chapter, the forests in the region are widely perceived to have gone through two periods of change. The first period, from the late 19th until the early 20th century involved extensive and unmanaged logging in the northern jarrah forest which changed the structure of the forest among other things making it more prone to intensive fires. The second period spans several decades following World War II in which the forests have been increasingly affected by droughts and declining rainfall, by dieback caused by the introduced pathogen *Phytophtora cinnamomi,* by intensification of forestry and logging, along with processes that have fragmented the region, such as open pit bauxite mining, more roads, softwood plantations, and increases in tourist facilities, hobby farms, and lifestyle migrants. Even if researchers and forest managers knew exactly how aboriginal people used to burn, to conceive of the forests as changed means it might not be possible or even appropriate to do it the same way anymore. They might not be burning comparable forests. This idea of course, as true as it may be, allows indigenous burning once again to be cast outside of relevance. In effect, the forest itself, as a degraded place undergoing climate change, can come to contribute to naturalizing exclusion.

In all of these cases, then, the indigenous person who used to burn is engaged with as a figure. Indigenous people—actual indigenous people—do live in the southwest. But for fire managers, indigenous land managers are for the most part engaged with as a discursive, imaginative, and politically charged figure. “Aboriginal fire management” and “indigenous burning” are rich knowledge forms through which people capture the

landscape in certain ways, and make sense of the present and the past. Indigenous people too have to engage with this figure, that is, the figure that they are for others, and in some of those cases, fire management is not their primary concern.

For fire managers, the figure of the indigenous person burning comes to play a role in how the southwest is understood to be a pyro-landscape. It contributes to the notion of a fire regime, and it is part of fire managers' frameworks of knowledge. It is part of fire managers' earnest attempts to understand what they encounter in the forest. But these earnest attempts to understand are also tied to processes of exclusion, ways in which indigeneity and the environment is sometimes pulled apart and sometimes pushed together in each case to serve other ends.

As the southwest becomes an even more fiery place, we might now ask—though perhaps not yet answer—what happens to exclusion processes in situations of pyro-landscape *exacerbation*? To open for this question is useful in itself, but we may also speculate. Perhaps, as the distance grows between the forests of today and the forests of pre-European times, and as fire managers more often have a sense of losing touch with their own fire regime and their grasp of the forest, "indigenous burning" may come to be a less useful imaginative resource. We can also wonder if, in a possible future thought of as less mild and manageable, fire managers will find other figures to see the forests through than the indigenous regime, and mosaics and regimes more generally. If indigenous people are, in part, excluded by being mobilized as a figure, is there a future in which aboriginal Australians might be included in forests that no longer appear closely comparable to the ones their ancestors lived in and managed?

Part 2 — Ambiguity

Fig. 3. Even the most severely burned areas—like here in the Waroona fire scar—compel fire managers to consider simultaneous opposite possibilities.

Chapter 3—Forest ambiguity and the relation to degradation

In many places along its eastern edge, the forest of the southwest ends abruptly. Instead of a gradual transition to a different landscape, straight lines and rectangular fields cut into the forest. Here starts the Wheatbelt, and further south, the Great Southern region, Western Australia's major pastoral and agricultural regions, as well as the regions where most of the species extinctions in the state have been recorded, in large part due to land clearing and habitat fragmentation. In the Wheatbelt, woodlands and shrublands have been cleared for agriculture since the end of the 19th century. There were major pushes in the 1920s and early 30s under Premier James "Moo Cow" Mitchell, who earned his nickname for his staunch support of agricultural development, as well as with the soldier resettlement schemes following both world wars, and eventually the "million acres a year program" in the 1950s, a policy which aimed to release a million acres of land for agriculture every year.

The Wheatbelt and the Great Southern make up a significant portion of the southwest Global Biodiversity Hotspot, a dubious distinction Bradshaw points out, as it "signifies global areas of high endemicity with exceptional loss of habitat" (2012: 112). Particularly important—both for its richness and its loss—is a vegetation community called "Kwongan," an aboriginal-derived word referring to "southwestern sclerophyll shrublands other than mallee" (Beard 1990: 18). The Kwongan is comparable to chaparall, fynbos and other Mediterranean shrubland communities, and it is celebrated for its exceptional species richness. Currently the Kwongan

Foundation, a group started by botanists from the University of Western Australia, are seeking world heritage status for the Kwongan as it contains about 70 % of the ~8000 native plant species of the Southwest Australian Floristic Region (Hopper 2014: 4).

The Wheatbelt is a place of extremes: extreme species richness and extreme loss—some would say extreme folly. In a documentary film that is often shown in West Australian schools (Rijavec 2002), farmers in the Great Southern region who received land in the million acres a year program tell stories about a poorly planned project—one of them mentions a neighbor who used to own a lady's dress shop to illustrate the point that many of the "new land farmers" had no prior experience. They also tell of broad scale land clearing that has left huge parts of the country useless because of stream salinity, species that have become extinct, and whole ecosystems that have been wiped away. They narrate how they eventually came to the opinion that this land was never suitable for agriculture, and many of the farmers interviewed in the film had started revegetation and land care projects. Today, one historian describes how "saline watercourses run like stretch marks across the lumpy and freckled skin of this old land" (Gaynor 2015 np) in what could have been, and according to those who tell such stories *should* have been, diverse and species-rich woodlands and kwongan vegetation. A vivid comparison is also employed by another author who notes that an area "the size of a small European nation" (Beresford 2001: 414) is affected by salinity in the Wheatbelt. To many, the Wheatbelt represents an ecological disaster, to many in academia it is a prime example of "developmentalism" and a settler's urge to dominate the nature of the new land. But it is also the state's food basket, where WA

gets a large proportion of its wheat, wool, and several other products. The Wheatbelt seems caught in a bind, where the notion that agriculture cannot be altogether negative meets the notion that land clearing cannot possibly be good. Alongside ruined farmlands where former farmers try to regenerate the land, are productive wheat fields and sheep runs that will always also be Kwongan ghosts.

I start this chapter with a contrast. The Wheatbelt is a constitutive outside for the forest region, it can show us what the forests is *not* understood to have become. The Wheatbelt lends itself to a common modern narrative of decline: it seems to be a ruin of sorts, that is, in Stoler's terms, a site that can "animate both despair and new possibilities" (Stoler 2013: 14). The Wheatbelt is "what people are left with" (Stoler 2013: 9)—its story can begin anew, after degradation, with recovery, restoration, betterment, and hope. With ruin comes certainty about the destructive past, an opportunity for moral clarity in the present, and an opening for optimism for the future. The wheatbelt, like so many landscapes in the world today, finds itself after degradation.

The forests region, in contrast, is a different kind of place. Before European invasion, the southwest forests are estimated to have covered nearly 4.2 million hectares (Conservation Commission 2004), of which 3 million hectares were dominated by jarrah or karri. Today, 2.6 million hectares remain, roughly 2 million of jarrah and karri. Two thirds of the forests of the southwest are still forests, complex ecological communities valued for a variety of reasons. The forests in the southwest are sites of variability and change, but significant parts of these areas are still forests. They are

subtle and dramatic. They inspire forest managers to think with ambiguity. But the forests have also several times over the past century been thought to be on the edge of ruination: by overcutting in the late 19th and early 20th century, phytophthora dieback from the 60s onwards, the continuous threat of developmentalist projects of agriculture, mining, and changes in water use; and finally, by climate change and the ongoing drying trend and the combined effects of a drying climate, intensified use, dieback, and fire. If the Wheatbelt has experienced wreckage, in some places with hopeful possibilities of recovery, the forests have been repeatedly imagined to be on the edge of ruin, but never quite fallen off. Consequently, ruin is not something of the past in the forests, but still a possible impending future, imagined not so much alongside recovery as together with the possibility that the forest might well after all prove to be resilient.[50]

It is common in many places today to imagine ourselves and our landscapes as being situated either before or after a great modern degradation event. We have precedents for this from all over the world, and many such stories have been told by anthropologists and environmental historians[51]. In the age of the Anthropocene, if we aren't already after a big degradation event, we must always face the possibility that our degradation event is impending. In the wheatbelt, it seems, the degradation event

[50] Even the harshest critics of the past century's forest management practices, such as Bill Lines, for whom the idea that "most of the forest still behaves as a natural system" is a "necessary delusion" that forest managers tell themselves in order to continue to manage according to an ideology of production (Lines 1998: 78), expresses ambiguities, as he simultaneously celebrates the magnificence of a forest that still allows him to think of it as a place that can be saved, rather than restored.
[51] See for instance environmental history's narratives of decline (Cronon 1983, Worster 1979).

lies in the past, which makes it possible, in certain cases, to look forward to restoration and in other cases to more easily open for continued degradation. In the southwest's forests, however, it is far from clear whether we are currently before or after a decisive moment of degradation. The forests embody a profound ambiguity, which for forest managers and researchers mean that they are sites that can, and perhaps must, be observed and understood as at once resilient and on the verge of collapse.

I - Cutover and burnt out

By the early 20th century, the State's first professional foresters regarded the southwest forests to be at serious threat from the incursion of agriculture. There was considerable friction between proponents of settlement through agriculture and the foresters who had as one of their principal objectives in the first few decades of the Forest Department to get land dedicated permanently as State Forest. But aside from the areas that were given over to farmers, large parts of the forest itself were seen to have been changed by this time. Much of the jarrah forest was considered by some foresters to be destroyed, perhaps irreversibly, by unwise timber exploitation and the wildfires that followed. This is the first moment when forest managers saw in the forest a landscape that might be close to collapse.

In the first two decades of the 20th century, several sources associated with the Forests Department paint a rather sorry picture of the northern jarrah forest. "The bulk of the eucalyptus forests are very disappointing at first sight!" wrote David Hutchins in

1916 (p. 102). Hutchins, a British forester with experience from several of the colonies, published a detailed and controversial account of Australian forestry after having toured the forests of the country in 1914 with the British Association for the Advancement of Science (see Roche 2010). The book that resulted, *A Discussion of Australian Forestry*, was dominated by material from the southwest of Western Australia as it was also meant to serve as a report on the state's forests for the Western Australian Minister of Mines, Phillip Collier—also the minister in charge of the forests (ibid.). In addition to seeing the 'uncultivated' forests as falling far short of their potential, Hutchins blamed fire for the condition they were in at the time; the fires of "the blacks," but more importantly, the fires of the settlers, which "have become more severe, and in the absence of any demarcation and control of the forests, have entirely destroyed the most valuable accessible forests near towns and settlements" (Hutchins 1916: 365). If we were to ask what "entirely destroyed" meant for Hutchins, the first explanation we might reach would be to interpret it as mainly destruction of the timber resource. Like many of his time, Hutchins would have seen a timber crop when he looked at the forest, and the loss of a timber crop in a forest that was "destroyed." But we can also ask, what kind of trees and what kind of landscapes prompted such an assessment? What kind of knowledge frameworks and expectations enabled him to see the forest in such a way? Hutchins, who blamed the follies of the early Australian timber industry on the "English glasses"[52] they viewed

[52] "Among all the strange sights and sounds on the island Continent there is nothing more remarkable than the attitude of the people with regard to modern scientific Forestry. […] the country in its most fertile part is losing its beauty and its perennial waters owing to the destruction of its forests; and yet

the forests through has since been criticized for the same, particularly in his view on the role of fire in the forest. Hutchins might have seen young jarrah trees re-sprout from stumps and then consumed by hot fires. He might have seen in such fires something that he didn't expect would have to be there, and in burnt trees something that could otherwise have been straight and rapidly growing poles.

Charles Lane Poole, who was appointed Conservator of Forests in Western Australia at the recommendation of Hutchins, was another who deplored the uncontrolled exploitation of the "prime" jarrah forest which had been going on with little thought for the future. In 1920, Lane Poole wrote, to an audience he seemed to feel needed to be yanked with force out of the entrenchment of current practices, that: "At the present time it may be estimated that the existing area of prime forests in Western Australia does not exceed 3,000,000 acres, AND THE BULK OF THIS AREA HAS BEEN CUT OVER" (Lane Poole 1920: 27, CAPS in original).

Like Hutchins, Lane Poole found the 'natural' forest, with its "imperfect trees—mis-shapen, fire-damaged, or otherwise defective" (1920: 11), something that ought to be improved. This could not be achieved without regulating the sawmillers, whom, he alleged, were driven solely by short term profit[53], and would therefore "remove the

its workers, its public men, and its men of letters, with few exceptions know little of what modern Forestry science is doing for other countries. The only explanation I can find for this strange mental attitude is the tendency to look at everything in Australia through English glasses…" (Hutchins 1916: 149)

[53] This is also the assessment of Bunning's biographer Jenny Mills, who writes concerning the friction between Lane Poole and the sawmillers that "Immediate self interest was more important to the majority of the sawmillers" (Mills 1986: 65).

best and most desirable trees, leaving the inferior, badly grown, or mis-shapen trees still standing" (12). The "cut-over" areas of Lane Poole's time, it seems, would have been dominated by trees he recognized as undesirable trees, defective trees, trees that failed to live up to what he expected they could be. And he saw in the young growth something that was "destroyed" by the "constant firing of forests" (38).

By 1920, nearly 1 million acres of the jarrah forest, primarily in the north, had been "cut over" (Wallace 1966: 35), in addition to some areas of karri forest mostly near the port towns Augusta and Denmark. According to the foresters, the northern jarrah forest had been overexploited, and severely burned—and the two were closely connected. The fires were understood as a result of an opened canopy, huge amounts of logging debris left on the forest floor by sawmills and sleeper cutters, and new sources of ignition. In a paper about the trend towards irregular stocking in the jarrah forest, foresters Kessell and Stoate write of the first century of white settlement: "…during this period the whole forest canopy has steadily deteriorated owing to frequent burning and over very large areas has been reduced to a scanty clothing of epicormic shoots on the larger branches" (Kessell and Stoate 1937: 18). In another vivid description, Stoate and Bednall describe how "Jarrah crowns deteriorated becoming a gaunt framework of limbs which were dead some 20 feet from their extremities" (Stoate and Bednall nd., cited in the Davison 2015). These dramatic changes were also thought to be related to rising water tables following logging, in addition to severe fires and less canopy cover (Davison 2015). It all amounted to a serious challenge for foresters of the time. Wallace writes: "Faced with the scarred

and blackened boles of the cut-over areas and the grossly malformed stems of the second growth trees, together with the mass of scrub and weed trees on the one million acres of cut-over forests, the newly appointed foresters found themselves with staggering problems in both fire protection and silviculture" (Wallace 1966: 36).

The challenges of the early twentieth century is a significant part of what we may regard as the origin myth of the WA Forests Department and not least its fire management program. In an accessibly written pamphlet about Forestry published by the Department in 1957 the story is told like this:

> "Rapid and excessive exploitation removed most of the large trees opening up large gaps in the canopy to let in sunlight which favored the excessive growth of scrub and understorey species. Logging debris such as discarded logs, branches, leaves and bark also accumulated on the forest floor to add to the scrub fuel. This, due to man's careless handling of fire, resulted in large fierce fires which caused great damage to standing trees and young regeneration. The natural condition of the forest had been aggravated by almost a century of uncontrolled exploitation when the Forests Department first took steps to organize against uncontrolled fires." (Forests Department 1957: 84)

Uncontrolled exploitation went hand in hand with uncontrolled fire, and are presented, along with the threat from agricultural expansion, as the raison d'être of the Forests Department and the Forests Act of 1918. We also see here that the notion that the forest was very different in pre-European times is far from a new one. It is a stark contrast between descriptions of 'virgin forests' with large trees and sparse undergrowth (e.g. Beard 1990: 78) and the logged forest dominated by dead trees, 'malformed' regrowth, logging debris, and tall shrubs. In contrast to the "…original virgin forest with its carpet of leaf litter and low shrubs […] an ideal fuel bed through

which a summer fire could *creep* for weeks on end" (Wallace 1966: 34, my emphasis), the forest appeared to have become one where fires were "fierce" and destructive, where they could attain "holocaust" (Wallace 1966: 36) proportions. In the eyes of early 20th century foresters then, the material relationality of the forest had been altered. They found in the cutover forests new kinds of relations between fire and vegetation.

What would these landscapes have looked like, that made early 20th century foresters see them as deficient and "completely destroyed?" What features and details did these stories respond to? Hutchins, Lane Poole, and Wallace all encountered trees that inspired in them images of a lack or a shortcoming. Trees were *mal*formed, defective, "inferior, badly grown, and mis-shapen" (Lane Poole cited above). They saw the forest with expectations of a potential and they saw how actual trees fell short. Deficient forests in the eyes of both Hutchins and Lane Poole may have been a product of a certain kind of heterogeneity and unnecessary variety of form—a forest with trees of many different ages and a variety of different shapes. Seeing oddly shaped trees as deficient reveals a preference for a particular kind of form—for straightness, tallness, and an absence of branches. The foresters would have seen examples of trees that clearly had such potential—tall straight jarrahs 30-40 meters tall—and they would have seen trees that fell short of such an ideal. They would have seen oddly shaped trees—curved trees, trees in clusters, slanted trees, and trees with branches along their stems—and they would have seen them alongside the potential for straight and tall trees. What would cause foresters to declare a forest to be

destroyed were among other things the burnt and "malformed" regrowth among "excessive scrub and understorey species." It was the "scanty epicormic clothing" and the "gaunt framework of limbs" as we saw above. These things are clearly aspects of what foresters would think of as unproductive forests, a mismanaged resource, but we can just as easily read in the foresters' descriptions signs of emotional connections to forests, perhaps to the idea that a healthy forest ought not to be dominated by such forms—forms that look the them not to be vigorously growing. And we can read in these dramatic descriptions a first instance in which forests of the southwest were imagined to be on the brink of a decisive moment of degradation.

In my interviews and conversations with forest managers and retired foresters, I sometimes asked them whether they thought the forest was in better health today than it was in the 1920s. I had seen a fair bit of the forest, and with my partly trained eyes I could not quite recognize the devastation that was described in the early decades of the century. When I travelled around the southwest, I saw many patches of burnt forest, many patches of forest dominated by multi-stemmed trees, and patches with a lot of small trees—or indeed burnt patches of small multi-stemmed trees. But they didn't incline me to think of the forest as destroyed. One or two people alerted me to the forest "improvement" work that was carried out on cut over areas in the northern jarrah forest during the depression in the 1930s. Others specified that it was a question that would apply mostly to the northern forest. But most, if not all of those I asked this question to, would tell me it was difficult to say, a complicated matter. After all, the forests Hutchins, Lane Poole and other early foresters encountered in the

northern jarrah forest would not turn out to be so completely destroyed as they feared. Nonetheless, within the story of southwest forests and the origin of forest management, lies a precedent for understanding the forest as threatened and nearly destroyed, as well as a precedent for understanding the forest as resilient, one that can withstand and bounce back.

My interlocutors' answers also revealed an understanding of the forests of today as different from the forests of the 1950s and 60s. To separate the past century into two periods of change, parted by the lull in forest activities in the 40s and some of the 50s—the war and the early period after the war—is something I believe makes a lot of sense to the forest managers I spoke with. Additionally, though I'd like to be cautious with both connecting and severing events and processes in Western Australia from events elsewhere, it is hard to miss the fact that the 50s and 60s are also the point when the J-curves and the hockey-stick graphs of global environment change and the anthropocene seriously begin their ominous upward rise (see e.g. Steffen et al. 2015). The processes commonly associated with the age when humans have become a prime agent of environmental, atmospheric, and geological change include such things as increased population, urbanization, fertilizer use, water consumption, more and larger dams, increased paper production, and increased transportation (ibid.). These are all good descriptors for Western Australia in the past 70 years. Many West Australians see themselves as living in a remote place, and I found in matters pertaining to the environment that they would usually emphasize internal processes over external influences and Western Australia's place in larger processes. But in

post-war land use trends, Western Australia's resonate in many ways strongly with changes elsewhere. Turning now to the post-war period, we will see a number of new pressures and processes of change. But a pattern also recurs, as the forests once again will be thought of as threatened by development, and at risk of being destroyed.

II – Intensification, phytophthora, bauxite, drought

The forest industries needed several years after the end of the war to recover, but by 1952, propelled by a high internal demand for housing timber, production exceeded for the first time pre-depression levels[54]. It was reported as "in many respects the most successful year in forestry since the passing of the Forests Act in 1918" (Forests Department 1952: 3), and it was followed by several years of growth and several decades of steady high production. But it would also soon be followed by a crisis, as *Phytophthora cinnamomi*, commonly called "dieback," would prompt forest managers widely to conceive of the forest as on the verge of collapse.

Phytophthora, of course, is a portmanteau phenomenon (cf. Crosby 1986), it didn't act alone, but in concert with other processes such as intensification and changes in forestry and the timber industry, with changes in water use, with drought, and with mining. The latter, mainly bauxite mining, has created patches within the jarrah forest

[54] "Sawn timber production for the year under review, 1951-52, was 14,717,112 cubic feet. This volume of sawn timber has never previously been exceeded." (Forests Department 1952: 3) However, "While in the year under review there was a record sawn timber output, the total timber production was much less than in 1926 when hewn sleepers were also produced. Sleeper hewing has now been replaced by the operations of sleeper mills."(ibid)

that are, unlike the surrounding forest, on the other side of degradation, and are currently going through processes of "restoration." Changes in forestry also created more and more patches that were resolved in a different way, namely plantations of pine and Tasmanian bluegum.

The forestry and harvesting techniques in the decades after World War 2 were not the same as they were in the early decades of the century. For instance, the independent sleeper hewers who were partially responsible for filling the forest with flammable debris were no longer there, and harvesting by sawmills was regulated, preceded by tree-marking and followed by controlled burning to remove debris, promote regeneration, and protect the forests from bushfires. Nevertheless, timber production from the 50s and 60s onwards has been deemed to be an intensification (e.g. Stoneman et al. 1989: 337). More extensive use of heavy machinery is an important aspect, and more sophisticated milling techniques allowed sawmills to utilize smaller trees than before, meaning that in the 50s, "areas previously regarded as worked out for marketable timber have in recent years been cut again for low-grade logs and small logs" (Forests Department 1952: 4). Forestry also spread more widely into the southern jarrah and karri forests, most of which was then uncut, "virgin forest,"[55] while many areas in the north were harvested for the second or even third time.

Intensification occurred over most of the island continent and was accompanied by new waves of criticism. Philosophers and environmentalists Richard and Val

[55] Some very early Forest Department sources also called it "maiden bush."

Routley[56], whose 1973 book *The Fight for the Forests* had a major influence on the burgeoning environmental movement (Dargavel 1995) and ultimately on federal forest policies (Dargavel 2004), were especially critical of woodchipping, softwood plantations, and of dominant forest economics. To the Routleys, these were all aspects of worrying trends in Australian forestry, examples of intensification they regarded to be driven by a dominant wood production ideology. It is worth saying a few words about each of these to give a sense of what went on in the region in this period.

In the southwest, woodchipping, which allowed for utilization of marri trees (*Corymbia calophylla)* and lower grade karri and export for the Japanese paper making industry, began outside of Manjimup in the mid-70s. Before woodchipping, marri trees were mostly an inconvenience for foresters. Marri trees are similar to jarrahs in many ways, they grow to a similar size, and they shed leaves and burn in similar ways. They mingle with both jarrah and karri trees. But one small difference caused them to be a nuisance and not a resource for the timber industry. Marri trees had too many kino veins (also called gum veins) to be utilized efficiently by the sawmills, but more importantly in a silvicultural perspective, they would act as an impediment to the growth of the new cohort of trees if they were left behind after logging. Woodchipping therefore represented an opportunity for the foresters to carry out what they saw as better regeneration of the forests. Instead of "merely creating

[56] Later Richard Sylvan and Val Plumwood.

silvicultural problems in the regeneration of the State's karri and jarrah forests" (Forests Department 1973: 3), now marri logs and karri culls could finally be put to use, a Forests Department publication reported enthusiastically in 1973. Marri trees looked different for foresters when woodchipping became a possibility, indeed entire patches changed. Marri trees and patches with a lot of marri trees might then no longer prompt feelings of being constrained. Trees that used to have a practical and affective hold on them were altered by the possibilities that woodchipping afforded. The forest changed for the Routleys and other environmentalists too. For them, woodchipping represented an exploitative attitude to the forest. The worst part, for many, was that it enabled clear felling and a more extensive harvesting of previously unlogged areas of forest. Woodchipping has been consistently controversial and has been criticized and opposed[57] by environmentalists ever since the 70s. What some saw as progress towards better forestry practices and self-sufficiency in timber in the long term, others viewed as destruction of priceless native forests driven by an unrelenting faith in economic development.

[57] In an incident that stands out from the otherwise non-violent modes of protest of environmental activists over the years, the woodchip export terminal in Bunbury was bombed in 1976 by two men in their late 20s who were driven by anti-capitalist and environmental sentiments. O'Donnell and Ewart's assessment of the event as now "largely forgotten" (2017: 26) fits well with my own experiences. The act was unprecedented in Australia and contrasted extremely strongly with the environmental movement's usual methods in the 50s, 60s, and 70s (although the 70s has been described as a transitional period towards more direct action; see Chapman 2005) which were, according to Chapman (2005), non-confrontational and set within institutional frameworks, such as law suits. The environmental movement also strongly condemned the bombing. Today, the Bunbury bombing is still an aberration, and it is mobilized in neither the environmental movement's narrative about themselves nor in the narratives told by the forest industry.

The Routleys were critical of plantations for similar reasons. Planting of exotic softwood timbers had always been an explicit aim of the Forests Department, driven early on by a desire for self-sufficiency in timber which required softwoods to complement the naturally growing hardwoods of the southwest. But this endeavor was accelerated in the post-war decades. *Pinus radiata* and *Pinus pinaster* were planted, and angular patches with straight rows of trees contributed to fragmenting the region. Many of the plantations were established on former agricultural land, but there were also large areas of jarrah forest converted to pine plantations, for instance in the Donnybrook Sunklands. Here, some of the forests were regarded as being of "poor quality," with relatively small trees; land that was "unattractive to early settlers who passed it by for more remote but more fertile land" (Forest Focus 1975a: 3). For the same reasons—being relatively unattractive for both agriculture and timber production—the Sunklands also had areas that had only been barely used by white Australians, and some of these were declared priority areas for recreation or flora and fauna in the late 1970s (Forests Department 1977a).

The Sunklands also had extensive areas that were found to be heavily affected by dieback, which was another factor that caused them to be thought of as suitable for conversion to pines. The area was seen as degraded, and therefore open to be put to different use. "Dieback" is an important key to understanding forests and forestry in the decades after the war. One retired forester I interviewed told me about distinctive phases in what the Forests Department and its successor the Department of Conservation and Land Management focused on in different decades. In the 30s, the

emphasis was on silviculture, in the 60s fire was the main thing, in the 80s they were back to silviculture again, but in the 70s, he said, the Department directed a lot of its efforts towards understanding and combating dieback. Unexplained deaths of patches of jarrah trees had been reported as early as 1921 (Dell et al. 2005). These became more widespread in the 1940s, and as the problem "assumed economic dimensions" (Dell and Malajczuk 1989: 68) the Forests Department initiated investigations into its occurrence and possible cause. In the course of the 60s, the association between the dying groups of trees and the soil borne non-native pathogen *Phytophtora cinnamomi* was gradually strengthened. Forester Frank Podger ruled out a number of other explanations, such as drought, waterlogging[58], increased salinity, and the changes caused by heavy logging and altered fire regimes and managed with the help of *Phytophtora* specialist George Zentmyer to isolate the pathogen from jarrah roots grown in soil collected from dieback sites. Increasingly, forest managers could see in dying trees a bigger story.

In the 70s, considerable changes were made in forest management practices in large part because of what was seen as an urgent need to deal with the spread of *Phytophtora.* Throughout most of the forests region the occurrence of dieback was also mapped by aerial surveys and field sampling, and in 1974, 172 000 hectares was found to be affected, a number which was expected to continue to grow by 20 000

[58] It has since been suggested that Podger and the Forests Department interpreted too much to be caused by Phytophtora and that some of those areas may have been caused by waterlogging (in some especially wet years between the 40s and the 60s—see Davison) and by drought (in the unusually dry years since the 70s—Joe Fontaine, pers. com.).

hectares a year (Shea 1975). Echoing Hutchins 60 years earlier, Syd Shea from the Forests Department deemed jarrah dieback to be causing "almost total destruction" (Shea 1975: 3). In addition to halting growth of the valuable timber resource, he mentioned the risk of increased salinity in catchments due to loss of canopy cover caused by dieback, as well as the effects the pathogen would have on flora and fauna and on recreation. *Phytophtora*, he wrote, "destroys the total forest together with its multiplicity of values" (Shea 1975: 8).[59]

The pathogen was found to be associated with roadways, with moisture, and with certain highly susceptible understorey species such as bull banksia (*Banksia grandis*) and grasstrees (*Xanthorrea preissii*). It could be spread rapidly by 4wds and forest machinery inadvertently moving soil around, and in addition, areas down slope from affected sites were automatically assumed to be at risk. The forest became a place of anticipated flows. The pathogen pushed forest managers to conceive of new ways to discriminate elements in the landscape. It nudged them to develop an attentiveness to how moisture travels across the land, to gradual spread and to seasonal variability in dryness. And it nudged them to try to see the forest as a place where movement through soil could be constrained. Banksias and grasstrees entered their field of attention in a way that they had not before, as indicators and as important causal actors carrying the pathogen.

[59] In light of what happened for instance with American chestnut, a once very widespread tree species nearly brought to extinction by the pathogen *Cryphonectria parasitica*, it would not at all have been unreasonable for West Australian forest managers to be pessimistic about phytophtora.

Many areas where foresters recognize these landscape features are currently categorized as “un-protectable.” Following increases in road building after the war and extensive efforts to create more forest roads and tracks for fire management purposes during the 60s, in the 70s, the Forests Department set in place quarantine areas, hygiene procedures in logging and forest management operations, and created so called intensive management units (IMUs). An unintended effect of fire protection, logging, and forestry activities had likely been to spread the pathogen faster. In the case of fire management, efforts to protect the forest against one threatening agent had made it more vulnerable to another.

As the forest came to be seen as a place not just of tree growth and fire, but of pathogenic spread and flow, interventions began to take different forms as well. Quarantined areas (Disease Risk Areas, or DRAs), for instance, were mostly to be left alone, with restrictions on entry, in order to buy time, both for the symptoms to be expressed in the vegetation and for developments in research to take place. Standards concerning “forest hygiene,” for instance requirements for cleaning vehicles and machinery were mobilized to halt flows. As were awareness campaigns and countless signs across the forest that barred entry to the public. Meanwhile, forest researchers were searching for symptoms in the field. They were both looking for known signs, such as dying grasstrees and banksias, as well as trying to recognize what might be signs they couldn’t yet see.

The Intensive Management Units on the other hand were areas of high quality forest with little or no sign of *Phytophtora* that were set aside for “improvement,” to be

managed "with a view to realizing the full site potential, and increasing both the volume and rate of production of high quality material such as poles, piles and veneer logs from them" (Forests Department 1971: 16).[60] Changes in silviculture were also implemented more broadly, making *Phytophtora* another impulse for intensification in the jarrah forest, as well as a factor pointing towards a more zoning-based approach to forest management. As Stoneman et al. explains: "A heavier cut reduced the area cutover each year, and hence the area placed at risk of infection" (Stoneman et al. 1989: 337). In some affected areas, salvage logging was carried out and the areas replanted with pines and later with different eastern states eucalypts. In heavily affected areas and areas thought to be irreversibly degraded, dieback created patches that were thought of as ruins, which opened for new kinds of exploitation. In most places, however, dieback was engaged through attempts to manage flows and movements. In 1977, the Forests Department reported that "Logging operations are excluded from forest disease risk areas, and activity is mainly confined to clean cutting on dieback affected forest in the north and selection cutting in the south" (Forests Department 1977b: 7). The discovery of *Phytophthora* lead to an extended moment of possibly impending collapse and it contributed to a different kind of forestry on many levels. In some parts of the forest, what foresters now engaged with were ruins to be restored or places to be actively kept from becoming ruins.

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[60] "Immediate operations include then thinning of regrowth stands, the poisoning of cull veterans trees, and the location of understocked stands and their regeneration." (Forests Department 1971: 32)

Sometimes during my time in the southwest, I got the impression that the reactions and concerns of the 60s and 70s are thought of today as being over-reactions, a kind of pre-mature shock treatment imposed on the forest borne out of panic. The forests didn't collapse completely in 20s, and they didn't do so in the 70s either. In those years, according to Dell et al., "Once *P. cinnamomi* was determined to be the causal agent of the jarrah deaths, it was concluded 'that the battle was virtually lost once the pathogen was introduced'" (2005: 393). In a Forests Department report from 1974 it was estimated that *Phytophthora*, without any control measures, would leave the jarrah forest with "a life expectancy of 50 to 60 years" (Forests Department, cited in Dell et al. 2005: 394). Already in the early 80s however, publications from the Forests Department reveal a more optimistic view of *Phytophthora* in the southwest. Far from being a threat to the entire forest region, it was gradually found that a lot of areas in the jarrah forest were less susceptible. Ridges and slopes were usually less severely affected and the karri forest was not susceptible in any significant way. There were also understorey species, such as many legumes, that were not affected, and after some years there was a gradual recognition that the pathogen usually didn't cause mortality in every single jarrah tree. There was some talk in these years of trying to adjust their burning so as to promote plants that were not affected by dieback. Today, more than 1 million hectares across the southwest is categorized as infected, but there are comparatively few so called "graveyard sites." Not many places are unambiguously ruins.

"Dieback has had a terrible reputation. There's a lot of emotion around it, but I'd like to think that we can look forward with a great deal more optimism" said plant pathologist Elaine Davison in her talk at a one-day symposium I attended on management of the banksia woodlands of the southwest. She talked about the lack of good long-term data sets in WA, about how little we know about what happens in long infected banksia sites, and about the importance of understanding the "puzzle" of susceptible plants that survive—are they disease escapes, tolerant hosts, or resistant hosts? In banksia woodlands, the character of the site can change as a decrease in canopy cover leads to landscapes that are wetter in winter and drier in summer and therefore suitable for different species of plants. But an important finding, and a reason to be optimistic, was that detection rates of *Phytophthora* in many old dieback sites now had been found to be relatively low. "The impression one gets is that every grain of sand in dieback sites has a phytophthora spore attached to it, am I right?" she asked to an emphatically concurring hum from the audience. "Phytophthora is often seen as a capsule for everything that's wrong with an area."

There is no doubt that *Phytophthora* is still regarded as one of the most serious environmental threats in the state[61], even though the forests seem to fare markedly better than people feared in the 60s and 70s. There were certainly times when I had the impression that many still thought it was a lost cause. Whereas the concern early on was largely centered on the jarrah tree, and other susceptible species were

[61] It has been named a key threatening process (one of 21 key threatening processes in Australia) under the Environment Protection and Biodiversity Conservation Act 1999 and an official threat abatement plan was released in 2014. This plan deals with *Phytophtora* in all of Australia.

interesting mostly in so far as they could indicate the presence of the pathogen, there is now a broad awareness that *Phytophthora* has a detrimental effect on a wide array of the southwest flora. *Phytophthora* management is still largely focused on minimizing spread and the risk of infestation, and there are still uncertainties associated with the pathogen. When Elaine Davison got a question from the audience about the interacting effects of dieback and fire, she elected with a humorous self-awareness to skip it. She was already "in hot water with dieback," she said, and would get herself in even more hot water if she were to speculate on its relationship to fire.

Phytophthora was a grave threat in the eyes of foresters and environmental activists alike. So was bauxite mining, another feature of post-war development in the region. Bauxite mining started in the southwest in 1963 when Alcoa of Australia opened up their first open cut mine near Jarrahdale. Both the environmental movement (see Chapman 2008) and the foresters were critical. Foresters were concerned among other things because the Mining Act had precedence over the Forests Act—a relic from the early days of gold mining, they indicated in an annual report, and not appropriate for the more modern levels of mining (Forests Department 1970: 11)—and that huge areas of State Forests were therefore at risk of eventually being mined (ibid.). It was also, and many would say still is, uncertain whether the rehabilitation methods that followed in the mine sites would ever give forests that were close to what they were before mining, both in terms of productive potential and biodiversity. In the early years, several different eucalyptus species from the eastern states of Australia were

trialed and planted in bauxite rehabilitation sites in efforts to find species that were both resistant to *Phytophthora* and good timber trees. The dire prospects for jarrah that *Phytophthora* was seen to indicate caused foresters to search for alternative trees. Today, they plant jarrah and marri in rehabilitation sites along with a seed mix of understorey species. They also replace the topsoil in their rehabilitation site. But most of these sites are still young, and it may be difficult to see whether they are flourishing or not.

Grace, a former president of the Shire of Serpentine-Jarrahdale, showed me laminated maps of the Jarrahdale region where bauxite rehabilitation sites were colored bright orange and contrasted sharply with the green forested background. The orange made up a significant proportion of the forest around Jarrahdale, in specks and patches, long or short, thin strips or large blotches and squares. The orange emanated from roads snaking their way throughout the region and it looked almost as though someone had poured a liquid from the roads that slowly trickled out onto the green. Grace was originally from South Perth, but she had had lived in Jarrahdale since the 70s, after some years out of state, and by that time, she told me, Alcoa were planting eastern states eucalypts in their rehabilitation sites, and no longer pine. It wasn't until 1988 that they began planting only plants native to the area, focusing on jarrah and marri. "The poor old jarrah forest has been hammered by logging," Grace said as she weaved a story that alternated between mining and the timber industry. She wasn't opposed to these practices categorically, but it had been too much in her view, and too much had that had been done unwisely. As we sat in the shade on her deck she

would occasionally point out towards the forest in the direction of certain patches of forest. She knew these places. She had walked in the forest there for several decades. She had seen them change.

Fig. 4. Map of the Jarrahdale region with bauxite sites highlighted.

Alcoa and Worsley, the two multi-nationally owned bauxite mining companies operating in the southwest together supply a significant percentage of the world market in aluminum. In its fifty-odd years of production, Alcoa, the larger of the two companies, has extracted more than one billion tons of bauxite, and currently, more than 1000 hectares of the forest is cleared each year for mining. In their mine sites, Alcoa's target is to rehabilitate so as to achieve "70 per cent species similarity and 100 per cent species richness" (WA Mining Group 2014: 6) compared to un-mined forest and it is also required that rehabilitated areas are "integrated into the surrounding landscape," that they support resilient and productive vegetation, and that

they “meet landuse objectives” (Alcoa 2015: 4). Alcoa pride themselves on conducting a “sustainable” mining operation.

They are “much more sophisticated than anything we’ve got here,” Grace told me, referring to the company’s methods for information management, dealing with the media, and the fact that they are a huge contributor of funds to science, education, land care and conservation projects, and local community development. Alcoa and Worsley have altered ecosystems for over 50 years, adding to the forest numerous patches with uncertain prospects. Currently (2019), the first mine sites rehabilitated with jarrah and marri and with the objective of restoring the sites to something close to their pre-mining condition are about 30 years old and most are much younger. Together, the patches contribute to a landscape made up of a somewhat larger portion of young and uniformly aged forest.[62] Patches where straight and thin jarrah trees grow close to each other.

Nevertheless, Alcoa carry out what many find to be a relatively successful rehabilitation program, based on research and ‘adaptive management’ (Gardner and Stoneman 2003; Standish et al. 2008). There are many uncertain points, however, for instance concerning the effects of P-fertilizer on species richness, compositions, and diversity (Standish et al. 2008), and regarding reasons for poor tree growth in certain sites (Szota 2009). The many patches of young regrowth are also a complication in

[62] Gardner and Stoneman estimate that “Over an expected 100-year or so life of the viable bauxite reserves, Alcoa will have disturbed approximately 2.7 % of all jarrah forest” (Gardner and Stoneman 2003:np).

prescribed burning. The biggest issue, however, according to Grace, is water problems after mining and rehabilitation. She told me about creeks drying up in the area, and farmers struggling because of it. Was it due to mining, I enquired, or was it is due to declining rainfall? Well, "that's the rub, you see," she answered, "cause Alcoa says it's just the rainfall." Grace, however, had no doubt that they are having effects together. She explained how young jarrahs suck up a lot of water, and that Alcoa are not planting and managing the rehabilitation in a good way. In the beginning, springs would dry up earlier and they would start flowing again later. Drying used to be temperature dependent, she told me, so that it would dry later or earlier depending on the season. But then it dropped off to just being catchment dependent. And then, "just nothing." When seeing a forest you know to be targeted by bauxite extraction your attention is drawn not just to trees, but to the soil, to the underwater aquifers, and to adjacent places that may be affected by changes in runoff and transpiration in mining sites.

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Is Western Australia running out of water? asks Ruth Morgan in her recent book about the history of water use in Western Australia (Morgan 2015). In it, she chronicles how Western Australians gradually have lost more and more of their "hydroresilience," accompanied by an ever greater dependence on "big water," grand engineering solutions, and water sources that were prone to depletion. Many of WA's approaches to water, she argues, exhibit "an unwillingness to change or a lack of support for adaptation to local conditions" (Morgan 2015: 40). Western Australians,

instead of trying to work within the bounds of the new country, would for instance build a massive pipeline from Mundaring Weir in the Perth Hills to supply water to the Goldfields, which then "mitigated the need for settler Australians to adapt to the environment" (41). More and bigger dams, pipelines, desalination plants, pumping water from underground aquifers and pumping recycled water back,[63] are all features of the contemporary forest. They may also well be seen as attempts to circumvent the seasons, to impose consistency on an unreliable environment.[64] And this is an interpretation that does not necessarily imply that any of them are wrong within the current circumstances.

In the decades following the war, Morgan describes how thirsty suburbs spread rapidly around Perth.[65] Meanwhile, outside of the sprawling city, series of wet seasons in the 40s, 50s, and 60s combined with a faith in technological solutions and a strong belief that settlement through agricultural cultivation was the key to developing the state and contributed to usher in the "million acres a year" program in the late 50s. Morgan is only one among many commentators in academia who

[63] According to the Guardian, this is part of a plan to make Perth's water supply "climate-independent" (https://www.theguardian.com/australia-news/2017/may/29/perth-ramps-up-groundwater-replenishment-scheme-to-drought-proof-city).

[64] There are also more spectacular examples, such as cloud seeding projects trialed by CSIRO, the Commonwealth Scientific and Industrial Research Organisation (see Home 2005), and a proposal to build a pipeline (in the late 80s) or canal (in the mid 2000s) from the Fitzroy River in the Kimberley down to Perth, a distance of 3700 km (about 7 times longer than the Goldfields pipeline from Perth to Kalgoorlie).

[65] One aspect of the so called Australian Dream is to own a house on a quarter-acre block in the suburbs, and a green well-watered garden has long been a sign of prosperity and "an important symbol of the middle-class" (Morgan 2015: 36). It is only fairly recently that there has been a trend towards more native (and often less thirsty) plants in suburban gardens. Moreover, several sources have recently prophesized, or even already declared, the death of the Australian dream (Kellett 2011; New York Times 2017; The Guardian 2016), largely because fewer young people can afford to buy a house, but also because the suburban quarter-acre block has become somewhat less universally desirable.

diagnose what happened in the post-war decades, and some would say is still happening, as a case of severe "developmentalism." For Morgan, developmentalism seems to refer to a political will or attitude in which settlement through agriculture and development of resource exploitation is systematically prioritized and valued as something good for society[66]. She also describes how the "Western Australian brand of developmentalism" changed in the 50s with a government that was "increasingly receptive to large-scale foreign investment in resource development and was willing to relinquish its ownership and control of these ventures" (Morgan 2015: 72). Until then, WA had had a lukewarm attitude, at best, to large-scale international investments, and instead a focus on employment creation and industries that carried out resource processing as well as extraction within the state (Layman 1982). In contrast, international investments have been central to several of the post-war development projects we have seen in this chapter, including Alcoa's[67] bauxite mining venture and the WA Chip and Pulp company, the latter currently owned by the Japanese Marubeni Corporation. Starting in the 50s, and with strengthening force in the following decades, WA would promote itself to large international capital sources with generous incentives, publicity literature, and personal meetings at the

[66] Historian Lenore Layman goes into more detail in describing what she calls WA's development ideology, which, she argues, is characterized by "an active interventionist state both initiating development and ensuring its successful implementation; an agricultural/pastoral and mining development mix with manufacturing the ever-elusive prospect; an anti-eastern states, anti-federal (often populist) polemic which has cultivated existing feelings of state loyalty and identity; and an inflated rhetoric which has claimed for Western Australia a 'greatness' to match its geographical area" (1982: 234). See also Brueckner et al (2014).

[67] Forty percent of Alcoa Australia is owned by Alumina Limited, a publicly listed Australian company descended from Western Mining Corporation, originally a gold mining company that started up in the 1930s. The remaining 60 percent is owned by the Aluminum Company of America.

board room level (Layman 1982: 259). With reference to the recent ‘resource boom’ in WA, Brueckner et al. (2014) state unequivocally that “The exploitation of the state’s natural assets has been a political priority in Western Australia (WA) since white settlement in the mid 1820s” (315). Moreover, accounts of development projects in both the post-war era and earlier (e.g. Layman 1982, Beresford 2002) show them to have been conducted both enthusiastically and with great optimism, sometimes in the face of significant criticism from the scientific community (cf. Beresford 2002), but just as often with immense public support.

Scaling out even more could make developmentalism one piece in a story of settler Australia. Environmental historians in Australia tend to tell one of two big stories, either a story of decline and degradation or a story of increasing awareness of ecological processes and of gradually more responsible land use. Bill Lines (1991) is one who clearly exemplifies the former. Just as the Europeans conquered the Aboriginal people, they also attempted to conquer Australian nature, he argues. An enlightenment philosophy about human mastery over nature underlay the mentality of the settlers. They also sought profit and mapped out the land with a view to what was economically useful. Lines is explicitly condemnatory of the settlers and their destructive propensities. In the end, he concludes, "the environmental history of Australia is essentially a political history and bears the stamp of human will, ideals and purposes" (279). In contrast, Cary and Barr argue that "human settlement has been a process of learning to live within the delicately balanced capacity of the dry infertile soils" (1992: 1). Settlers arrived in a strange land and they had to learn how

to deal with an environment that didn't conform to their European expectations. Cary and Barr start from the assumption that people in their time acted from beliefs that their practices were in fact sustainable. The same processes that Lines found to be due to irresponsible profit seeking—erosion, decline in native grasses, extinctions, dieback, and increasing soil salinity—are here regarded as the unfortunate side effects of the development of better land management practices. Others, such as forest historian John Dargavel, express a desire to make room for both extremes. Dargavel seeks to find a place in history for the romantic image of the logger working the land, the early settlers' struggle for survival and the gradual rise of 'wise use' policies and modern environmentalism (Dargavel 1994: 80; Dargavel 1995), as well the "cruel injuries, gross exploitation for a foreign market, erosion, degradation of the forest's productivity, loss of its diversity, carelessness and waste which also shape the forest landscape" (ibid.).

In Western Australia, an ethos or ideology of development most commonly refers without much qualification to the government’s stance on mining and agricultural development outside of the southwest forests. Forestry, but also tourism, are among the aspects that are more ambiguously placed in relation to the ideology of developmentalism. The most widely regretted changes in the post-war period seem to be those that happened in the Wheatbelt and the Great Southern Region. The Wheatbelt shows a kind of change that hasn’t quite occurred in the forest region. In the latter, forests are still forests; in the former, Wheatfields are what used to be woodlands and kwongan.

In both the period prior to the formation of the Forests Department and in the decades following World War II, large scale land clearing happened outside the jarrah and karri forests, but there were also great changes within the forested areas that have *remained as forest*. Since the 50s, the forests region became more roaded, more visited by tourists and travelers, and it saw the rise of new industries, including the wine industry, in addition to being affected by mining, dieback, and the changes in logging and forestry. The notion that if it wasn't for forestry the southwest forests might have been cleared by the second half of the 20th century, can seem to make the impacts of the timber industry and its associated effects more ambiguous. After all, they are still forests, even though they have changed.

Another controversial point regards the impact of timber production and forestry on forest health and biodiversity, and this is perhaps more unclear in the second than in the first period of change. Just like Grace, the former shire president, there are countless people across the southwest who lament the way the forests have been "hammered by logging." Forestry and timber production were prominent in the public debate especially in the 90s and leading up to the 2001 state election where the promise of ending all logging of "old growth" forest carried the labor party to a landslide victory. For many, the opinion that un-logged forests ought to be kept that way and formally protected was coupled with the belief that logging and forestry (which perhaps are too easy to conflate) in general had degraded the forests and that the Forests Department and later the Department of Conservation and Land Management had managed the lands irresponsibly. On the other hand, forest

managers and former foresters sometimes point to studies conducted over the years showing forestry and silviculture to have a relatively modest impact on a range of ecosystem indicators. Stoneman (2007) for instance assesses forestry in the southwest to be in accordance with Seymour and Hunter's (1999) criteria for "ecological forestry." Another example is Forestcheck, an extended inquiry based on surveys conducted with the help of numerous volunteers over several years into the effect of silviculture on many different parts of the biota including birds, vascular flora, terrestrial vertebrates, invertebrates, soil, fungi and more. The results from Forestcheck are complex, but Abbott and Williams note in a paper synthesizing the results that "most species groups were resilient to the disturbances" and that "For all species groups studied, the imprint of harvesting 40 or more years earlier on species composition had become indistinguishable from that on grids never harvested" (2011: 350). Critics of Forestcheck would perhaps inject that the unlogged reference plots are not undisturbed, or that the lines drawn around "silviculture" do not encompass enough (such as road building and other activities that contributed to spreading phytophtora).

At the same time, the effects of forest activities is still very much an open question for Parks and Wildlife and the Forest Products Commission. It is not my intention here to give anyone the final word on the matter of forestry and forest health in the southwest. Instead, the point is that Forestcheck and related projects show that the forests are not necessarily thought to be ruins. Instead, they show a perspective on the forest as a place to inquire into, a place that is changing, and that has more to tell us

than what we currently know. These two kinds of places—those that are ruins in a decisive way and those that are more ambiguous—also prompt different affective responses. In degraded landscapes, restoration can bring hope, in ambiguous landscapes the worst might still be ahead. In the forest, both optimism and pessimism seem tempered. Hope is subdued and qualified but so are predictions of collapse, more so today than they appeared to be in the 1920s and in the 60s and 70s.

Just as clearly as the jarrah forest in the 1970s was thought to be on the verge of collapse, it can still be experienced of as a healthy ecosystem where relatively few species have declined. These are powerful stories of both stability and instability, they are an important part of the knowledge frameworks through which forest managers and others see and engage with the forests of the southwest. These knowledge frameworks have been nudged and swayed throughout the century by a lively forest; by jarrah trees that grow straight and jarrah trees that are slanted, by inconvenient marri trees, indicator banksias, and jarrahs that unexpectedly survived phytophthora; by dry creeks and wet gullies, slopes and pathogenic flows. Experiences with such lively forests strengthen tendencies to think with ambiguity. Through a century with myriad influencing factors, people concerned with the southwest forests have stories through which they can understand the forest as a place that has radically changed, a place repeatedly at risk of being ruined, as well as a place that has mostly stayed the same.

III – Old growth or already collapsed?

The final moment when forests are understood to possibly be on the verge of collapse is the extended ongoing present. I delve more into this long moment in the next chapter, but for now, I would like to take you into some ambiguous patches of forest that may or may not be "old growth" and may or may not already have been set on a path towards collapse. Forest ambiguity, as I suggested in the introduction, is something that points to both the forest itself and the frameworks of knowledge through which people apprehend the forest. Here I will show that when we interact with the forest today, we're thinking with precedents from the past century—we know that the forest has previously been on the verge of collapse, and we have plenty of other contemporary precedents for collapse—and we are also tugged and pulled by the forest itself to see simultaneous opposite possibilities in the present.

In the southern parts of the southwest forest region, there are significant areas of forest that are categorized as old growth. Many of them have never been logged. In the northern jarrah forest, however, old growth patches are much rarer.[68] We had decided to make a day of it, Joe, Raymond and I. Joe Fontaine, an ecologist at Murdoch University and Raymond, one of his PhD students, both work with fire and drought and are part of Murdoch's Terrestrial Ecology Research Group. Intrigued by the lack of unlogged northern jarrah forest and a curiosity about what the small remaining patches might look like, we made a plan to head out to see if we could find

[68] An official map of old growth forest in the southwest accompanies the latest Forest Management Plan (2014-2023): https://www.dpaw.wa.gov.au/management/forests/managing-our-forests/161-a-plan-for-managing-our-state-s-south-west-forests

a few of them. I had gotten a tip from a forest researcher in Parks and Wildlife about two different sites. One of them was a patch of old growth he himself had visited periodically over the last few decades and where he had witnessed the slow process of senescence and renewal. Joe knew about a third. The three of us were all cautious about what we could hope to find. We knew that even if the patches had never been logged, they would not have been free of disturbance, and there was also the possibility that the forest had been left unlogged because they were regarded as low quality or 'fringe' jarrah forest. In that case they would still be interesting but wouldn't necessarily tell us much about what the forest that had been logged used to look like. From the beginning we were prepared to find something that wouldn't give us clear answers. None of us, I believe, thought we would find something corresponding to a myth of the "pristine" and "untouched." Nevertheless, over a few beers a week earlier, Joe and I had mused about whether it would make a difference for management decisions to have some clearer indications of what the forest today would have looked like if it hadn't ever been logged.

The first place we went to was the one we were most confident about. Right opposite the cemetery in the town of Jarrahdale, Serpentine National Park starts with a very small patch of forest that Joe was pretty certain had never been logged. We chatted casually about what we were seeing as we walked through. Joe mentioned "tree architecture" and now and then we stopped by a tree and talked about how it might have grown to be the shape it was. Some of them appeared to have been growing without too much close competition, for instance, so that they spread their branches

out widely or slanted to one or another side. We also noticed the prevalence of trees with a single stem, rather than clusters of trees with small stems. I mentioned that it looked like there was more canopy cover than I was used to seeing in the northern jarrah forest. And taller, Joe added. There were slanted trees, trees with large branches that might have grown back after the drought about ten years ago, or they could have been caused by insect damage, or something else altogether. We were looking for something that might tell us what we should be looking for, and here we thought we might have found it.

In the car on the way to our next stop, we talked about what the jarrah forest might turn into. Some people believe there is a possibility that parts of it might become something with more of a woodland and heath structure, Joe said. We discussed what it would take for such a change to occur. The disconnection of streamflow and groundwater seemed important—if the groundwater no longer contributes to streamflow, moisture in the landscape is more dependent on rainfall—as did drought and fire. But we also talked about jarrah being resilient. We knew jarrah as a species to have a high degree of plasticity—to be able to take on different shapes depending on how much moisture, light, and nutrients were available. Being in the forest, looking at tree shapes, it did seem hard for us to imagine that the jarrah forest would collapse, even though it's difficult to know how the forest will respond to the changes. Joe mentioned a theory which says that ecological systems can already have tipped long before we see the physical manifestations of it. Parts of the jarrah forest might already have had the foundations of its current form taken away.

At Amphion forest block we were puzzled. The track from the bitumen into the forest forked three times. The first way we tried led us into a stand with many small multi-stemmed jarrahs and very few larger trees. This was a kind of forest structure that we knew could result from harvest operations, but it was also not completely out of the range of what could conceivably occur without logging. On the second way, we found a couple of old log landings, beginning to grow back with understorey species and some young shrubby jarrahs and marris, but still distinctly rectangular clearings by the side of the track, unequivocally telling us that this was not a patch of un-logged forest. The third direction was confusing. Parts of it were fairly open, not at all dense with regrowth, and it had large mature trees. But we did see stumps that looked like they had been cut, and with a casual glance around we counted at least four in the vicinity of where we stood. We discussed some interesting trees, trees in strange shapes. Some were slanted and crooked. They may have grown in relation to neighboring trees that were no longer there. We looked at one particular tree which had a couple of big branches that Joe and Raymond could tell had originated from epicormic shoots—new shoots that grow back along the stem and in the canopy after disturbances, such as fire or drought. Raymond suggested that they might be traces from the Dwellingup fire in 1961.

Joe was also puzzled by the understorey. It seemed to lack in diversity, he said, almost as if something had been removed. He seemed to see with unspecified expectations of what ought to be there—expectations that let him apprehend a vague lack, but not to clearly know what was lacking. At the same time, things in the

landscape pulled at him, nudged him to raise possibilities in his mind. Was this an absence? Could it be a sign of more dramatic changes that were already occurring?

At Amphion, we are interpreting landscapes not only by reading physical traces (including absences), but by knowing, and inferring from, the range of disturbances that we know may have happened here in the last 100 years or so. As such, we were abstracting from particular forest areas to something area-wide and back, sometimes our abstractions even extended to something "global." For every dead tree, so to speak, we have a range of culprits, a repertoire of factors and ways they may interact with one another. The fire in '61 and several burns in the decades since then, the recent drought, insect damage, phytophthora, logging, or a combination of several processes; for every absence, every snag, and every epicormic shoot, we have more than one possible cause.

Joe and Raymond involved me in a kind of forest forensics (cf. Wessels 2010), a search for details directed and constrained by incomplete assumptions, but also a search that aimed to let the forest be the source of answers. We looked at the forest patches with knowledge frameworks that told us it might be possible that parts of the forest were already on the way to collapse. The forest nudged us to think with ambiguity—plasticity and possible collapse.

The jarrah forest gives ambiguous signals, even to seasoned observers. Stumps or their absence are the closest thing to a clear indication of whether a site is old-growth or not. But we were not simply looking for forests without stumps. When forests are

assessed for old-growth, they can have a small number of stumps (4-5 per hectare) as long as they fulfill other criteria such as "ecological maturity" and "negligible past disturbance." In the northern jarrah forest, ecologically mature forest is scarce and interesting. But for me, what is even more interesting is how few questions these patches of "old growth" forest can settle. Amphion forest block, to us, could be both old growth jarrah forest and a forest that was undergoing such drastic changes that it made it meaningful to consider it in connection to theories of ecosystem collapse. In the jarrah forest we engaged with landscape details that for us could be indicative of two simultaneous opposite possibilities. But I don't think we need to think of this as an inquiry of ours on which the forest is silent. It doesn't have to be that the forest doesn't give us answers—it may instead be that the forest *compels* ambiguity in us. It draws us in two directions simultaneously. Here were things that drew us towards the possibility of collapse, and here were also things that drew us towards plasticity and resilience. And here were things we knew could pull us in both directions. Here were things we couldn't allow us *not* to pull us in both directions.

To reiterate, this is ambiguity as something quite specific, as simultaneous opposite possibilities. It is seeing in a vague sense of absence, in small differences between a particular place and what we're used to, or in trees that change their shape, elements and patterns that draw us in two directions. Ambiguity stems from how knowledge frameworks allow us to see the forest in certain ways (through precedents from the past, through stories of what has happened here in the past, and what has happened in similar situations elsewhere), and from how the forest impinges on our ways of

thinking, and has a pull on us. Ambiguity doesn't lie in a failure to grasp, it lies in taking both precedents and the forest seriously. It lies in seeing with certain knowledge frameworks and it lies in going along with how you feel yourself to be pulled, even sometimes compelled, by the forest. Our excursion to what may have been old growth shows, once again, a forest that is ambiguous and unresolved, both resilient and vulnerable at the same time.

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With the cutover and burnt forest of the early 20th century, *phytophthora* dieback in the 60s and 70s, and today's forest possibly on the verge of a shift, we have seen three partly separated long instances over the past hundred years where the forest is imaginable as destroyed, or at risk of being destroyed. At the same time, "developmentalism" in a variety of guises—tied to the state of Western Australia almost tautologically—has appeared to many as something of a relentless force threatening to gradually minimize and fragment the forest and leaving traces even when it has been kept at bay. In the southwest, furthermore, it has emphatically not been the case that there was little change for a long time and then along came climate change. Here, forest managers and others concerned with the forest will not easily conceive of climate change as occurring against a background of something fixed—the drying climate is not the region's first modern anthropogenic source of degradation and possible collapse. It is not the first time it has been on the edge of ruin, nor would it be the first time if it once again turned out not to fall off. Instability and stability have coexisted in the forest and in imaginaries of the forested landscape

for a long time. People in the region have long been nudged by the forest to see simultaneous opposite possibilities.

The forests of the southwest, for the most part, are still forests. They are not commonly imagined to have passed their decisive degradation event. But at the same time, it is very possible to conceive of the possibility that their degradation event may have already been set in motion. The forests may or may not currently be ruined. The relation to degradation clearly affects what kind of interventions are thinkable. Often, a conception of a landscape as being degraded enables either further degradation (see for instance Voyles 2015) or restoration. In the ambiguous southwest it is different. Here, restoration only takes place on patches that have been mined for bauxite or on former agricultural land—patches that have been stripped bare and may then be built back up again. Otherwise, the forests are complicated places—like Amphion block—which have not been so degraded as to clearly warrant restoration or to open up for further degradation, but which have still been changed, perhaps more dramatically than we are currently able to notice. These are places that find themselves in contests of interpretation between different groups, but more interestingly, that figure simultaneously in two different possible states for one and the same person or group, and perhaps even for themselves. These are forests that have been drastically changed, but may still be mostly the same, and which, as well shall see in the next chapter, are at the same time resilient, forgiving, and possibly on the verge of collapse.

Chapter 4—Resilient, forgiving, and on the verge of collapse

The forested areas burned in the Waroona fire in 2016 were striking and dramatic in my eyes. Along the southwest highway there is a stretch of a few km where the trees on both sides of the road were charred and defoliated. Some had fresh green shoots gradually renewing the crown, but many seemed to be completely dead. To my northern European eyes, the defoliated trees reminded me of a seasonal change, as if I were driving from summer to autumn and back into summer a few km later. It's a strange feeling to have in a land with few deciduous trees. Once properly within the burned forests, however, they bore little resemblance to any landscape I'd seen before.

In December 2016, when I spent the better part of a week in the fire-scar helping out with fieldwork for a research project about the effects of bushfire in combination with drought, less than a year had passed since the Waroona fire. I was mostly the scribe, filling numbers in little boxes, but Raymond and Sophie, researcher and field technician respectively, looked at the vegetation with discerning eyes. We counted and recorded the many blackened and defoliated trees, and we quantified their degree of deadness, their decay, and the vigor with which they were growing back. Dylan, who was the other volunteer, had the job of circling a measuring tape around the stems of all the trees we recorded to get the diameter at breast height, and by the end of the day he would look as I imagine people do if they have just come out of a coalmine—his hands, face, and shirt covered in a mixture of charcoal and sweat. In

some of the sites, most of the trees received mortality scores of a hundred percent, in which case, naturally, their vigor was zero. But no site had all dead trees, and there could also be trees for which we recorded a high mortality as well as a high score for re-sprouting vigor, either from green shoots at the base of the trees or from epicormic shoots along the stem and along branches further up in the crown. For a small portion of trees, we recorded char height, which was only necessary in cases when less than the full height of the tree had been scorched. Sometimes, we came across trees that would cause us to pause. One remarkable tree that made it into my fieldnotes was a marri that had fallen over but had new branches growing from what was now a large horizontal log—a striking image, we thought, of strangeness and resilience.

We also counted new seedlings, saplings and germinants, mostly of jarrah and marri. Usually, we did these counts within circles with a three or six-meter radius, and dozens of new shoots were not uncommon. I hesitate to describe any of the places I saw as typical, but I was at sites in the Waroona fire-scar where we stood among countless multi-stemmed blackened young jarrahs and marris; sites with some larger stems, medium sized stems, and huge sawn stumps; and sites where dozens of grasstrees were flowering with their characteristic long vertical inflorescent spikes. Every site was dominated by fresh green hues set against the blackened stems of the burnt trees. The ground was almost free of leaf litter, which usually forms a near-continuous carpet as early as only two or three years after a fire, depending on the site. In most places, I could see down to the bare soil which was strewn with small chunks of charcoal as well as the larger remnants of trees—a black, broken,

hollowed-out jarrah, burnt sections of marri, or a large circular indentation where there once was a stump. The understorey which was starting to reclaim its strata, now reached hip height in clumps here and there, but more often bracken ferns, zamia palms, and many small plants I was not familiar with barely stretched above our ankles. I cannot recall if the fire-scar had a particular smell, but it was a soundscape dominated by the incessant buzz and chirp of insects, which almost disappeared from notice after a while, and at night I would go to bed with the eerie lingering phantom sensation of flies still walking on my face.

Fig. 5. Fieldwork in the Waroona fire scar. Here you can see what looked to us like healthy re-growth of grasstrees and zamia palms in the middle of the frame. A vigorous sapling can be seen on the far right. Note also that there is almost no leaf litter on the ground.

In landscapes burned by wildfire, some people see destruction whereas others see life. It is possible in these landscapes to see change—forests now burning differently because of climate change and other modern human activities—and it is possible to see stability—liveliness in green shoots; cycles of growth, senescence, decay, and fire that stubbornly or indifferently endure. Many people see both.

These stories of stability and collapse are not quite stories *about* landscapes and climate change, nor are they primarily stories that Australians tell themselves about themselves. Rather than a *being about,* I suggest that they are tied to the forests and its elements by affective ties—a commitment to try to tell stories that are true to the landscape—and responsive ties—they are stories that respond to landscapes' features, elements, and patterns; stories nudged and pulled by a lively forest. Just like my own reading of the Waroona fire scar, West Australians' forest stories arise through bodies that are moved by the landscape. Forest managers and others allow themselves to be moved by incessantly involving themselves in the forest and its elements through what we may think of as an intense ongoing dialogue. Forest managers pose questions to the trees and the understorey. Questions such as what is your relation to the soil? What is your relation to pathogens, insects, and animals? How will you change during the day, during the week, or in the course of a season? How will you change with the drier and warmer climate? What is your relation to historical events from the past century? And perhaps above all, how will you burn? In turn, they get answers that compel them to think with ambiguity.

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Recently, a new motivation has arisen for studies of human-non-human relations, including our relations with landscapes. If the last decades' turns towards non-humans—the turn to things (Appadurai 1986, Henare et al. 2007, Holbraad 2011), the animal turn (e.g. Kirksey and Helmreich 2010, Haraway 2008, Willerslev 2007, Govindrajan 2018), and the less widespread plant turn (Myers 2015b) were driven in part by philosophical questions and the scholarly momentum that came from a desire to find ways beyond cartesian dualism, today, it seems, inquiry is more strongly driven by the urgency of a time of crisis. We are motivated now to study non-humans and issues concerning nature by our conspicuous vulnerability, the precarity of lifeways, and the tenuous grasp with which we hold onto the earth. This is shown clearly for instance in the recent flourishing of scholarship on toxicity (Liboiron, Tironi and Calvillo 2018, Chen 2011), exposure (Alaimo 2016, Shapiro 2015, Wiebe 2017), radiation (Stawkowski 2016, Hecht 2012), and the microbial (Paxsons and Helmreich 2014, Sagan 2011). These topics allow analysts to focus on the ways in which injustices, power relations, and the desires and flows of capital suffuse our bodies and the bodies of the non-humans we live with; they are phenomena that simultaneously bring into view the cellular and the planetary. Alongside these scale-shattering topics, elemental forces are also among the new non-humans that we're called to be attentive to (e.g. Clark 2012, Clark and Yusoff 2018, Petryna 2018). Alongside floods, earthquakes and storms, wildfires shatter scales in a similar way, as they are dramatic intersections of modern human time and deep ecological time—the latter a scale on which landscapes inevitably will burn and the former a scale on

which we have now nevertheless caused them to burn differently. And these topics also confound our usual sense of distance—as "local" events and occurrences that are also constructively affected by distributed non-local processes.

At the same time, and very much related, anthropology and associated fields have turned towards ruins as a key analytic—the ruins of modernity, capitalism, colonialism, and, quite often, all of the above. The "Anthropocene" points to both a ruined earth—as in Povinelli's (2016) figure of "the desert"—and something radically distributed and interconnected. In a sense, ruins can be one thing that toxicity and elemental disasters have in common. But the focus on ruin[69] also almost invariably comes with a focus on life, and on recovery. Tsing writes about life in capitalist ruins, Gomez-Barris on potential in extractive zones (Gomez-Barris 2017), Stoetzer (2018) on the ruderal ecologies that flourish in ruins, and Povinelli again writes that "The Desert is the space where life was, is not now, but could be if knowledges, techniques, and resources were properly managed" (Povinelli 2016: 16). Dawdy, for one, has argued that anthropology's focus on the ruins of modernity often work within, rather than against, modernist temporalities that begin with "an account of rupture" (Dawdy 2010: 763) or are oriented around "a sudden temporal break" (ibid.).

Degradation is a pivot around which many landscapes are currently understood. After degradation, it seems, comes either restoration of further degradation (cf. Voyles 2015). According to Dawdy, ruins have been written about both as places that have a

[69] "…anthropology it seems, has become a science of ruins" (Stoetzer 2018: 298).

"political and economic usefulness" (776) for those in power, as they can imagine abandoned places as empty, "ripe for imperial planning" (ibid.), as well as places that act as "opportunity zones for alternative […] life" (ibid.) and subversion of power. If one of the big questions for our times is how to live within ruins (and how best to confront situations where there are some that benefit from processes of ruination) then there seems to be no question that our landscapes are in fact ruins.

The forests of the southwest are a different kind of place, one that may be just as common in the world today, but fits perhaps less well with the dominant narratives of the Anthropocene: namely landscapes of ambiguity. This is not an argument against ruins, it is simply to say there is also a lot to learn from places that may not be so unambiguously destroyed. These places are settled, or perhaps still being settled, but they are also still unresolved. Landscapes of ambiguity speak to places that may or may not currently be ruins, places that are not yet—and just perhaps won't ever be—on the other side of destruction, at the same time as they are places that may already have been set on a path towards collapse. Places that are not wilderness, but are still wild, that are acting with a liveliness beyond our grasp and our control. Places that may be actively "managed," but are not dominated and controlled. Such places are not the protected areas to be left to themselves, nor do they correspond to the figure of the plantation, the garden or the park. These are ordinary places—they merely stand out because so many other places now seem, as ruins, to be resolved.

In WA, forest managers engage with such landscapes through stories of change and stories of stability—and these are stories that coexist. And they engage with

landscapes through *ambiguity* as a mode of engagement, a knowledge framework that includes ambiguity as a thought style (cf. Fleck 1935). People don't strive to create simple stories; they don't always strive to resolve ambiguity. First and foremost, ambiguity in my case lies in the simultaneous consideration of opposite possibilities—for instance resilience and collapse. It is in other words a quite specific form of complexity. This is not ambiguity as an engagement with something vague or indistinct, for instance experiences for which people don't have a category, schema, or precedent and which therefore "resist objectification" (Throop 2005: 503). These are not "ineffable experiences [that] can only be lived but never thought" (Throop 2005: 503 citing Schutz 1932). Instead, this is ambiguity in the sense of an experience of something being necessarily open to two opposite objectifications at the same time. These are experiences that fall sometimes equally well into two categories, schemas, or precedents; experiences that spark simultaneous opposite possibilities.

What then are the elements that make this kind of ambiguity a meaningful and responsible way of engaging with landscapes for people in the southwest? First, it lies in embodied experience with landscape features that can point in different directions and accommodate opposite possibilities. The forest's answers are ambiguous for forest managers and researchers, and the act of posing questions to the forest is a way of making oneself available to be affected in material and bodily ways. From this follows an appreciation for a multiplicity of interacting factors, including on the one hand prescribed burning as a precedent for relative control, and on the other hand the unpredictable emergent quality of new and interacting processes; the

partial compromise between scales of engagement (weather and climate) and the pragmatic disutility of single-cause stories; an openness to being surprised by the landscape; and the (perhaps characteristically Australian) normality of the unusual and extreme when it comes to weather and the environment.

New patterns of fire

The Waroona fire was something out of the ordinary. I was told among other things that it was so intense that it created its own weather system, with lightning storms, ember showers, and so called "pyro-cumulonimbus clouds." But along with other recent fires in the southwest it can be made to form a pattern. It is one among several recent fires that are widely known by name; fires which, after the region had been mostly spared from catastrophic fires since the Dwellingup fire in 1961, are now unusually large and damaging. The year before Waroona, two major incidents, the O'Sullivan fire, more commonly known as the Northcliffe-fire, and the Lower Hotham-fire, also known as the Boddington-fire, burned 98 000 hectares and 52 000 hectares respectively (Department of Fire and Emergency Services 2015). Neither of those fires caused great property damages, as they occurred in relatively remote parts of the forests, but they threatened several smaller communities, and significant areas of young karri regrowth were damaged in the O'Sullivan fire. The fire seasons of 2010-11 and 2011-12 were also especially severe. The Perth Hills fires in early 2011 and the Margaret River fire later that same year both happened in the rural-urban

interface (also called the peri-urban zone) and although the total area burned was relatively modest, around 100 homes were destroyed in the two incidents together.

The Margaret River fire, importantly, was an escape from a prescribed burn ignited by the Department of Environment and Conservation (later Parks and Wildlife) about six weeks earlier in Leuwin-Naturaliste National Park, and it was an incident that made the Department the target of significant public criticism. Margaret River is a popular destination for tourists, both domestic and from overseas. It's a busy little town close to both ocean and forest, famous for its surf breaks, natural attractions, and a nearby wine region. Escapes from prescribed burns happen regularly—it is a part of the game, I was told—and the vast majority of escapes are small and receive little attention. But when they occur in a place like Margaret River, it is another matter. Perth Hills and Margaret River together brought a number of new issues to the fore, among others, risk management, burn safety, and the hazards of the rural-urban interface. The Office of Bushfire Risk Management was created after the Keelty reports[70], and following the incident, DEC was prohibited from burning in the management zones closest to built up areas until they had shown that they had brought their burning practices and procedures in line with international standards

[70] The two Keelty reports (the process in both cases were led by Mick Keelty) were official independent special inquiries into the Perth Hills and Margaret River incidents, titled "A shared responsibility" and "Appreciating the risk." These titles reveal certain assumptions about wildfire. Risk is implied to be something that is inherent in burning and fire, something we must appreciate, not something we should think that we can ever eliminate. A shared responsibility is also interesting. It shows an attitude to causes of fire. The reasons why a fire is destructive never lies with any one agency and it is insufficient to point simply to the ignition.

(specifically the International Organization for Standardization's ISO 31000)[71]. Both of the fires were also widely mobilized to highlight the risks associated with a particular kind of landscape: the rural-urban interface. For large parts of the broader public, Margaret River arguably made drastically more visible the possibility that prescribed burns may escape and cause damage, and for some it nurtured an already quite strong sense of distrust in the Department.

The Milyeannup fire of 2011 is an interesting contrast to Margaret River. Even though it happened in the same district (Blackwood District), at almost exactly the same time, and burned an area many times the size of the Margaret River fire, few people outside the Department still talk about the Milyeannup fire. While the Department's resources were focused on containing the fire in Margaret River, the Milyeannup fire (also an escape) grew to be one of the biggest fires in the southwest in many decades. But this one required no special inquiry (only a post-incident analysis) and no homes were lost in the very sparsely populated areas in the vicinity of Milyeannup forest block. In a reconstruction and assessment of the fire and the prescribed burn that escaped, Burrows (2012) identified high fuel loads within and surrounding the site of the burn to have been an underlying cause of the fire, along with some issues with how the edging of the burn had been carried out (it was too patchy, not deep enough, and not well enough consolidated). This latter problem, he

[71] Another recent fire which catalyzed changes in the Department's safety procedures was the Black Cat Creek fire near Albany in 2012 where one Department fire fighter lost their life in a burnover incident. Some of the drills and training exercises I participated in before the 2016-2017 fire season had been systematized and formalized as a result of reviews into this incident.

writes, was in part a consequence of soils being “unseasonably” dry (Burrows 2012: 15). Interestingly, Burrows also notes that the fire behavior during the Milyeannup fire was neither unusual nor surprising given the fuel loads and weather.

The Babbington fire in 2012 is a similar case—an underreported fire that burned large areas of mostly forest and heathland, far from where most people in the region live. The “Battle of Babbington,” (Bennett and Rouse 2012) was started by a lightning strike and nearly 34 000 hectares were burned, close, and in parts adjacent to, where the Northcliffe fire would burn 3 year later. A story in the Department’s magazine *Landscope* (ibid.) depicts a successful collaborative effort to control the fire in forests that had not been burned for a long time. Clearly, neither the Milyeannup fire nor the Babbington fire were understood as “disasters.” Neither of them were presented as having particularly strong ties to climate change.

Fig. 6. Somewhere in the Boddington firescar about two years after the fire. The epicormic shoots along the stems and in the canopy can justifiably be described as vigorous.

Spared of the complications of a peri-urban interface, fires such as Babbington and Milyeannup are often presented as phenomena that reflect weather, soil, terrain, and the conditions of the forest. The degree to which fires lend themselves to be framed as anthropogenic differs widely, between the Margaret River fire on the one end—an

escaped prescribed fire that burned managed vegetation and structures built close to the bush—and the Babbington fire on the other—a fire ignited by lightning and understood to be shaped by weather, fuel, and terrain. If the Margaret River fire was conspicuously anthropogenic, the Babbington fire was much more subtly so.

All of these fires are talked about to some extent in the southwest forests region, though the more recent and the more damaging were discussed the most. All of them also still have noticeable traces in the landscape. Along a stretch of the Albany highway, for instance, the intense green of epicormic shoots along trunks and branches indicate that these trees were defoliated in the Boddington fire. In contrast, few people get to see the areas worst affected by the Northcliffe fire—for instance, in the remote Boorara forest block southeast of Northcliffe townsite where young karri trees stand like grey-white telephone poles among the returning understorey. These trees seem much more unambiguously dead than the jarrahs of the Waroona fire, and they currently await salvage logging and replanting, which the Forest Products Commission is struggling to afford. Meanwhile, the Margaret River fire and the Perth Hills fire have left significant traces, not so much across the forested landscape as in the public consciousness and in fire management policies and organization.

It is stated in the Incident Review for the O'Sullivan and Lower Hotham fires that "Major fires in the South West are becoming more frequent and more complex" (Department of Fire and Emergency Services 2015: 14) and the causes are said to be "changes in climate, reductions in prescribed burns and rising populations in the rural-urban interface" (ibid.). Similarly, Enright and Fontaine (2014) point out that

global environmental change, population growth, and the contention that fire managers no longer do sufficient amounts of prescribed burning are the three things most often employed to explain the "unusually high recurrence rate for large wildfires" (34) in the years since 2000. This trio of possible and entangled causes recur in numerous places in conversations and publications in the southwest.[72] In these examples and many more, the very different fires I've briefly presented above come together within a trend that has a common set of causes, the drying climate being one of them. At the same time, not all of the fires were clearly conceived of as disasters, and some of them were not remarkable in themselves. Several factors temper a worrying trend, including the fact that any one fire is the outcome of many contributing forces, the very large range of what must be considered expectable fire behavior, the vigorous regeneration after fires that seem to indicate that forests are able to cope and even thrive with the disturbance, and prescribed burning itself as a recent experience of having been able to keep bushfires relatively mild and manageable. In other words, the patterns that make recent large bushfires concerning also express several elements of ambiguity. These are stability stories that coexist with the possibility that the current trend might also actually be something

[72] Interestingly, in some other Mediterranean climate regions, it is often a duo of underlying causes, rather than a trio, as prescribed burning or its absence is mentioned far more seldom. Following the northern California wildfires of 2017, for instance, immediate causes were discussed (was it a lightning strike, arson, or a downed power line?) along with weather, climate change, and the fact that people are living in the fire prone peri-urban zone, whereas prescribed burning was hardly mentioned at all (see e.g. New York times, October 11. 2017).

dramatically new. The fires of recent years inspire in fire fighters and forest managers considerations of both of these possibilities.

Ambiguously climate change

It seems increasingly the case that people around the world conceive of large and damaging wildfires as "climate change-fires," both because they together form a particular pattern that is novel and different, and in many cases also because individual fires seem to burn faster and more ferociously than people are used to (see e.g. Petryna 2018). Shortly after I returned from Australia, California found itself in the midst of yet another record-breaking fire season, and a few months before that wildfires that assumed deadly proportions raged in southern France and Portugal. A year later, Norway, Sweden, and Greece, were the ones experiencing a fire season unlike anything they have on record—in fact, in the northern countries, the concept of a wildfire season is itself something new to most people. There is no shortage of news stories and commentaries linking these fires to climate change, even while many also point out that fires will always happen, especially in Mediterranean climate regions. It is inevitable, but even the inevitable seems like it might be changing, as landscapes are sometimes understood to be entrenching themselves into a "new normal" state.[73]

In Western Australia however, catastrophic bushfires may be less clearly inevitable than in either California or the Mediterranean (or the Australian east coast), but also

[73] E.g. https://www.nytimes.com/2018/07/02/us/fires-california-colorado.html

closer to seeming inevitable than ever before. Here, precedents for stability and change come together in complex ways. In a similar way to how Wallace (1966) contrasted the fires of the "virgin" forest, which could creep quietly around for weeks with the fierce and destructive holocaust fires of the period following early uncontrolled logging (see previous chapter), we can point to a noticeable difference between how fire historian Stephen Pyne described West Australian fire in his 1991 book and how it is beginning to be conceived of a quarter of a century later. Pyne's portrayal of the southwest as a place where fire is relatively benign, where it is "endemic, not demonic" (49), "chronic rather than catastrophic," (296), and "persistent [rather than] perverse" (ibid.), would for many people in the region be difficult to reconcile with events such as the Waroona fire, which burned 70 000 hectares, at times had a rate of spread in excess of 3000 meters per hour, and generated enough heat to develop its own fire-driven weather system. If WA—with its traditionally benign fires and gently undulating terrain—used to be a place that lent itself easily to fire control, perhaps it does so no more.

But interacting factors introduce ambiguity. In addition to conceptions of fire as traditionally benign in the southwest, another reason why conflagrations are not as unambiguously inevitable is the region's long history of prescribed burning. The embodied experience of prescribed burning is a stability story that often means that for forest managers narratives of collapse and destruction cannot stand alone. Let me give an example: Tropical cyclones sometimes make their way down to the southwest, and Cyclone Alby, a category 5 cyclone which hit the region in early

autumn 1978, is regarded as one of the most severe ever recorded. Around ninety different bushfires burned in the region in only a few days with Alby's high winds and lightning storms. I brought up the fires of 1978 in a conversation I had with Bruce, Parks and Wildlife's regional manager in the southwest. He had just mentioned some of the big and destructive fires of the last 10 years—Milleyannup, Lower Hotham, Waroona, Margaret River—and he was in the middle of expounding on the importance of getting fuel loads back down across the forest. When you get a continuum of unburned areas, a few patches of prescribed burning won't stop a bushfire, he said—that's what happened with Lower Hotham and Waroona. All of a sudden, the cause seemed simple: it was a question of leaf litter and patchiness, and for a moment climate change receded. What about the 1978 fires? I asked. He hesitated, and I wondered for a moment if I had gotten the year wrong, but he quickly realized I must have been referring to Cyclone Alby. Not very much burned during Cyclone Alby, he told me, even though you had extreme winds and suitable weather, and plenty of lighting ignition.[74] That's the "proof in the pudding," he added. There was a mosaic in the forest back then, he said, which is not there to the same extent today.

Cyclone Alby has been used for a long time by proponents of fuel reduction burning as an example of what systematic burning can accomplish. In a Forests Department Working Plan from 1982, it is stated that "Experience with Cyclone Alby

[74] About 114 000 hectares burned during cyclone Alby. Seemingly quite a large area, but dividing it by 90 bushfires, means that the vast majority of these remained fairly small.

demonstrated the value of the Department's fuel reduction burning policy for the protection of forest and communities from wild fire" (Forests Department 1982: 5). For Bruce, the critical variable that could shed light on present and past bushfires is the amount and distribution of fuel in the forest. When I asked him whether the increase in bushfires in recent years was also due to climate change, he answered with a resolute "maybe." Bruce is by no means a climate skeptic, earlier on in our conversation he had talked at some length about the many difficulties caused by drier vegetation—Bruce is very aware of the region's long and ongoing drying trend. But I don't believe he would regard catastrophic bushfires as inevitable. Even with a drying climate, Bruce has faith that prescribed burning can contribute to making the majority of bushfire mild and manageable. Put bluntly, Bruce and many others in the southwest have a fairly recent experience of the region as a place where fire was mild and manageable.

In the early period of forest exploitation in the southwest, from the late 19th to the early 20th century, foresters understood the forests as becoming more fire prone and burning more often and more intensely because of forest debris left following logging and the lack of any kind of management. They also recognized a feedback mechanism whereby these intense fires damaged trees and re-growth and opened up the canopy further. In the post-war decades, and especially from the 70s, a drying climate is in part understood as a cause for the region becoming more fire prone. Interestingly, though, in both periods, it is difficult to disentangle the effects of prescribed burning from other influences—logging induced changes in forest structure in the first period,

and climate change in more recent years. The Waroona fire for instance, occurred across large swathes of forest that had not been burned for ten years or more (McCaw et al. 2016: 8), including several rehabilitated bauxite mining pits of different ages. But it also burned during a hot and dry summer following a 40 year long drying trend in the region as well as several years after the turn of the millennium with very low rainfall (ibid.), among others the extremely dry 2010-11 season. Undoubtedly, one might say, these are interacting effects. However, both fuel load and fire weather (and climate) are sometimes pushed to operate as ultimate explanations. Consequently, it is possible to make the argument that both logging and climate matter little for wildfire risk as long as fuels are kept low and in mosaic patterns. But is it also possible to argue that fuel reduction or the lack of it is not the primary determinant for how the forest burns, that with a pre-European climate and forest structure even summer bushfires would be slow creeping fires that rarely reached the canopy, and conversely, that with present day climate and forest structure, forests can burn ferociously even with relatively low fuel.

In practice of course, West Australians don't live with pre-European forests, or with forest that are simple products of the drying climate alone. In between my broad and general questions about climate change, history, and the forest, Bruce was far more excited to talk about specific things, such as "moisture differentials" in the landscape, his ideas concerning "soft-edge mosaics," and the practice of "stacking" adjacent burns over successive seasons. When the how's of management are the more pressing concern, and you are in a position from which you can practically carry out

management practices, a “maybe” regarding underlying patterns such as climate change may just be enough. A narrative with a single ultimate cause is usually something that forest managers resist.

In both the period prior to the institution of forestry and the period after the war, moreover, fire is positioned as both caused by and contributing to the forests being changed. Early logging had made the forest more fire prone, but the fires of a logged and unmanaged forest also contributed to forest change. Similarly, a drying climate alters the forest at the same time as it contributes to a new kind or a new frequency of forest-altering fires. As such, the region is conceived of as becoming both increasingly fire affected and increasingly fire prone. Sometimes, by way of a complex interaction of climate change, myriad anthropogenic interventions and a persistent proneness to burn, the bush and the forests seem almost to have become a danger to themselves, ferociously burning in ways that *they* are not used to. I found this idea explicitly stated in a presentation given by an environmental officer from the city of Cockburn at a bushfire workshop in 2002 (Strano 2002). In bushland around Perth, invasive weeds, such as veldtgrass, that burn readily and thrive after fire, along with drier conditions were seen as causing these landscapes to be a “danger to themselves.” People have asked these bushlands about its various relations and about its future and they have gotten indications of answers that are concerning. In addition to this somewhat obscure reference to a fifteen-year-old workshop, it is a notion that is tacitly held by many, and closely related to the idea that some parts of the forest may be on the verge of collapse.

One might find it an odd and remarkable thing that it is possible to conceive of landscapes that are so widely and unproblematically conceptualized as fire prone and fire-adapted (see chapter 2) as also at risk of burning more intensely than they themselves can handle. But people in the southwest are not confused, there is no paradox. It is possible for people to hold simultaneously in mind the notion that the forests are hardy and resilient and that they are prone to collapse, a danger to themselves. Both are stories that respond to features and elements of the landscape; to what the landscape tells them in response to their inquiries and probes. People in the southwest are moved by invasive weeds and bushland fire, and by cyclones and prescribed burns to think of possibilities for the southwest landscape that are different, but do not negate the possibility of the other.

There are also precedents involved, interacting stories of stability and change that have been around for quite some time. In the early 1930s, the Forests Department seemed to be remarkably optimistic. They were still struggling to deal with large areas that had been cut over in the late nineteenth and early twentieth century, and in 1932, their Annual Report noted that the Reforestation Fund could only support treatment of the areas cut over every year and not the regrowth from previous logging where a "mal-formed young forest" damaged by severe fires (Forests Department 1932: 5) was growing back. However, there was no cause for alarm: "Fortunately, Nature is kind in the Jarrah forest, and a fast-growing healthy new crop can be established on these areas without fail" (ibid.). Far from being a danger to itself, in 1932, the forest was seen as *kind.* There was simply more moisture in the landscape

in the past according the Ben the fire manager we met in chapter 1. He likes to think of the southwest before the drying trend began as having been "a more forgiving landscape." It is possible to think of the forest as a danger to itself and as having a kind and forgiving nature. It is thinkable, and in no way outlandish, that the forest is a danger to itself and nearing collapse, but it is also not at all strange to think of it as resilient. People may have less faith in the forest, and an ever growing set of global precedents for thinking about environmental destruction and loss, but both the hardy, kind, and forgiving jarrah forest and the jarrah forest on the verge of collapse have existed together for a long time in some form in discourse and conceptions among people in the southwest (recall the destruction *phytophtora* was anticipated to cause, and the destruction recognized by early foresters in the cutover and burnt out jarrah forest). Still today, narratives of fragility and durability coexist.

Changes—dramatic and subtle.

After Joe, Raymond, and I had left Amphion forest block where we were looking for old growth forest, we drove north towards the final place we had planned for the day, a fairly large section of old growth off Brookton Hwy near the eastern edge of the northern jarrah forest. It turned out to be something of a disappointment as most of the block consisted of wandoo (*Eucalyptus wandoo*) and not the un-logged jarrah forest we were hoping to find. But on the drive there, through jarrah forest that had likely been harvested at least two or three times, we happened across something more interesting. Instead of the sealed Albany Hwy, one of the region's main

thoroughfares, we had decided to take a narrow dirt track with the puzzling name Metro Road. Joe, Raymond and several of their colleagues had been working for some years with projects that seek to understand the drought-induced forest die-offs associated with the extremely dry 2010-2011 season. The die-off events had occurred in numerous places across the forest, where "tree crowns began to rapidly discolour and die […] resulting in discrete patches of nearly complete canopy loss" (Ruthrof et al. 2016: 820). It was another one of these patches that we unexpectedly came across off Metro Road.

We stopped and got out of the car. Joe told me that this was a great example of what some people expect more of the jarrah forest to turn into. He saved the location on his GPS, and we all went in to have a look. How do you distinguish these sites from *phytophthora* sites, I asked. He said it was difficult to diagnose dieback sites, but a lot of it came down to what we can say from the site itself. For instance, if it's close to rocky outcrops, then that is a sign of drought. The presence of species known to be highly susceptible to dieback, such as banksias and grasstrees, is another thing to look for. The vegetation also tends to die differently from the two disturbances. Phytophthora causes the trees to die back from the outer foliage and kill the tree completely, whereas trees often re-sprout with epicormic shoots along the branches and stem after drought die-offs. Another thing is that dieback occurs like a frontline, he said, because it's due to the spread of a pathogen through the soil. Drought die-offs happen more in discrete patches, not necessarily connected to each other. I could see several of these features where we were. It also looked like the area had been burned

quite recently as many of the jarrah clusters had blackened stems and some looked like they had been defoliated. Raymond had walked a little way ahead of us, and we followed him out to an opening with a rocky area, some grasstrees and heath vegetation, with the dead trees now in the background. Joe was kind of excited. This was just about "a textbook example" of a drought site, he said. We took pictures.

Fig. 7. The drought site on Metro road.

Here, the drying climate has led to a noticeable mortality event that may even foreshadow what greater parts of the forest could turn into. Just like the recent fires, the drought die-offs are both event and pattern—they are a discrete event that happened within the long drying trend and an exceptionally warm and dry season, but they are also occurrences expected to become more frequent. Additionally, they share with fires the character of being thought of as both caused by and contributing to landscape change. Crucially, they may be both caused by and further contributing to a

more fire prone forest, which in turn would be caused by and contributing to the forest becoming more drought-prone. Much more often than with such striking events, though, climate change has effects that are simultaneously quite subtle and potentially very dramatic. In fact, in all the places we have visited so far, people know there to be changes, likely even the most drastic ones, that we cannot easily see.

In a report about timber harvesting in the southwest under conditions of climate change, DPAW researchers Deirdre Maher, Lachie McCaw, and Colin Yates note that "unlike the northern hemisphere, observed impacts of climate change on WA biodiversity are very limited and largely restricted to conspicuous avifauna" (Maher et al. 2010: 16). Reasons for this are several, they explain, including a lack of knowledge about ecological thresholds and species' adaptive capacity, and the fact that "it is not always easy to distinguish climate effects from other human pressures" (ibid.). Rainfall has been decreasing in the region since the seventies, in many areas by 15 % or more, and it has been steadily getting warmer. But so far, observable effects clearly caused by the changing climate have been few and modest. The report, however, opens to different possibilities, some of which are much more dramatic. Despite there being only limited obvious impacts, there are still things in the landscape that make these researchers consider the possibility of collapse.

Based on an assumption that the 600 mm rainfall isohyet may be the limit of the distribution of jarrah forest, one part of the report consists of assessing how much more of the jarrah forest is liable under different climate scenarios to fall below this line. The limit of dryness is creeping further west, and areas such as the drought-

stricken patch Joe, Raymond, and I found off Metro Road may well be among the roughly 80 000 hectares (or 5.1 % of the current jarrah forest) which could fall below the 600 mm limit by 2030 under a high severity scenario. A similar percentage of the karri forest is estimated to fall below its assumed limit of 900 mm annual rainfall. In other words, more than 80 000 hectares of forest is thought at worst to no longer be viable as forests a decade from now. And as the drying trend is a process not easily reversed, this seems to be a collapse that is not merely imminent, but that has virtually already happened and need now only manifest. The echoes from earlier times are loud and clear as the forest is once again thought to be at risk of disappearing. But in some ways, the forest itself is also making it difficult for us to know what change is currently occurring: "The inherent drought tolerance of much of the vascular flora of SWWA, including the dominant forest trees, is likely to also mask the effects of changing climate to a greater extent than in some other environments" (Maher et al. 2010: 18). Here, it seems, we cannot be sure, when looking at a modestly affected flora, whether we are witnessing resilience or something that merely *looks like* resilience and masks fragility. In sum, these forest researchers are thinking with ambiguity and telling stories of resilience and collapse at the same time—of a flora that is drought tolerant and so far only modestly affected along with a possible scenario in which large areas of forest may no longer be viable as forests in as little as 10-15 years. Moreover, the stories temper each other. Neither can be known with certainty at the same time as both are, with certainty, possibilities.

One of the most drastic changes in the southwest forests may be occurring largely underground, as several factors are contributing to disconnecting groundwater from stream flow. In addition to lower rainfall, the influences include “abstraction” of groundwater, a shift towards thirstier forests with more young trees brought on by logging and bauxite mining, less canopy cover (caused, among other things, by dieback) leading to higher evapotransporation, and possibly also altered fire patterns.

Almost adjacent to Amphion forest block lies Yarragil, one of the main sites where jarrah forest hydrology has been studied in the past few decades. It is an especially valuable site, explained forest researcher Geoff Stoneman when I met him at his home in the City Beach area of Perth on a sunny May afternoon. The reason it is an important site, is that they have such extensive long-term data. For the project that started in the 70s, they now have 15 years of pre-treatment data as well as about 30 years of post-treatment data. And all this, Geoff added, during a period of climate change. At first, the questions that the Forests Department researchers asked were related to salinity. The concern was that logging could lead to over-salinization of streams, which is what happened after land clearing in the Wheatbelt. It was only later that the focus of the research turned towards examining whether silvicultural methods could be used to increase streamflow and enhance the water supply. Thinning was the treatment in question, and it was hoped that it would enhance water production as well as increase the growth of crop trees. With reference to a different hydrology study, the Wungong trial in the Perth Hills, Geoff told me that in the end there were decisive issues related to cost. It turned out, partly because the Water

Corporation had chosen a less than ideal site, and partly because of the drying climate, that thinning treatments for water production would be very expensive. Either forestry or the water corporation would have to pay for it, and neither one would.

Groundwater levels have been declining since the 70s, he continued, in some places by as much as 20 meters. What they found, Geoff continued, referring to the Yarragil study area, is that in 1983 groundwater and streamflow were just at the point of disconnection. They managed, through the thinning treatment, to re-establish the connection, but the groundwater and streamflow have been disconnected again since 2001. This means that groundwater currently doesn't contribute to streamflow at all in these areas. Perennial streams have turned to intermittent streams, Geoff said, and some streams that used to be intermittent are now just about dried out. Needless to say, stream salinity, arising from too much run-off causing streams to mix with a higher proportion of saline groundwater[75], was not a problem anymore. If you want to maintain the connection, he explained, you will have to keep thinning indefinitely, and it is very unlikely that will ever happen. At some point it will reach "a new state," but what happens in that process is very uncertain, Geoff said as he made references to researchers who were working with the drought induced forest die-offs that happened in 2011. Jarrah's adaptation to drought is through their deep roots systems, so when they lack water, they just dig for water further down in the ground, and when

[75] Salinity is less of an issue in very dry areas, where the groundwater is too deep to mix with streamflow and it also not an issue in very wet areas, where groundwater is not very saline, because of lower levels of transpiration (see Kinal and Stoneman 2012).

they run out, they die. What will happen to the forest? It might be “a mass collapse,” Geoff said, or it might be “a general reduction in leaf area.”

I didn’t leave Geoff’s place with a great sense of optimism. Instead, I recall at the time thinking of his view as a measured defeatism. Realistically, it seemed there was little that could be done, and even though they had been able to re-connect the groundwater and streamflow once before, the funds and the political will were not there, and the conditions were more difficult now than in the 80s. Still, though, collapse was only one possibility that was conceivable to Geoff. The other one he mentioned, a general reduction in leaf area, would be far less conspicuous, likely a change most people would scarcely be able to notice. Massive drought induced forest collapse or a less leafy landscape are drastically different scenarios—they stand in well as concrete examples of ruin or resilience. For Geoff it was possible, even necessary, to imagine both.

Weather and climate

In early November, Parks and Wildlife had just gotten started with their spring burn program in the mixed jarrah and karri forests of the Warren region. I had recently come from a couple of weeks in Wellington District further south, and on my first day in Manjimup Frank introduced me around the office. After a while, a few of us—Frank, the regional fire coordinator, Steve, who is in charge of visitor services in the region, and Geoff who is part of the Department’s Fire Management Development Program—got to talking about the weather. There had been light rain the day before,

and rain on the forecast in a couple of days, and they weren't sure if they would be able to do much burning this week—it might just be too wet. Perhaps noticing that I seemed interested in the changing weather patterns, Rod found some graphs to show me on his computer. They displayed the Soil Dryness Index (SDI) with several differently colored curves, one for each of the past six seasons, including this year, and one bold black curve for a running five-year average. All the curves started near zero on the index for the months of August and September, and rose sharply from about October through January, indicating steadily drying soil, before they made a jaggedly hesitant downward turn somewhere between March and May. The index runs from zero, indicating that the soil is completely saturated to a depth of two meters, to 2000, at which point the soil is dry to the same depth. Each season differed, some quite a lot, and it could be more than a month of variation between seasons in the time when the soil started drying up in spring as well as when it started getting wetter in autumn. On this particular graph, Frank explained, we could see that this year was wetter than the five-year average, but he also mentioned that the five-year average was "not very good," only barely dipping down to zero. In the driest of the recent years, 2010-11, the low hovered around 200. This year, Frank mentioned, was more like the "old normal," what it used to be like back in the day. Down here, Geoff chimed in, they used to have "rain, with drizzle in between."

Here, the jagged curves of annual soil dryness and running averages sit alongside yesterday's drizzle, today's sun, and the rain forecast for Thursday, as well as recollections of seasons long past. Weather and climate are connected with links that

are tentative and inconclusive, suggested and unresolved. To all of us, they're just as obviously different as they're obviously, in a sense, the same.

In 2012, the Indian Ocean Climate Initiative, a long-term research partnership run by the WA State Government, CSIRO, and the Bureau of Meteorology, released the report from stage 3 of the project. If there is such a thing as an authoritative statement on the state's future weather, this might be it. In a review published in *Australian Forestry*, fire researcher Lachie McCaw (2013) calls it "essential reading for those involved in the management of forests and natural resources in south-western Western Australia" (110). The weather of the southwest, the report explains, is driven to a significant extent by the subtropical jet stream and the cold weather south of Australia. Both of these drivers are changing in ways that are consistent with what could be expected from increases in greenhouse gases. The report presents a logical causal chain[76]—higher concentrations of greenhouse gases have led to a weakening of the subtropical jet stream and a warming south of 30°, which has then led to fewer winter storms and thereby lower rainfall across the southwest. The jet stream, "a belt of strong, upper-level westerly winds" (Bates et al. 2012: 26) is a major force generating storms, and its weakening is associated with a more stable atmosphere. Similarly, the warmer weather in the south has "reduced the equator-to-pole temperature gradient" (27), representing another stabilizing process. Both changes have made it less likely that winter storms, which account for a significant portion of

[76] They also point out a number of uncertainties, primarily with regards to differences between models, with choosing a baseline, and the complex issues with ascertaining what is caused by anthropocenic forces.

the region's annual rainfall, will form in the southwest. Furthermore, whereas fewer low pressure systems were the main cause of rainfall declines from the late 60s until around 2000, since then, the continued drying trend has been driven by a higher incidence of high pressure systems. These systems seem to persist further into autumn, which is reflected in a 25 % decline in May rainfall since the year 2000 (40). The atmospheric drivers of WA's weather manifest differently in the summer months, where deep surface troughs—formations of low-pressure areas in the atmosphere—along the west coast and occasional lingering tropical cyclones are important features. Under a subheading called "Knowledge gaps and future directions," (35), the authors speculate that interactions between the El Nino Southern Oscillation, the Indian Ocean Dipole, and other weather systems could cause more tropical weather to "intrude further south" (35), possibly bringing more rainfall and more frequent extreme weather events in summer. Decaying tropical cyclones can bring large amounts of rain to the southwest, but they also sometimes bring dry lightning and high winds, just like Cyclone Alby did in 1978.

In a small oven in the innermost corner of a large shed storing all kinds of firefighting equipment, I saw karri leaves being dried at a rate much faster than by climate change. Right after we had finished a burn planning meeting for Frankland District in the small south coast town of Walpole, Hayden asked me if I wanted to come along and have a look at where they do the profile moisture content measurements. In among hoses and fire blankets, pumps and generators, rakes and shovels, the incredibly low-tech equipment for measuring how moist the understorey profile is

consisted of an old sooty oven, a clip-board with a data sheet and a pencil, and half a dozen metal cylinders filled with leaves and other vegetation matter from the karri forest understorey. Hayden explained that in the karri forest they do profile moisture content in addition to surface moisture content, since a lot of the fuel is higher up than just on the forest floor. It's in the "profile" of the forest, not just on the surface. Today's samples were from the Ordnance burn, which they had going at the moment. Hayden had been out there the day before to collect the samples, and he explained that the cylinders were supposed to sit in the oven for 18 hours on 105 degrees (Celsius). He took them out one by one and put them on a small scale and wrote the weight on the form. He had entered the moist weight on the form before he put them in the oven, and after he had weighed all of the little cylinders, he emptied them and then weighed the empty cylinders as well. Then, later, he would take all the numbers and enter them into a spread sheet that would give him a percentage for the Profile Moisture Content. After that, another set of calculations, also incorporating current temperature, humidity, and winds, would give him an expected Rate of Spread (ROS) for a fire lit under these conditions. Hayden knows climate through moist and dried leaves, through forms and calculations, and through concrete effects—how things burn—that hardly ever completely correspond to predictions. With samples, an oven, a weight, some spreadsheets and an algorithm, Hayden is asking questions of the forest—what condition are you in? and how will you burn? —and aiming to find out something that can inform his actions.

Profile moisture content is only one of the complications that makes burning in the karri forest distinct from jarrah. Another complication Hayden told me about was related to the seasons. Karri burning is often conducted in the summer months, but last summer, they hardly got any karri burning done at all in this district. This, he explained, was because of a couple of high rainfall events. There was a cyclone that had a little bit of an impact down here and at one point during summer they got around 100 mm of rain. This meant that they had to wait for a month or so for the karri to dry up again. Hayden knows climate through inconvenient summer rain, complications, through planning, waiting, and plans that have to be changed, plans that they expect may have to change, plans that are at the mercy of unpredictable forces. Even dry season within a long drying trend can be highly variable. Hayden knows he may not always get the answers he wants from the forest.

The Southern Australian Seasonal Bushfire Outlook 2017, released by the Bushfire and Natural Hazards Cooperative Research Centre, assesses there to be "potential for above normal bushfire activity" in the southwest region for the 2017-18 season. The year before was also assessed as having "above normal fire potential." For 2016, yet another winter of low rainfall, and "an underlying long-term deficit in soil moisture," were the main reasons for the assessment. For 2017, despite an unusually wet summer, the following autumn was the driest in five years, and below average rainfall was expected for spring. In an updated hazard note released in November 2017, it is noted that the southwest of WA "has now experienced 12 consecutive cool seasons with below average rainfall."

On Australia Day, January 26th, 2017, a tropical low up north extended a surface trough down along the west coast, which brought temperatures in the high 30s, unstable atmospheric conditions, and winds to the southwest. I could feel the smoke seeping in through the aircon of my car, and as I got closer to the town of Donnybrook where I was staying that night, I saw the menacing plume from what the radio told me was a bushfire at Gwindinup, a few km south of town. The "watch and act warning" had by the afternoon become an "emergency warning," and people close to the fire were urged to take immediate action. But by evening the wind had eased, the plume was nearly gone, and in Parks and Wildlife's office in Kirup the next morning, talk of the fire had to compete with how people had spent their Australia Day, and with the leftover pavlova someone had brought in to share.

There is a sense in which the Gwindinup fire very mundanely can, and indeed must, form part of climate change. It lines up with the patterns: the soil and vegetation dryness, as conditions under which it burned, can be seen in light of the long term drying trend, of the weakening jet stream and the lower rainfall, the warming south and the more persisting high-pressure systems in autumn, the season with "higher than normal potential for bushfire activity;" and the deep surface trough contributes to the pattern of tropical weather more often creeping further south. It can be a climate change-fire, by definition. It contributes to the patterns on the basis of which other large and damaging fires can be understood as climate change fires. But it is also just a bushfire, and, as I learned to see it, quite an unremarkable one at that.

When I went out to Gwindinup with Erin from Parks and Wildlife a few weeks later to have a look at the area that had burned, I found myself involved in what I would now call a stability story. We had been working on a prescription for a burn, and when we finished a bit early in the day, Erin suggested that we'd go out to Gwindinup. Gary, another fire manager in the Kirup office, mentioned to me before Erin and I drove out that this fire would be interesting for me to see. It would give me a chance to see what difference a prescribed burn can make, he said. With this fire, we would have private property with high fuel loads right next to some Parks and Wildlife land which was burned two years earlier. I would really get to see the difference, he said.

After about half an hour's drive from Kirup, we took off from the highway and very soon after, burned areas came up on our right-hand side. No one in the office seemed to be completely sure how the fire had started, but they knew where. Apparently, it was on the other side of the road, down near the river somewhere, but it was the forest on our right-hand side that was severely burned. It had also come very close to houses in some areas. I mentioned that I'd heard that they lost a few sheds in the fire, and Erin confirmed this, and added that they'd been really lucky not to have lost more. The first section we drove through was on private property. Most of the trees were scorched all the way up to the crown, but the majority of them didn't seem to be completely defoliated. The leaves were grayish, dead, but they hadn't been consumed by the fire. Some thin young jarrah trees were defoliated and left as dead sticks and

poles, but most of the trees still had leaves on them, just now in a different color. The ground was black and almost completely free of leaves and shrubs.

We kept going, looking for a track that would take us around the burn boundary. Erin knew there was a track that had been made by the bulldozer as the boundary for the burn. We found it after a bit, and as we drove along the track, which was quite rough and rocky, we were now getting into the part of the fire which was on recently burned Parks and Wildlife land. Erin somehow knew where the boundary was, though I couldn't pick up how she was able to tell. We continued up a steep slope, and Erin noted that it didn't look like it had been burning very intensely up here, even though the fire had been going uphill. She didn't say so explicitly, but it was more than clear enough that this would have been because of the low fuel load. We saw the forest with a variable in mind—recently burned or not. Hardly any of the trees here were defoliated, and when the track flattened out on the top of the hill, we could even see some trees that still had green leaves on them. Erin attributed this to the difference that the recent prescribed burn had made, and I nodded concurringly. The difference was indeed noticeable. But Erin also mentioned that under some conditions low fuels from recent prescribed burns wouldn't necessarily be able to stop a fire, if the weather conditions were really severe. When we drove back out of the burn area on a very rough track that had been made by a bulldozer as a containment line during the fire, Erin told me that they usually block these fire-break-roads off afterwards, so as not to encourage people to use them. She also said they rehabilitate the boundaries. Mostly

it involves closing them off and allowing them to do their thing, and she said it wouldn't take too many years before it grows over.

There are two stability stories involved here—one is about prescribed burning and the other is about forest resilience. We have seen several instances of both already. At Gwindinup, the recent prescribed burn hadn't stopped the fire, but it appeared to have made the fire easier and safer to contain and had caused it to be a less intense fire than it might otherwise have been. In a sense, it is a concrete bodily experience that allows fire managers more easily to conceive of bushfire as something manageable. Crucially, and perhaps curiously, almost any fire in the southwest can be understood in light of an instability story about climate change as well as a stability story about bushfire and prescribed burning. Details and patterns in the landscape can accommodate both of these stories. These narratives can coexist without cancelling out, or even necessarily challenging, one another. Any fire can tell us how the forest is undergoing drastic change, at the same time as any fire can show us the possibility that the forests may stay the same and be maintained as mild and manageable places. The other stability story comes through in the assumption that the jarrah forest only needs a few years to erase the impact of a bulldozer track. Here, the forest is still of a forgiving nature. Sometimes, the forest, the same one which is on the verge of collapse, seems not only resilient, but almost completely impervious and indifferent to our treatment of it.

Settler dislocation or a commitment to accountable stories

I could go on with more examples of how the changing climate is experienced in the southwest. I could tell you that some researchers are particularly worried that the drier climate will mean that peat swamps now will be at risk of burning in bushfires, that already variable spring and autumn burning seasons are thought of by many fire managers as shrinking, that recent major fires such as the Waroona fire is opening to new research about extreme fire behavior and the dynamics of fire-generated weather patterns, or that hydrologists warn that if groundwater abstraction continues we would be looking at scenarios in certain vegetation communities of having to turn the attention away from conservation towards doing restoration after collapse. Not all of these are necessarily counterbalanced by narratives of stability. On the other hand, I could also show many situations in which climate change seems to be hardly present at all, where stability stories exist on their own.[77]

In many situations it is also difficult to disentangle the extent to which uncertainties and complications are understood as new, arising from climate change and others factors of change, and to what extent they are newly known, having always been present in an Australian environment that European settlers, after all, have only known for a relatively short time. And not only have settlers not known their landscapes and their climate for very long, they had not known them very long before they started changing, before they weren't quite the same anymore.

[77] National parks, for instance, could be seen as a claim about continuity.

Two different explanatory models can account for why people engage with landscapes as ambiguous. The first is a settler dislocation model which argues that settler's knowledge and conceptions of the landscape is skewed. This model implies an external world that is ambiguous in relation to culture. A world that is static and ambiguous because culture is flexible and dynamic on its own. Here, the world doesn't resist different interpretations, it doesn't involve itself in knowledge, and knowledge and conceptualizations are set apart from the material world. The second model is the one I advance. Here, ambiguity cannot ever be definitively situated in either mind or in matter. Ambiguity lies in between and in both. It lies in troubled ties that are bodily and affective, that consist of a ceaseless questioning of the forest.

Ruth Morgan describes in the case of the southwest how the variability of seasons, and particularly the variable timing of winter rains— "arriving at any time from early April to the end of May" (Morgan 2015: 18)—caused problems for early settlers in the region. "The seasons did not conform to the colonists' expectations" (ibid.), she states, articulating an observation that has often been made about settlers' encounter with the land down under[78]. The deceptive impression of predictability left by certain

[78] That the new land didn't fulfill expectations is, for one thing, reflected in many place names, such as Lake Disappointment in the Pilbara or Useless Inlet in Shark Bay on the west coast. J.M. Arthur finds the source of settler disconcertment and distortions to lie in the English language: "the words look for what is not there" (Arthur 2003: 24), causing curious ways of apprehending the landscape. Arthur presents examples of "Australian rivers which do not seem to know how to be rivers" (18), and landscapes which "[do] not produce satisfactory lakes," (21) among many other things. "The vocabulary remembers another place" (23), against which the Australian landscape comes to appear strange and deficient. With regards to trees and forests, this theme often revolves around settlers' disconcertment with the lack of color, lack of seasonal change, or the fact that eucalyptus trees often shed their bark rather than their leaves. George Seddon explains the disconcertment somewhat differently than Arthur with the example of Judge Barron Field who "deplored the monotony of the unchanging grey-green eucalypt forest" (Seddon 2005: 189) in the early days of settlement in Sydney.

series of similar seasons, such as the "sanguine seasons of the post-war decades" (Morgan 2015: 96), also confounded settler Australians. That settlers saw Australia through European eyes is also very much a vernacular explanatory model, one that has been around for quite a long time, and one I can confidently say my interlocutors in the southwest knew quite well. In short, it is an interpretation that puts Australians at a distance from the landscapes, where settlers may look at forests through distorted lenses, or look at forests and not be able to grasp what's going on.

Joseph Gentilli, possibly the most influential researcher on climatology in Western Australia, noted in 1989 serious gaps (clearly, for him, science-shaped gaps that couldn't be filled by aboriginal knowledge) and shortcomings in data about climate in the jarrah forest: "there are many rain gauges in the agricultural areas, and very few in the jarrah forest […] most of these have only been in use for very short periods, while timber was being milled in the vicinity" (Gentilli 1989: 23). As we saw in the

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In the forests, Barron Field saw the absence of nothing less than one of the founding myths of the western world: "of Orpheus and Eurydice, of the Crucifixion and Resurrection, of a death that brings life […] He mourned a metaphor, one that had shaped his culture" (ibid.). But Seddon also suggests that Australian English has gradually come to adapt to the environment in some ways, for instance with some distinctively Australian terms for water ways and water bodies.

Another version of this theme is found in criticism of visual representations of Australian nature. Art critic Neville Weston likens a common view of Australian landscape art to the sleeping beauty myth: "that a true representation of Australia—its remarkable landforms, devastatingly bright light, strange and wonderful flora and fauna—could only emerge when the scales of European visual prejudice fell from Australian artists' eyes" (Weston 2003: 172). Interestingly, he reports that in the art world this is commonly thought to have been achieved with the Heidelberg School in the late 19th century. Otherwise, it seems to me like the theme of European bias is much more persistent than that, even to the extent that the theme seems nearly inexhaustible—in the sense that it is just about impossible to know when the scales of European prejudice have been shed, or when the language apprehends the landscape accurately on its own right (if such a thing is possible). An alternative to continuing to ask whether or not we are right or wrong, or getting closer, may be to find lively and powerful landscapes in their capacity to demand new words and new forms of noticing.

previous chapter, at no point in the 20th century have changes to the forest arrived against a baseline of stability. In this chapter we have seen glimpses of how seasons and weather are understood to be changing. But changing seasons are also not altering something that used to be thought of as stable, they are altering something that has long been recognized—and felt—as extremely variable, and something that settlers barely had gotten used to before it started to change in a qualitatively different way. Gentili presents what appears to be the common variability of seasons in the southwest, sans climate change. Rather than simply having a dry summer, he writes, "south-western Australia suffers a seasonal drought that may last from 4 to 6 or 7 months" (Gentillie 1989: 26). Furthermore, "autumn and spring […] can vary significantly from year to year, being often overpowered by summer" (Gentilli 1989: 27). With regards to the wet season, he mentions "enormous variations in June rainfall" (29). All this represents an immense variability within what is taken to be normal.[79]

I found a similar pattern while reading Forests Department annual reports from the 1920s until recent years. Even before the drying trend started in the early 70s, it was hard to find many seasons in over 50 years of annual reports that did not stand out in some way. Variability is what is expected. It is a curious thing—in sections

[79] That Australia has extremely variable weather is widely recognized, by scholars (e.g. Sherrat et al. 2005) as well as in popular culture. European expectations also seem to be incredibly persistent. A Huffington Post piece from 2015 with the title "Weird weather: Why Sydney and Melbourne are sizzling one day, freezing the next,"" for instance, asks: "So what's going on? Why can't spring just gradually warm until it turns into summer? Why is there such a violent tug-of-war between the seasons?" The answer provided is of course that this is "normal spring," but it is telling that the Australian weather still seems "weird" to many settler Australians.

describing the season and its fire weather, the idea of a "normal" season is often invoked, but it is mostly as an absence. Forest managers express ideas about "normal seasons" at the same time as hardly a single normal season ever seems to occur. Or perhaps rather, what is normal in the southwest is for any season to be notable in some way. Highly variable seasons are not outside of normality—it is common for every year to have something notable about it. Today, as ever, running averages are composed of series of unusual seasons. These are stability stories against backgrounds of variability. Here, experiences of stability and instability coexist. The normality of immense variation is an imaginary that may blunt the new peaks and diffuse the new trends of global climate change. Regardless of being wrong or right, past stories of landscapes and weather now serve as part of the knowledge frameworks through which today's forest managers apprehend the forest.

The summer of 33-34 was "one of the most trying on record," (Forests Department 1934: 16), and the summer of 35-36 was reported as one of the driest on record (FD 1936).[80] In 1944, the annual report notes the "absence of the usual early March rains" (FD 1944: 9) as a cause for burn offs turning into bushfires, 1945 included an "exceptionally wet winter" (FD 1946: 10), 1947-48 was "remarkable for the lengthy dry spell over late spring, summer and autumn," (FD 1948: 8) and the forest being "tinder dry" even into June (ibid.). The 1948-49 season was also a "very dry season" where "fires were running freely up to June 15th" (FD 1949: 4). The 49-50 season was

[80] There is a gap here not because the late 30s and early 40s were reported as being "normal" years, but partly because there were no annual reports produced in the war years.

"notable for the persistent dry weather through March and April" (FD 1950: 10), the 51-52 season stood out due to "rains in the months of November and December" which was "followed by 100 days of dry weather" (FD 1952: 4), the 52-53 season saw summer weather "rise sharply to Dangerous Hazard, but then fell again steeply, and in that respect was abnormal" (FD 1953: 4), and the summer of 53-54 stood out for its unusually high number of lighting caused fires (FD 1954: 15). The 54-55 season "was unusual in several factors" (FD 1955: 17), including a "phenomenally dry winter," above average rains in October and November, and four dangerous days in mid-March (ibid.). The following year had a "prolonged wet winter" (FD 1956: 6), the year following that had wet days in autumn and spring that "curtailed burning very considerably" (FD 1957: 20), and the next year after that was again "one of the driest on record" (FD 1958: 23). 1958-1959 had an "abnormally dry period from November to March in the karri forest" (FD 1959:25), 1960 had a tornado, and 1961 was "very severe with several heatwaves associated with cyclonic disturbances giving rise to a number of lightning strikes" (FD 1961: 21), and of course the massive Dwellingup fire, which destroyed, among many other things, the Forests Department's fire weather station and its fire weather research records from the past 27 years.

The pattern is clear—most years were understood to have some kind of 'unusual', 'abnormal', or otherwise notable weather, long before climate change began. We may also note the resonances between the types of abnormalities mentioned in the annual reports and Gentilli's discussion of the normal seasonal variation in the southwest, as

well as with the trends pointed out in the climate outlooks and predictions discussed earlier in this chapter. In a sense, what is unusual about the weather today—persistent dry weather far into autumn, tropical weather intruding south in summer, longer dry spells, successive record-dry seasons, and dry winters—are among the same things that have been unusual about the regions' weather for as long as settlers have records and recollection. Climate change can become somewhat subtle here. The dramatic changes may not be so easily recognized in extremes—West Australians have always known extremes—but instead seem to manifest in the slow and cumulative effects of something only slightly more unusual than the kind of unusual that people are used to.

I take this not to be a story of dislocation and a distorted view of nature, but a fragmented record of how people in the past have seen the forest through both embodied experiences and frameworks of knowledge. Then, we can see in historical sources glimpses of what may have moved them and how they may have allowed themselves to be moved.

West Australians today inherit strong precedents for understanding the forests both as resilient and as perched upon the brink of collapse, both pervasively altered and pretty much the same. Precedents are not quite models, nor are they quite scripts or schemes. Insofar as its useful to define them, I'd suggest that they are instances of how something has occurred before. Precedents, as I understand them, don't imply that things *will* happen the same way as they did before, they only suggest that they *can.* Additionally, precedents are not abstracted or generalized in the same way as

models. Precedents don't depart from the concrete in the same way—they are *particular* occurrences speaking to other particular occurrences. In the southwest, the cutover and burnt forests of the early 20th century speak to phytophthora dieback, and both of those occurrences speak to climate change and the forests of today. But so do the experiences of Cyclone Alby, the fresh green growth that filled up the forests after the Dwellingup fires in 61 and those that are currently filling in forests around Waroona. As do the decades of concerted and relatively successful efforts to limit wildfires by controlled burns. These involve ambiguous answers from the forest that allow for and call for continued questioning.

The southwest forests are not ruins—they are ambiguous and unresolved. Instances of possibly imminent threat and collapse coexist with the ordinariness of extremes, occurrences that seem to be the forests' imperviousness to change, landscapes that are still heterogeneous and complex, and a forest that might still after all have a kind nature. In today's play of precedents, there is no reason why one set of stories should win out over the others. Indeed, they aren't even necessarily in conflict.

What I must emphasize is how easy it is, after all, to sit with these apparently contradictory images simultaneously in mind—that is, in the same breath to tell stories of stability and collapse. Or, put differently, how deeply troublesome it would be to definitively conclude on either side, how troublesome it would be not to tolerate ambiguity; how jarring a single simple story would be if forest managers brought it out with them in the forest. This points us to what I believe is a strong commitment among those I met in the southwest to create patterns and tell stories that as far as

possible are true to the landscape. These were not people who engaged with the landscape from a distance, who looked at the forest without being able to see what's going on. Instead, they are people who engage closely, in embodied and experiential ways, in moist and smoldering ways, who engage with patterns and features of landscapes, and come to the tentative stance that there might be more than one thing going on.

It is troublesome for people who closely engage with southwest landscapes to conclude that the forest is *either* forgiving *or* a danger to itself; it would seem irresponsible to settle on either collapse or a less leafy landscape; it seems unnecessarily confining, or perhaps just unnecessary, to regard the Gwindinup fire, the Waroona fire, the Boddington fire, or the Margaret River fire either as climate change-fires or as simply bushfires; and it would be an irresponsible story to tell of these fires that didn't include both a complex forest that grows back, and one that may not be the same forest for very long; that didn't include both the promise of prescribed burning as a key to keep the forest mild and manageable, and the possibility that prescribed burning may no longer easily prevent catastrophic and unmanageable fires. In order to tell stories that respond to the landscape, as well as to precedents from the past century of landscape change, it seems necessary to be open to forests that are at the same time resilient, forgiving, and possibly on the verge of collapse.

Part 3 — Heterogeneity

Fig. 8. A burn with low flames creates within-burn-patchiness of burnt and un-burnt areas.

Chapter 5—After forestry?

In Lewin and Graphite forest blocks in the southern karri forests I encountered trees and patches of trees that foresters involve in their vision of good forms of diversity. I was out with Noel, planning manager from the Forest Products Commission (FPC) in Manjimup. He had taken the day to show me some elements of their forestry practices and just after 10 in the morning we took off from the FPC office in Noel's white Toyota. Dirt roads took us first to Lewin forest block west of Manjimup where we made a stop in the quiet shade of tall trees. Noel pulled out a folder with all the planning documents for Lewin coupe 5 and 6 and we talked about the upcoming logging operations. These coupes were set for a harvest this season and everything was ready to go. A map of the coupes showed outlines of the available area in red, with stream zones and other "excluded zones" in green. Noel pointed and explained and I nodded with interest. Inside the car we sat with a representation that tied these patches of forest to visions of what the forest could become. Outside, we were looking at a forest that would very shortly be intervened with.

In Graphite, the foresters had just done a cut and we drove through to see what it looked like. We came to an open patch dotted with a few large karri trees and a bulldozer that was parked on a gentle slope. Some small remnants of burnt karri heaps were still smoking here and there in the open. This was a compartment that had just been cut, the tops and branches that were left after logs were taken away had been gathered into heaps and burned. After that, the bulldozer had distributed the ash

around the site to get the ash bed effect of stimulating regrowth in the entire area. In the coming winter, they would then plant new karri seedlings that had been raised in a nursery nearby. Prior to the 1970s, regeneration of karri would be achieved through seed-trees and selective cuts rather than clear-felling and planting. But since karri trees produce seed more seldom than every year, planting nursery-raised seedlings give foresters a lot more predictability. Understorey species are not planted, but assumed to grow back from the seed bank in the soil. It was a scene of scorch, smoke, and metal, one where some people see destruction and others see regeneration and new life.

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There's a peculiar thing about forestry. In many cases, the same action is meant to do two things: in the foresters' terms, the "harvest" is also part of the "regeneration." To cut down a tree, if it's the right tree in the right place, can also make room for the next tree to grow, to cut down a patch of trees can also be the action that prompts a new cycle to start. In some cases foresters plant new seedlings after trees have been cut, but often it is the cutting itself, and the burn that follows, that allows for seeds to fall, that creates space to grow for the trees that are left in the forest, that activates seeds that are already in the ground, or allows saplings to become trees. When the forester decides which trees can be cut at what time and in what place, and which should be left in the forest, he has, above all, *the future* in mind.

But these are changing times in the southwest of Western Australia. Many others now have different futures in mind for the forest. After turbulent and conflictual years in the 90s, with forest occupations and a broad mobilization of environmental groups against logging, sweeping policy changes were initiated in the early 2000s that put an end to all logging of old growth forest and placed large areas of the southwest into reserves. More than half of the publicly owned forests in the southwest are now in formal or informal reserves (Conservation Commission 2013). The total area on which logging activities were carried out in 2017 was just under 5000 hectares, down from a little over 20 000 in 2000, and nearly 35 000 hectares in the mid-70s.[81] As we saw in chapter 1, several saw mills have closed down in recent years and many former mill towns face uncertain futures. But what seemed to concern the foresters I spoke to the most is that they have less and less opportunity and funds to create forests that will be healthy and productive forests in the future. The industry that has had defining effects on the region for most of the past century may be about to disappear. An industry and a landscape practice that has been involved in a large societal project in the 20th century is, as some foresters put it, "on its last legs." Today, as we shall see, some foresters create forests for a future they don't believe ever will come.

[81] The more technical measure is bole volume of logs in cubic meters, the so-called allowable cut. Annual allowable cut in the current forest management plan is 229 000 cubic meters of saw logs. In 2019, the Forest Products Commission are planning to harvest 177 000 cubic meters. This is not including lower grade logs and chip logs.

Associated with all this is an involvement of more and more different people in the region. Some have argued that capitalism in the 20th century is characterized by "rapid cycles of industrialization and abandonment" (DeSilvey and Edensor 2012: 465). But there are also many places where industries give way to increased involvement and new kinds of use, which are not necessarily new kinds of industrialization. More people and more different groups now lay a claim to the southwest: notably environmental groups, scientists, wine growers, people working in tourism, beekeepers and wildflower collectors, bushwalkers and mountain bikers, grey nomads and backpackers, and a growing bauxite mining venture. More people involve themselves in the region and seek to involve the region in their own lives. More people claim to speak for the forest and to promote what they consider to be best for the forest itself and best for WA.

If the southwest is seeing the demise of an industry, it may also be the demise of a mode of engagement, a management regime, a set of patterns for how to think about and interact with the landscape. It is not just the withdrawal of a regional economy based on natural resources, but the gradual withdrawal of a pattern of landscape interaction. Logging and forestry in the southwest were always about producing saw logs, but it was also always more than just extraction. I'm interested not so much in the extractive industry, but in the regime of intervention that went along with it: forestry and silviculture. What comes after logging and forestry is not entirely clear, but it is clear that it is not something entirely new. The people who call themselves foresters are witnesses to an industry and its decline, but also the continuation of

some of its central forms of engagement with landscape. If the withdrawal of the industry seems like it could soon be nearly complete, many of its underlying modes of engagement seem nevertheless to persist.

The southwest is not primarily abandoned, and the involvement of an increasing number of groups and people is among the processes that have contributed to a transition in the management regime from one where timber production was a central concern to one more oriented towards conservation and tourism. The region is also not abandoned by forestry, even if forestry is on its last legs. What remains and persists after forestry is not a void, but modes of engagement, assumptions about the landscape, and patterns of intervention. These modes of engagement are the focus of this chapter. I'm interested in what happens to nature-practices when a pattern of intervention in the environment is going away. Rather than what happens to local communities when an industry disappears or gives way to others, I'm interested in what happens to the things people do in the environment when a long-standing regime of interaction is disappearing. In other words, what happens to forest management after forestry.

These are important questions in part because transitions in regimes of environmental intervention is something happening a lot these days, or perhaps happening more rapidly and more frequently. Modernity itself is often partly understood in terms of such a transition – from 'traditional', 'small scale', 'non-state' kinds of landscape practices to 'modern', industrial, market-based modes of interventions in nature.

Now, we're increasingly seeing the withdrawal, collapse, or the very troubling persistence, of many of these modern forms. It might look like a shifting around of extraction if one could take a wide synoptic view—Swanson points out that "as former sacrifice zones become sites of conservation […] often the 'zone' is simply moved elsewhere" (Swanson 2015: 102)—but from the perspective of a single location it looks like a transition from one mode of engaging with environments to another.[82] Moreover, these landscape practices are part of wider societal projects. Timber production and forestry can also be seen as clusters of practice and thought that embody a particular vision of the state's future, and forest management as something that involves visions of a good life for people in the region. They have for most of the 20th century been part of large societal projects of prosperity and a good life, and of the sustainment of the West Australian settler state. If forestry was indeed a modern landscape intervention, then West Australian forestry at the end of forestry can show us that this modern landscape intervention consisted of several imaginaries of diversity, all of which linger in some way when the timber industry disappears. Modernity was always multi-temporal (Jordheim 2014), and forestry embodies long time scales and a kind of cyclicality we don't usually associate with modernity, at the same time as it was clearly involved in the larger societal project of the modern West Australian settler state.

[82] In Swanson's case the links appear to be very direct, between extraction in Chile and environmental protection in Japan. In the southwest of WA there isn't one distinct site onto which the ecological shadow of prosperity and a good life is cast.

I ask: what exactly is it that continues and what is changed when places shift from being extractive zones to sites of conservation? What is continuity and what is change in processes where landscapes practices involved in modern societal projects give way to something else? To answer these questions, I delve into the details, and specifically, in my case, insights can be found in the forms of heterogeneity that forest managers at different moments in time have sought to actualize in the landscape. This chapter, then is also part of an argument about heterogenetiy. I begin here to build up characteristics and parameters for forest-based concepts of heterogeneity. In chapter 6 and 7, we will see what heterogeneity can be when it is also based on fire and burning.

Diversity is a term widely used by people in the southwest. Heterogeneity is not a term they use much. I therefore aim for heterogeneity to carry a somewhat greater theoretical weight. Diversity is understood to exist along numerous dimensions. Some dimensions we will encounter in this chapter are diversity of *tree ages*, diversity of *tree shapes*, diversity of *forest uses*, and diversity of *species of flora and fauna*. The changes in forest management over the 20th century might look on the one hand like a progressive addition of more and more dimensions of diversity that forester managers have to take into account. But I will argue that there are also qualitative changes over time in assumptions about what diversity itself is, and that these are even more consequential. I use the notion of 'forms of heterogeneity'[83] to point out that when we

[83] As I argued in the introduction, in STS and anthropology, heterogeneity and related concepts have usually been defined by being other to dualism or to simplification.

think and act with diversity, heterogeneity, and other notions of mixedness there is always a qualitative aspect at play. It's not just a matter of different dimensions of the same thing, rather heterogeneity itself in each case is something specific, and could always have been something else. More concretely, "diversity" itself is not quite the same in 'diversity of tree ages', 'diversity of uses', and 'biodiversity'.

The question for this chapter is: what happens to management after forestry, what happens when a dominant form of landscape interventions is coming to an end? I argue that what persists are certain "management forms," and in my case they can be found in different distinctive versions of heterogeneity and in the tensions that exist between them.

Forest policies as visions of heterogeneity

In this section I present a portrait of each of the different forest doctrines that have officially driven forest management in the southwest over the past century, interspersed with scenes from the forests of today. In looking at forestry doctrine and silvicultural methodology—I am concerned with what forests the foresters sought to create and what landscapes they regarded as good outcomes. The ideal forests of forestry, as we shall see in the next chapter, have a lot in common with the ideal forests of fire management—especially in shared images of heterogeneity. All the different forest policies present an image of diversity or heterogeneity, sometimes as an explicit objective, sometimes as a necessity for other objectives to be met, and sometimes as a fortunate side effect of the attainment of other objectives. The

tensions and intersections between these versions of heterogeneity is the key to understanding what happens to forest management after forestry and one of the keys to understanding what might happen to the landscapes of the southwest in the future.

"Sustained yield" of timber in perpetuity was the vision the first professional foresters in Western Australia had for the southwest forests. Basically, to achieve sustained yield, no more timber could be extracted from the forest every year than the amount which is annually added to forests in the form of regrowth ("cut" and "increment" are terms commonly used). In 1921, WA's first Conservator of Forests Charles Lane Poole described an ideal version of sustained yield forestry. His imagined example was of a forester who has a 50 000-acre plot of jarrah that takes 100 years to grow to maturity. This means that the forester can cut 500 acres each year and by the time the entire block has been cut, the first block that was cut will be 100 years old again, and he can proceed to cut that block once again. "Systematic forest policy" was for Lane Poole an explicit alternative to "exploitation." In contrast to "the sawmillers and others [who] have a definite objective in view—that of getting as much timber as they can in the shortest amount of time" Lane Poole argued that "the forester must take long views, for a century may elapse between the sowing of the seed and reaping of the mature tree." Such a view, furthermore, calls for a system, a forest policy "that will ensure to future generations a sufficient supply of timber" (Lane Poole 1921: 12).

From the beginning, then, forestry was involved—and foresters involved themselves—in a societal project. The project of systematic forestry was intertwined with aspirations for the West Australian state—it was part of the state thinking about itself as a state. Only a hundred years after the first European settlers arrived in Western Australia, foresters constructed imaginaries remarkably far into the future. These were imaginaries of stability, a sustained, and self-sustaining settler state, expressing a cyclical, non-teleological temporality that was still part of the modern project.[84]

What Lane Poole imagined is very close to the concept of the "regular forest," or "normalwald," a concept of the ideal distribution of age classes in a forest, developed as early as the mid-18th century in Europe (see e.g. Leslie 1966). In principle, sustained yield gives an image of distribution of forest ages, of structural diversity at a whole-of-forest scale. Moreover, it is an image in which every forest block or patch is relationally defined—the sustainable cut of a patch of forest relies on the existence of other patches that contribute to the annual growth increment. In other words, any patch is defined by its relation to all the other patches as they are distributed in time and space. The concept of sustained yield imagines, and attempts to produce, the forest as a particular kind of heterogenous place. This is a diversity *between* forest blocks, not necessarily within blocks, and it is also only concerned with trees, usually

[84] The modern forester may be an odd kind of modern figure. It is interesting to note that the sustainment- and cycle-oriented forester appears to have been well tolerated in the earlier modern times and not very well tolerated in the neo/late-liberal world economy.

one single species. In Western Australia Lane Poole was for the most part concerned with the grey-brown furrowed jarrah trees. These were the trees with which he hoped to create a patchwork of differently aged groups of trees.

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On our day out, Noel and I also looked at some patches of jarrah forest and one place we stopped was Alco forest block a bit north of Manjimup. We were in an area which had just been harvested and burned (I had participated in the burn myself a couple of months earlier). I followed Noel over to a low bushy jarrah, what they call an "advance growth." "Everything we do is based on these little fellas," he said referring to the underground lignotubers[85] from which the advance growth came. They can stay in that stage of growth for 15-20 years until there's a gap in the canopy and they send up a dynamic shoot, Noel told me. The harvest and regeneration methods in jarrah are all based on lignotubers. If there are enough lignotubers in an area, foresters can do gap release, and if there isn't, they do shelterwood. Through gap release they cut whole groups of trees to create gaps in the canopy that will allow seedling to grow to become larger trees, in other words to be released. Shelterwood does not create gaps, but leaves trees within the harvested areas. Noel also mentioned that shelterwood wasn't really the right term, it wasn't really shelterwood in the European sense. In jarrah forest, the seedlings don't need to be sheltered, so the retained trees are there more to supply seed. When doing shelterwood, the forester who marks trees would

[85] Americans call it "burl."

want to leave behind three different kinds of trees: seed trees, habitat trees, and crop trees. And these are not the same kind of trees. Good seed trees are big trees with a large canopy that can spread seed widely, good habitat trees have hollows or the potential for hollows and often dead branches in the upper canopy, and good crop trees are straight and vigorously growing without too many branches. Futures are sought not just through patterns and patchworks but in shapes and forms of trees as well. In every little patch that may contribute to the forest-wide and future-oriented patterns of sustained yield, foresters make small decisions based on negotiations with tree form and lignotubers that don't always seem collaborative.

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I say that foresters produced diversity, but this is not to say that it didn't also involve suppressing other kinds of diversity, kinds that were less valued by foresters at the time. Foresters sought to produce a diversity of tree ages, but wanted to limit a diversity of tree shapes, for instance. In sustained yield diversity works explicitly along one dimension—the age of trees. A certain kind of heterogeneity—a patchwork of forest stands evenly distributed across the landscape and in age from young regrowth to mature stand—is here a necessary and embraced side effect of the objective of providing timber both now and in the future. Perhaps we might say it's a compromise between the objective of supplying timber for society's needs and the biological and ecological properties of living trees.

The very long time-frame is also important to point out. The vision of a distribution of forest ages throughout the forest is not just a snap shot of an ideal present state. What is more important for the foresters is that it can act as an infrastructure for the future. Through sustained yield a future is imagined where timber is needed by those living in the state, and by a particular kind of heterogenous forest a future can be created where timber is available. But more important still is that any of the future points themselves can act as infrastructures for further futures.

Sustained yield runs through subsequent policy iterations as a foundation, and the specificities of what annual cut is sustainable has long been a matter of contention. A major concern for the Department has been to try to ensure that the cut did not exceed what could be sustained in perpetuity. At the same time, over most of the past century, it almost consistently did (Calver and Wardell-Johnson 2004; Sharp 2005). The 1950s is especially interesting with regard to sustained yield as it was a decade in which foresters at several points publicly expressed concern that the allowed cut from state forests exceeded what would be sustainable in the long term. In 1953, the Forests Department write that "This year's production represents a far greater output than the forests of the State can maintain" and that the outlook for timber in the future is "far from a pleasing one" (Forests Department 1953). Similarly, in their 1959 annual report, the Department write that "By the year 2,000 A.D. with an estimated population of 1.8 million […] even if we allow for a reduction of consumption […] we should still need to provide twice our current output from State Forests. […] the future position will not be a happy one." (Forests Department 1959: 9). At such points

foresters concernedly imagine a future without enough timber, as well as a future without the possibility to create further futures with timber. They worry about a growing distance between ideal and reality, which exists in the landscape but won't be felt until the future.

At several different points in the last century, the forest areas and the maximum allowed cut have been reassessed in response to changes in demand, changes in land tenure, but also changing assumptions about how the forests grow. In some cases, the gap between the forest, "the forest" (the image of heterogenous distribution of age classes) and the future forest (which is not just an image, but exists in an embryonic state in the forest as infrastructure for its future self) could in part be mended or shortened. This could happen for instance by more forest land being added to the state forests, or by reassessments of the time it took for trees to become mature enough to be cut, either because one found that growth increment was greater than previously assumed or that sawmills developed ways to accept smaller—younger—trees.

Finally, it should be noted that sustained yield to some extent is still a vision being applied to some parts of the forest. Even when, in later years, the focus of policy has decidedly turned away from forests primarily as sites of timber yield, sustained yield is still often seen as a base condition for the logging and forestry which is carried out. For instance, for forestry to be "ecologically sustainable," it cannot *just* be based on sustained yield, but it must *at least* cut within the limits of what can be sustained in perpetuity.

A major policy change came in the 1970s with the introduction of ***"multiple use"*** forest management. In this policy moment, we can see the introduction of another layer of diversity. Now, the relevant diversity is not just in a distribution of age classes, but also a distribution of purposes. The policy suggests a qualitatively different basis on which heterogeneity is conceived of in the forest. However, we can also see West Australian forestry playing with the notion that the same practices that ensure diversity of age classes and thereby sustained yield would also be able to ensure other kinds of diversity, such as diversity of use.

In early discussions of multiple use forestry in Australia we can see attempts to conceptualize management of forest areas for both timber production and grazing (Lucas and Sinden 1970) and timber production and water yield (Crane 1958). The coordination of these activities with other uses such as recreation (Crane) and wildlife conservation (Lucas and Siden) is seen as a practical challenge. Havel (1989), in hindsight, described the emergence of multiple use policies in Western Australia as a local response to competing demands on the forest which intensified from the 1960s. But multiple use as a concept only really starts to be emphasized in Forest Department sources from the beginning of the 1970s (about a decade after the "Multiple Use-Sustained Yield Act" was passed in the US). In 1970, the Forests Department write that they have "always supported the multiple use concept with relation to forest land apart from normal forest produce aspects, [and have] given attention to the needs of the Water Supply authorities, the naturalist, the tourist and the general public recreational requirements." (1970: 11). With multiple use the

foresters claimed continuity with sustained yield and presented themselves as attentive to many different values and a wider range of forest users. With multiple use, foresters appeared to embrace the change, but there's no doubt that they were already under pressure from more people and groups seeking to involve themselves in the region's forests.

When multiple use was officially included in the Forests Act in 1976, a Western Australian variant had come to take shape: "priority use."[86] A priority use version of multiple use can be seen as one specific response to a question about commensurability. Is timber production commensurable with recreation, wildlife conservation, water production, and mining? Priority use says yes with the caveat that some of the uses may have to be kept separate. As such, across the whole forest, "The Department manages forest land for the complete spectrum of land use activities and land values" (1984: 12). But, "In practice an area of forest is evaluated and 'zoned'. Each zone has characteristics suitable for particular purposes and is allocated these priority uses" (Forests Department 1977c: 3). Priority use, crucially, is not necessarily, and in practice very rarely, single use. "The demand for each forest value can only be met by managing in such a way that each area of forest land is used for a number of purposes" (Forests Department 1977a: 1), they write in the General Working Plan from 1977, and go on to mention some of the uses for the forests: water production, timber production, recreation and tourism, flora and fauna, science and

[86] This is somewhat different than the "equal priority doctrine" in US multiple use forest policy (see Hall 1963).

education, mining, public utilities, honey production, and wildflower production. Priority use involves a zoning of the forest based on already existing landscape characteristics into areas where one kind of use or value is prioritized but where other uses are also possible and embraced. Once priority use became official policy what followed were forest management plans over the coming years that included definitions of specific areas according to their priority use and their secondary uses, and made explicit the management practices that would ensure that those uses were maintained and realized.

However, one thing that was also expressed in the priority use policy was that logging and forestry was commensurable with most other uses (as opposed to mining, for instance). An area with production as its priority could also in fact be given almost all of the other values as secondary uses. “Maximum recreational opportunity should be allowed for in a wood production priority area” (Forests Department 1981: 23), they asserted in a Forests Department plan for conservation of the karri forest, indicating that wood production wouldn’t have to inhibit recreation. With such discussions, foresters appreciate and confront the notion that making some futures can disrupt others.

In the plan, areas defined as wood production priority areas are tentatively given a 100-year rotation length. Between and among these areas, in other words, sustained yield forestry, with relationally defined patches on rotation, distributed across the landscape and in age, continued to be the approach, even while such areas could also

contribute to multiple use. This management model, they explain, would only compromise other values in a minimal way: “Following clear felling, production activities may only disrupt other uses for perhaps two periods of two years during the next 100 years.” (Forests Department 1981: 29). In the General Working Plan from 1982 they clearly state that “Forestry activities are, on the whole, compatible with the conservation of flora and fauna” (Forests Department 1982: 37), but follow up with the caveat that if the goal is to preserve “the relationship between ground flora, the understorey, and the upper dominant strata” (ibid.) logging may have to be restricted. Priority use then, also kept some areas outside of rotation. Wood production was seen as commensurable with many other kinds of uses, but not always with environmental and aesthetic values. In areas with “Flora, fauna, and landscape” as priority use logging could be excluded. Interestingly, the same source cited above (Forests Department 1981) suggests that the flora, fauna and landscape priority use is also not always commensurable with recreation, and that some such areas should be closed to all road access.

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In state forest near Collie, slender tall jarrah trees stood veiled by the airborne remnants of a prescribed burn. I could see five or six stems deep into the forest and the cleared understory now revealed slight undulations in the landscape that we couldn’t see before. This was the “Discovery Forest,” a few hundred hectares of state forest with a priority: to be a place for the Department to do educational projects and

demonstrations of forest activities for the public. But it was also meant to be a place for recreation, with marked and maintained walking trails; it was involved in a state initiative of nature-based tourism, and it was meant be a place for nature conservation—it was part of the Department's recovery program for woylies (*Bettongia penicillate ogilbyia)*, a critically endangered small marsupial. Thomas, the fire manager I was shadowing, spoke passionately and at length about the virtues of sustainable forest management. As the sun set through a low hanging smoke haze, we paused and looked out across the recently thinned and even more recently burned patch of jarrah forest. It was Thomas' own project, he had planned the thinning operation where they had removed most of the smaller trees, and he had prepared the prescription for the burn. Now we were left with generously spaced tall jarrahs with wide canopies that stood as ghostly figures in the haze, along with the half-burned logging remnants of branches and tops on the forest floor. It might look a bit rough right now, Thomas conceded, but in a couple of decades, he assured me, it will be a magnificent forest. He could already imagine—he said in a tone that suggested to me that he was at the same time humble, proud, and anticipating nostalgia—one day bringing his son out here and being able to tell him, "I did that."

This is a forest that is there for the sake of future generations, but not one that is there for the timber industry, for foresters, and for the timber needs of the state. The uses imagined for the forest—recreation, appreciation, education, conservation—is about heterogeneity. It is about landscapes with a variety of features thought to lend themselves to a diverse array of different uses. A forest that looks a bit rough now,

but will be magnificent in the future is about heterogeneity. What Thomas sees in the forest and how he shapes the landscape are tied to visions of heterogeneity that are both inherited from earlier times and affected by his experiences in the forest. When Thomas plans the harvest and when he starts the burn, he assembles heterogeneities in thought and he affects heterogeneities in the forest.

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Priority use embraces a variety of different uses and users, but these are neither neutral nor innocent delineations. Recognized forest *uses* implicitly expressed which forest *users* were recognized and which were excluded. Recreation as a use, for instance, inscribes a dualism between work and leisure activities, a dualism in which some aboriginal landscape practices may be an awkward fit. All the uses moreover, were distinct, separate, clearly delineated uses mandated by the state. What the state recognized as aboriginal ways of using the landscape weren't included in policies until later (see chapter 2), and were then included as 'aboriginal cultural heritage' or as 'customary activities', as defined by the state. The definition of uses express a vision of the settler state, and of what the forest should be in the settler state. It includes a vision of a good life for people (at least for those that are recognized as users) in the region, a life that includes both work *and* recreation, where the forest could realize the needs of the state—timber, water, and public utilities—and the desires of a certain strata of the community—recreation and tourism, education, appreciation of flora and fauna. The forest could also increasingly be a place for

Australians to express who they saw themselves to be, for instance through flora and fauna icons that forest management now could present themselves and the state to be stewards for.

Priority use, just like sustained yield, give us an image of heterogeneity: "Ultimately the pattern of forest land use will consist of a *mosaic of areas*, each being *managed according to its inherent environmental capabilities*. Some areas will provide few resource values whereas others will allow a multiplicity of uses." (Forests Department 1976: 32, my emphasis). The vision of heterogeneity expressed in the concept of priority use is one where the heterogeneity of actual forest structure—the distribution of trees of different ages, the heterogeneity of "sustained yield"—is overlaid by a kind of virtual heterogeneity of categorization which aspires to be a link between landscape characteristics, the (mostly societal) uses that certain characteristics lend themselves to, and the practical management interventions that are regarded as suitable to strengthen that link and to make manifest in the landscape the virtual heterogeneity of categories.

Compared to sustained yield, priority use represents an addition of more dimensions for diversity, but it also involves some qualitative shifts in heterogeneity itself. There is now something inherent in the landscape, now diversity is seen to exist in the landscape itself as an affordance (cf. Ingold 2018), or a potential that can be brought out by management practices. The landscape is defined as heterogenous in a few different ways. First, there is a heterogeneity of enduring landscape features or

"inherent environmental capabilities" (as cited above) that make certain areas lend themselves to certain kinds of use. Then there is a heterogeneity partly made by illocutionary speech acts (Austin 1962), performatives, or inventive definitions (Holbraad 2012): claims that shape the landscape in their image. Having proclaimed an area as suitable for recreation, for instance, can change what people see and what they do when they encounter that place. These proclamations are part of the apparatus for actualizing the heterogeneity that forest managers found in landscape characteristics that lend themselves to certain kinds of use. Together, they express heterogeneity as something that is neither wholly external nor wholly imposed. It is neither simply found, nor can it be simply produced. Diversity must be drawn out and given shape, realized from potentialities. It is not a necessary side effect of reaching another goal, it lies in the negotiation between social desires and landscape features. Priority use, in sum, embodies a combination of something relationally defined, something defined by inherent characteristics that act as dispositions, something performatively defined, and something created.

Another important shift in policy occurred in the early 1990s with the introduction of the concept of ***ecologically sustainable forest management (ESFM)*.** "Sustainable" was a concept that foresters long had used, but ESFM as its own thing was something new. ESFM would likely have been influenced by external processes on several different levels—from the near global popularity of the concept of sustainability and sustainable development following the 1987 Brundtland Commission, to the process surrounding the federal Australian Regional Forests Agreements (RFA), down to

pressures from the environmental movement locally in Western Australian, and an urge for renewal that came with the organizational change that turned the Forests Department into the Department of Conservation and Land Management. In the Forest Management Plan for 1994-2003 ESFM was mentioned in the vision statement, but the preceding years' plans show that the concept was some years in the making. Reading ESFM as a claim about of heterogeneity, there are two main traits that are worth pointing out: more solidly defined areas, and what I call safeguards. Together they contribute to an image of heterogeneity as something which is inherent in the landscape and at risk of being lost.

Leading up to the ESFM doctrine, in the late 80s and early 90s, management plans (Department of Conservation and Land Management 1987a, 1987b) gradually introduced more solidly defined areas. Instead of being state forest that was zoned into priority management areas, now areas were given a more definitive definition as "nature reserve," "national park," "conservation park," and "timber reserve," among others. These, in effect, were claims about something enduring both in the past and into the future. Many areas that were previously state forest with a "flora, fauna, and landscape" priority use—these were non-permanent zoning definitions that were open to being changed—would become "nature reserves" or "national parks"—definitions that were meant to persist regardless of the needs and wants of society (the changing needs and wants of society being one of the main reasons why they should be permanent). Now, rather than a response to societal use and natural propensity, they would constitute a claim about something enduring and inherent—about something

that had been the way it was for very long and ought to stay that way indefinitely. From sustained yield, foresters got certain standards of time, for instance a century, the prescribed length of a rotation. With priority use, a near future is a relevant time scale, the time scale at which uses can be fulfilled for society as it is in the present, the scale at which the use-potentials within existing landscape characteristic can be realized. Neither of these are the time standards of ESFM. The century, especially, is not a very relevant duration in in this most recent policy moment. Here, instead we find an orientation towards on the one hand a variety of short durations—key species' life spans—and on the other hand a duration we can call 'the indefinite'.

In addition to their more solidly defined areas, ESFM also focused on limiting the possibly harmful effects of logging and related forest activities. This would be relevant mostly in the areas that were not given more definitive definitions, but stayed as multiple use state forests. We might see safeguards as caveats to sustained yield and multiple use. We can also see it as an attempt at limiting the occurrence of activities and practices that are not conducive to biodiversity (such as muddy tires that spread phytophthora). Safeguards came in the form of a fine-scale set of conditions. For instance, in 1992, proposals to amend the 1987 management plans specified conditions concerning "habitat trees" and forest structure. They write: "The multi-aged structure of the jarrah forest will be maintained. Mature trees will be retained on all areas harvested for timber." (Department of Conservation and Land Management 1992: 13). Based on an assumption that "Forest structure is a key determinant of biophysical complexity, and therefore of ecological diversity"

(Department of Conservation and Land Management 1994: 8), forestry activities should now always ensure "a multi-aged structure of the [jarrah] forest in all areas" (Department of Conservation and Land Management 1992: 14). We can see this as a safeguard against practices that could otherwise limit and compromise diversity, such as practices that lead to homogenous forests or juvenilized forests with few mature and senescent trees. Other safeguards included regulations on logging in stream zones and regulations specifying that gap sizes should not be too big and that there should be strips of undisturbed forest in between gaps. More conditions would follow in subsequent years, such as Fauna Habitat Zones to be retained within production forest and restrictions on logging at times of the year when the soil is wet.

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The first thing foresters do when planning, is to find areas that are suitable that they can harvest to meet the timber demand. A suitable area today would always be one that has been previously harvested. Back in Lewin forest block, for instance, there were many patches that had been cut with a selective cut (i.e. not clear felled) in the 1960s. After such suitable areas have been identified, harvesting coupes are planned through a long process of checks. In Noel's white Toyota at the edge of the forest block, we perused the long checklist they have to go through for every harvest plan. It spanned multiple pages and currently consisted of 86 points. There were points regarding biodiversity, points for dieback, points for water, points for old growth, for cultural heritage, and several other categories. Going through a point nearly always

involves checking maps and databases, but in some instances, it also involves going out and doing observations and surveys in the field. In this particular block the process of going through the checks had led them to find some old growth forest that hadn't previously been mapped. Through map checks and field surveys four patches in the northern part of the coupe had then been excluded from harvesting—17 hectares in total that for some reason hadn't been logged along with the rest of the coupe in the 1960s. We drove up past one of these patches. It didn't look dramatically different from the forest that was being harvested. It had fewer trees, and some of them were larger; fewer trees were in the young adult stage, fewer were straight poles, and more trees were on a slant, more trees were senescent with dead limbs in the upper canopy. Not far from these mature patches were other structures: clearfelled patches with trees of modestly varying sizes, some thinned patches that looked neat and tidy, some patches where the karri regrowth and the understorey almost blended together in a three-meter-tall wall of vegetation, and some older re-growth where the canopy only fanned out some 40-50 meters above our heads.

Most of the southwest forests, regardless of tenure, is divided into named forest blocks. In those parts of state forest that are open for logging, there are further divisions. For forestry purposes, blocks are divided into coupes, and coupes divided into compartments. In Lewin coupes 5 and 6, the compartments were mostly around 20 hectares in size and all different in shape as they intermingled with what the maps helped us see as stream zones, road side exclusion zones, temporary exclusion zones that separate compartments, areas defined as old growth, and various other excluded

zones, such as diverse ecotype zones and fauna habitat zones. I imagined the harvestable spaces to be the shapes you might get if you started out with squares and then sliced away everything that was defined as some kind of exclusion zone, which just as often gave curved and twisty incisions as straight lines. Compartments formed the harvestable space between several types of retention: those squares, blotches, slivers, and strips where forest structure would be intervened with, shaped, and managed, both violently and with care.

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The policy moments each suggest something fairly clear about forest heterogeneity. The kind of logging and forestry actually carried out in each period doesn't always align with what is imagined. According to Sharp (2005), as well as several I spoke to during my fieldwork, juvenilization has too often been allowed to be the outcome. What seems to be suggested by several critics is that reality lags quite far behind the ideals expressed in policies. Here, just like in the 1950s, there are worries about the distance between the forest and "the forest," between actual and sought for diversity. We can look at safeguards as ways of making forest activities less harmful, but we can also see them as a way to manage the distance between the ideal and the actual forest.

With ESFM, ecological diversity becomes an objective in itself, and it explicitly becomes something *to conserve*. Both the more solidly defined areas and the safeguards were geared towards conserving diversity. What is interesting for me is

not so much that ESFM is a turn towards placing greater value in something ecological alongside forest products, but that it is a shift in relation to heterogeneity. Heterogeneity has become an end, no longer an integral means for a different end (for timber yield to be sustained in perpetuity) or an embraced necessity for a suitable negotiation between environmental characteristics and society's needs (as in priority use). It is no longer an embraced side effect or a necessity of responding to what people want and value. It now becomes something that should be sought and promoted for its own sake. Furthermore, diversity becomes something that can be lost, or diminished. No longer something that is produced (as the diversity and distribution of age classes of sustained yield) or something that is made to emerge (in the relation between natural characteristics and societal needs, as in priority use), diversity is now something that is inherent and that could be compromised and put at risk.

There is a rub, though, or a tension. With ESFM, because it is a policy which still coexists with—which builds on and adds to, rather than replaces—sustained yield and priority use, forest policy now speaks with two voices. One voice that seems to say that we must make sure that our activities in the forest are not harmful to the existing diversity, and another voice that says that diversity can be promoted and maintained with practices that intervene with the underlying conditions of diversity, such as forest structure. The question is whether diversity is something that should be attained or maintained—seemingly a small nuance, but one with big implications.

A related tension in this policy moment lies in a distinction between diversity as a kind of sum (a collection of individual entities or happenings, the sum of many individuals) and diversity as an emergent quality (a higher-level relation, a whole that is bigger than the sum of its parts, the *relation between* rather than the *sum of*). For an analogy we can think of a gathering of individual people versus a culture. These two differences—from attainment to maintenance and from emergent to sum diversity—are perhaps the most important qualitative shifts in heterogeneity.

In some cases, and with some caveats, the methods to attain/maintain ecological diversity in ESFM are regarded in part as the same as those with which one could attain sustained yield. What can be managed practically in both cases is forest structure, the distribution of older and younger trees within and between differently sized patches. In sustained yield they had to attain a diversity of forest ages in order for the forest to be an infrastructure for the future. In ESFM one must *maintain* structural diversity because it is seen as a necessary condition for biodiversity. But ESFM also embodies the assumption that activities that interfere with the forest are potentially harmful. Logically, then, if you have a forest that is not already thought to be very diverse, forestry activities aiming to promote diversity would be simultaneously helpful and potentially harmful. And conversely, if you have a forest that is already thought to be quite diverse, then forestry activities might at best be not necessarily harmful. Moreover, in the tensions of current forest policy, diversity as sum and as emergent meet: forest activities can help attain diversity as an emergent quality (put bluntly, one clear-felled patch in an otherwise non-logged forest would

make it more diverse on this emergent level), even while it can threaten the maintenance of diversity as a sum (a clear-felled patch is a harmful event in itself and as an entity among other entities it is a non-diverse patch, and many non-diverse patches make a non-diverse sum). Hence, if people come to see diversity as inherent and as an sum phenomenon then there would be very little room for active forest management, regardless of timber production. If, however, diversity is an emergent phenomenon that one can not only maintain but *attain* as well, then this might open up for active management.

One way to see forest management today is as the coexistence of the forms of heterogeneity expressed in sustained yield, priority use, and ESFM. Assumptions from all three remains to some extent, often in tension. Many foresters regard forestry to be on its last legs. The two traits of ESFM—more solidly defined areas and more safeguards, where heterogeneity is inherent and at risk—served as a conceptual ground for the Protecting our Old Growth Forests Policy of 2001 which put an end to logging of all forest define as old growth and came with an increase in areas in the reserve system. As mentioned, the majority of the southwest forests are currently in various kinds of reserves—more solidly defined areas—where active interventions of the kind that manipulates forest structure are not permitted. Here, management today, lies for the most part in practices we can sum up as protecting and assessing (and it would be no great and original insight to point out that assessments breed more

assessments[87]). In protecting, I would include both such things as spraying for weeds and baiting for foxes and cats and activities focused on visitors and users of national parks. In the latter case, protecting lies for instance in creating visitor infrastructure that channels and focuses use in limited areas. That this is the majority of forest management is likely in part because of a lack of funding (as for instance Sharp 2005 argues), but it is also because in the version of heterogeneity expressed in ESFM, it is quite unclear what a positive interventionist kind of management might look like, if that would even make sense. Prescribed burning, however, is the very notable exception. Here, an understanding of heterogeneity as something emergent is a lot more pronounced. To be sure, prescribed burning is about protecting, but it is also a landscape intervention at a whole-of-forest scale that seeks to *create* forms of diversity.

In areas still open for harvesting, forest structure is altered on a relatively fine scale, and retained—left alone—on a similarly fine scale. The distance is never far from an area with one kind of structure to an area with another—neither in a car, on foot, for a

[87] Of the 19 recommendations in the mid-term review of the latest Forest Management Plan, i.e. a review of the overarching planning and policy document for the southwest forests, very few concern active interventions in the landscape. In fact, 8 of the recommendations in the review explicitly recommend more reviewing to be done, with phrases such as "measurement protocols be reviewed" and "performance targets be reviewed." Nearly all of the remaining 11 recommendations concern further reporting (e.g. that the Department present a progress report on the implementation of the recommendations in the review), slight shifts in prioritization (for instance that the Department prioritize reporting on carbon stores so that this information is available for the next Forest Management Plan), or something ongoing (e.g. "that there is continued focus of research towards understanding the implications of a drying climate" and "that the Department continues to manage the proposed formal reserves consistent with their intended reservation purpose"). The only recommendation that can conceivably point towards practical interventions in the landscape is a recommendation that the Forest Products Commission seek out opportunities to utilize more low-grade timber (so called "other bole volume," timber which is below first and second grade saw logs).

seed, or a for a flying ember. Zones and compartments form mosaics of forest ages and a patchwork of definitions on the basis of discovered and sought for characteristics. Here, in other words, several forms of heterogeneity come together. In the conception of heterogeneity as inherent and at risk, the available compartments are a loss, but hopefully—thanks to safeguards and checkpoints—a loss that one can afford to take on. If heterogeneity is an emergent quality, however, the compartments may represent a slight qualitative shift in landscape scale heterogeneity. In the latter case, we must consider the outcome as something positive—that is, as something that has been added to the world—and something ambiguous—in the sense that no shift promotes diversity in and of itself, but is dependent on other nearby patches.

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We're back in Graphite forest block where Noel and I continued on to a patch which had been harvested and replanted the previous year. Graphite forest block also had a folder which Noel had brought along, an even thicker one that the one for Lewin. Folders embody sought-for diversities, they keep the forest at a distance and they keep the forest suitably close. Folders can also be seen as messengers that help people connect the ideal and the real[88] or as material circuits through which assumptions are transmitted through time. Coupes with a longer harvesting history have thicker folders, I learned. We stepped out of the car and Noel pointed out some karri

[88] Folders are also an artifact of a long stability of tenure and a bureaucracy interested in recording elements of its own past.

seedlings. They were between half a meter and a meter high. The understorey was also growing. Noel told me that there hadn't been any studies showing any loss in flora species from karri harvesting. But he also added that there hasn't really been much research on this, so he couldn't tell me conclusively that harvesting doesn't harm understorey diversity. Some forms of heterogeneity are maintained and attained by management and retention, others are not very well known. For those, we can hope.

We could also see some retained trees for which the foresters had a particular intention. These large trees stood out prominently in the otherwise open area. They were meant to act as "habitat trees" or "secondary habitat trees," trees with hollows that many different animals use as their habitat. To retain trees for this purpose was a fairly new practice, only implemented a few years ago in the karri forest, and in the late 1980s in the jarrah forest. Many of the trees that forest managers define as habitat trees have hollows where animals live, but the habitat tree is also a figure that transmits the thought patterns present in multiple use and more clearly dominant in ESFM. It was with these semi-solid patterns of knowledge that Noel could point towards the trees and emphasize the epicormic shoots growing along the trunks, taking advantage of the opening of the canopy. He explained that some of these new shoots would become branches and when the young regrowth grew taller, some of these new branches would be outcompeted and die, and thereby form good hollows for birds and marsupials. Primary habitat trees would already have hollows, while

secondary habitat trees will form hollows in time and become habitat trees in the future.

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What remains of forestry in the karri forest happens at the intersection of heterogeneities. Inherent diversity exists alongside attained diversity. Safeguards to ensure that interventions are not too harmful exist alongside interventions that create a patchwork of small areas with differently aged trees. The possible tension between diversity as inherent and at risk and diversity as something that can be promoted and produced seems to be dealt with by shifts in scale. Diversity is attainable at the level of forest structure (i.e. distribution of trees of different sizes) and at the mosaic level, i.e. between patches. But it is inherent and to be protected at both a larger scale—the whole of forest scale where a certain percentage must be held in reserves in order for logging to be a loss that one can afford—and a smaller scale—the within-patch scale where habitats and understorey flora are elements at risk. The level in between, where a vision of diversity as emergent and attainable persists, is a mid-level both spatially and temporally—it's the level of the mosaic and the regime.

Moreover, forestry, as West Australian practitioners imagine it, is still decidedly cyclical (it doesn't exhibit the kind of linear temporality of modernist resource frontiers). Noel and others imagine harvest aiming for regeneration aiming for a future harvest aiming for regeneration aiming for a future harvest, and so on. When a patch of karri is clear-felled, it is imagined by foresters ideally to be a stage in a

cycle. The complication at the moment, however, is that few people believe there will actually be a future harvest. Noel didn't tell me so explicitly, but Henry did, a highly respected retired forester I interviewed in Manjimup. Yes, they would regenerate for a future harvest, he told me. But he didn't think anyone in the Forest Products Commission truly believe that this will ever happen, that what they are harvesting and treating for regeneration now will ever be harvested again[89]. Henry's worry was that there might come a time in the future when timber is wanted again more than it is today[90], and if you treat the forest without a future harvest in mind, he argued, you might exclude that possibility. And this was based on the idea, which he holds to, that regeneration for production would also create forests suitable for other uses. For some, the after-ness of forestry coexists with a faint possibility of return.

[89] There are notable precedents for turning karri regrowth into reserves or national parks, for instance Boranup forest in Leuwin-Naturaliste NP, or areas in Shannon NP.

[90] Several foresters and forest managers I met made arguments about something akin to what academics have termed "shadow ecologies" (Dauvergne 1997; Swanson 2015), specifically that placing more and more forests in Western Australia in reserves leads to greater pressures on timber resources elsewhere, for instance in Indonesia, where the methods are quite possibly less sustainable and also less just. Others indicated a similar process surrounding a shift in building materials—extraction of other (less sustainable) materials elsewhere enables the environmentalist shift in the southwest forests.

Fig. 9. “Habitat trees” and “secondary habitat trees” in a clear-felled compartment in Graphite forest block. The tree on a slant right of center is intended as a habitat tree, while the four trees to the left of it in the picture may become habitat trees in the future.

The good, the bad, and the ugly—compromises and a biased heterogeneity

It took some time before I came to see forestry as more a matter of choosing which trees to leave in the forest than a matter of choosing which ones to remove. This as a very pronounced feature of forestry in the jarrah forest, more so than in the karri forest. The jarrah forest is structurally diverse at a fine scale, not just between patches, but just as much within them, often to the extent that distinct patches don’t make that much sense. As we saw above, forest policy embraces the “natural” multi-age structure of the jarrah forest. In practice, in fact, because of distinctive features of jarrah trees as well as well as external constraints, it seems difficult to create a jarrah

forest that is *not* structurally diverse. What is produced, however, may not be the right kind of heterogeneity for everyone.

In Alco forest block, where Noel and I talked about lignotubers, the result of their harvest, according to Noel, was a bit of a compromise. It was not quite gap release and not quite shelterwood, but a kind of selective harvest. The main reason for this was the lack of a market for logs that aren't good sawlog quality, a lack of a market for "the culls." For the sake of regeneration, they would have wanted to take away more culls, but it would have had to be at an expense. Here, in other words, they mark the trees they want to retain and then a contractor comes in and removes the ones that the mills can take, and in many cases today this leaves leftovers, trees that the forester doesn't want to keep because they inhibit regeneration and that the mills don't want to take because they wouldn't yield good enough saw logs. Good, bad, and ugly trees give another dimension for differentiation. These trees are somewhere in between being good and bad in themselves and good and bad relationally. They are not inherently good or bad so much as enduringly good or bad, for instance because of a market acting as a persistent constraint. They are good and bad relationally for instance when there is an overabundance of trees that would have been good trees in other situations. A forest with only habitat trees may also be an infrastructure for a future with hardly any.

I learned more about jarrah silviculture in practice a few weeks later when I spent a day in the jarrah forest further north with Alfred, a forester from the Forest Products

Commission in the town of Harvey. Alfred's job for the day was to seed log landings to rehabilitate areas that had recently been used to haul away logs. We started early and were in for a very long day. Alfred was concerned there might be some rain in the afternoon and as the fertilizer would turn into a mush that was impossible to work with if it got wet, he wanted to get as many landings done as possible before that happened.

Catterick forest block was the first one we worked on. If the karri forest seemed to be a place of distinct patches, here I saw something very different. In between the landings, where Alfred walked around with a contraption strapped to his torso with which he spread a mixture of fertilizer and a locally specific seed-mix as a fan out in front of him, I asked him to tell me about what kind of harvest they had done in the different places. In Catterick, he described the forest as "scruffy," revealing at the same time that he could imagine a forest that is more neat or more tidy. The scruffy forest had trees of different ages and sizes and an understorey dominated by banksias and grass trees. They had done a harvest here in 2015, and it was burned in the spring of 2016. I asked Alfred about what kind of harvest or treatment it had been, expecting that it would be something close to the same treatment across a coupe, or at least across a compartment. He explained that it wasn't like that at all. Instead it was a mix of different objectives, some thinning that transitioned into some gaps, interspersed with some shelterwood. As Alfred told me, the foresters **"mark the trees according to how the forest presents itself."** It wasn't that they had a plan to cut this block with this or that treatment. Instead they look at a forest with a view to promoting

regeneration towards a future harvest. If there are good crop trees in an area this might mean thinning, if there are many trees with strong lignotubers they would try to make gaps in the canopy, and if they come across an area with few seedlings and young trees, they would try to retain mature trees with a wide canopy that can spread seed widely to establish a new cohort of young trees. But at the end of the day, Alfred has to record treatments in *silrec*, a software where they record all the harvesting and treatments, and to do that he has to make some cuts here and there and record a patch as shelterwood or another patch as thinning, even though it's messier and more fluid on the ground. Shelterwood, gap release, and thinning are principles, but they are also often names assigned to outcomes that foresters are well aware only partially fit with models and representations. Patches exist on maps and computers, but in many areas in the jarrah forest, structural diversity is much more continuous and gradual. Most of the forest is a messy sort of situation, nothing like a homogenous stand of crop trees. It could hardly be further from a plantation.

In Catterick, as in many parts of the jarrah forest, they try to **"make the best out of a bad situation,"** as Alfred put it, and as he said that, I caught myself thinking that a messy heterogenous sort of forest actually sounded pretty good. But it may not be the right kind of heterogeneity. Good and bad is a parameter not just for trees, but for heterogeneities as well. The "bad situation" involves several elements: dieback, coppice control, a lack of a market for small logs, and fire. The bad situation doesn't lie in messy heterogeneity in itself, but in the conception that it is a kind of swayed heterogeneity and in situations that block or inhibit valued kinds of change.

The bad situation lies in areas of the forest infested with dieback where foresters let sawmills take what they can and then retain around 30 % of the trees for an uncertain future. It lies in patches of small multi-stemmed jarrahs that foresters feel are “too crowded” and where they cannot afford to do coppice control. It lies in patches that couldn’t be thinned as much as the foresters would like due to a lack of markets for smaller logs. And it lies in areas burned too severely, or not burned at the right time, because of pressures on Parks and Wildlife to catch up on all their burns. Alfred showed me examples of all of these situations. He showed me dieback areas where there isn’t much to lose but also not a whole lot they can hope to accomplish. He showed me multi-stemmed young tree-clusters that he feared were “locked up” because of repeated disturbances of the wrong kind over the years. We walked through a dense stand that Alfred had tree marked himself, and which he admitted easily could have been thinned more, and we saw burned patches that Alfred referred to as having been “cooked.” Foresters tree-mark according to how the forest presents itself, but they want Parks and Wildlife to burn according to the most sensitive objective and this was not what was done in some of the cases Alfred showed me. It could have been the outcome of a compromise, where a less than optimal burn was conducted on a less than optimal day because Parks and Wildlife felt pressured to get the burn done.

In many parts of the jarrah forest, the outcome of logging and forestry activities is a fine-grained patchiness, but not always the kind that is desired. It is the outcome of compromises, both in relation to the current state of those parts of the forest that are

available for logging—when tree marking, they are at the mercy of the forest, a place of fickle lignotubers and many less than optimal interventions over the years—and in relation to other constraints, such as the priorities of fire management, and the market for jarrah logs. Foresters negotiate with fire managers and lignotubers, saw mills, pathogens, and coppiced trees. These kinds of compromises can be seen as producing a collection of compromised patches. But the delineation of patches is often an afterthought, a post-hoc simplification. The jarrah forest, for the most part, is not a forest made up of units, but instead of gradual transitions. It inspires me to think of an image made not of pixels, but perhaps something more like blending brushstrokes. In these forests, moreover, heterogeneity may be understood as something that has a tendency. What is produced from all of these compromises is a kind of biased heterogeneity. Structural diversity is everywhere, but it is swayed, for instance towards patches with an overabundance of young trees ("juvenilization") or patches with a tendency towards relatively few strong lignotubers.

Another aspect of good diversity for foresters is that it needs to be a structural diversity that is in motion. After forestry, foresters in the jarrah forest are left with a "bad situation" that they have to "make the best of." Making the best out of the situation for people like Alfred is not primarily about providing saw mills with enough logs, but rather about making interventions in the forest that promote regeneration. A good jarrah patch is one that is growing, where trees are in a process of changing for the better. A bad patch is for instance one that is "locked up," or one that finds itself in a state where the absence of intervention is thought to probably

inhibit growth at the same time as the intervention they would like to make is not currently feasible. A good jarrah forest is not just one that is diverse, it has to be diverse in a certain way: it must be not too biased and not arrested in a static state.

Is diversity in this case something that can be attained, or is it something that must be maintained? In the shade tolerant, lignotuberous jarrah forest, diversity at a fine scale seems just about inescapable. At this scale diversity is also nearly continuous. In other words, it is not a diversity that is composed of units. But valued kinds of diversity are often something that is *not* currently present in the jarrah forest, which is in part due to past forest interventions. In other words, the right kind of diversity is not always there to be maintained. But if it's not something to be maintained, diversity is also not easily attainable. It might be attainable in principle, but not possible in practice. If we wanted to put numbers to the "bad situation" that Alfred and other foresters seek to make the best of, we can find some in the draft mid-term review of the current Forest Management Plan where it is reported that in 45 percent of the harvesting done in the jarrah forest in the years 2012-2016 the silvicultural objectives were not met and that the outcome was instead "a selective harvest where insufficient trees were removed to meet the prescribed standard" and that another 34 percent of the harvesting in these years was not complete at the time of the review but also "unlikely to receive treatment to achieve objective" (Conservation and Parks Commission 2018: 53-54). [91] These numbers suggest that it is only in about 20

[91] It might be noted too that the report blames the lack of markets for lower grade timber for this situation. The lack of markets causes unwanted trees to have to be left in the forest which then come to

percent of the areas they harvest in the jarrah forest that foresters are able to do what they think is the best for the forest. What Alfred suggests, however, is that they *are* able to make what they regard to be positive interventions nonetheless.

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Forestry today consists of ***modest interventions in landscape structure*** carried out in smaller and smaller parts of the forest. Increasingly, foresters produce forests in ways that are dissociated from production for a market. In the karri forest, it involves creating patchiness aiming for a future harvest that will likely never occur. In the jarrah forest, it involves modest interventions with many constraints (the market is both enabler and constraint), that seek to nudge the forest towards something positively swayed and still in motion, but often turn out less than ideal. Alfred and Noel make modest interventions with limited confidence that they will turn out as intended. But they are still doing it, and doing it wholeheartedly. Alfred and Noel represent a change in visions for the future without it amounting to thinking in terms of a complete breakdown. We shouldn't take forestry's place today in Western Australia to be an image of the collapse of grand modernist aspirations, but perhaps an example of how to still live and work with one particular thwarted and frustrated modern formation's legacy and remains. Alfred and Noel have to continually confront the non-ideal outcomes of their interventions. But they also have experiences of the

inhibit regeneration. They point to what appears to be the immediate cause, then—why the trees we have in our forests are unwanted—rather than the underlying causes—why the forest currently is a place with an overabundance of unwanted trees: past logging and forest interventions, bushfires, and drought.

forest from a different time—before the majority of their interventions didn't go as planned; a time before climate change, the combination of past interventions, and the involvement of the environmental movement and other groups had so drastically affected what could conceivably be achieved. Foresters today have different ideas of what is possible in practice but many of the same visions of what is achievable in principle.

One retired forester I interviewed on two different occasions, Ian, imagined an ideal forest to be a place that was burned on rotation, that was thinned, and that was open to several different kinds of use. His ideal forest embodied a genuine commitment to sustained yield and multiple use and their forms of heterogeneity. When it comes to ESFM however, with its solidly defined areas and its assumptions that diversity is inherent and something to be maintained, Ian and many other foresters were not nearly as committed. But even so, foresters have taken active part in the changing policies over the years and in their developing visions of heterogeneity. As we saw above, elements of ESFM existed in a more embryonic stage in multiple use and multiple use was presented by foresters at the time as being a continuation of something they had already seen as possible and achievable with sustained yield. Areas defined by inherent characteristics to be maintained and protected in perpetuity were built on a foundation made from priority use and its assumption that certain parts of the landscape already had characteristics that would lend themselves to certain kinds of use. It is not a stretch to say that forestry in Western Australia has, inadvertently, participated in laying the grounds for its own underminement.

The current time is a decisive moment when "management" is formed in the tensions between production and protection, between different visions of heterogeneity, and between landscapes and landscape features as something to attain or maintain. Forest management after forestry is shaped in the interplay between sometimes complementary and sometimes competing visions of heterogeneity. In a situation involving the withdrawal of an industry and the increased involvement of many new people and groups, management forms that arose from forestry continue to guide the ways many people seek to involve themselves in the environment and the way they seek to shape the forest.

If forestry were to continue dissociated from production for a market, as forest management, it seems it would have to lie in manipulating structural diversity to attain certain forms of heterogeneity. But there is good reason to believe that forest management now has become something else, and that manipulating structural diversity will not be in the future for forest management in WA. The assumptions of ESFM, where heterogeneity is inherent and at risk, may preclude active manipulation—diversity can be maintained, but not attained or produced. But in WA, there is also good reason to believe that forestry's forms of heterogeneity will carry on in other practices. Certain forms of engagement with nature persist at the tail end of a management regime, even if the overt practices they used to be geared towards go away or drastically change. As we shall see, in the southwest these forms are carried on most strongly in prescribed burning. Prescribed burning shows us that there are elements of forest management that can be almost completely dissociated

from production.[92] But more than that, prescribed burning is, overtly, more and more dissociated from forestry as well, and that is precisely why it's important to realize that forestry's figures of heterogeneity, assumptions, and styles of thought are still among the primary patterns in which managers aspire to shape the forest.

The different policy moments are entwined in larger societal projects and they involve visions for the future. One transition we have seen is from sustained yield's hundred-year horizons for a continuing state to today's modest interventions that create infrastructures for a future that they don't expect will ever come. Another is from a whole forest managed actively in an integrated way, to more and more areas to be protected. Meanwhile, perhaps the most important future imagined in the moment of climate change, environmental degradation, and also ESFM is the future we most of all want to avoid—a future of loss, where diversity is inherent and at risk and the best outcome one can hope for is to limit the loss. Ultimately, it is a future we must try to avoid, but whose assumptions about heterogeneity compel us to avoid in other ways than by intervening.

[92] Prescribed burning today is not in any significant way tied to any market. It was tied to a market in the past when protection of timber was a central motivation and it might become tied to markets again in the near future, for instance a market in carbon credits. The withdrawal of industries seems often to be intimately tied to neoliberalism: opening up of markets enables extraction to be moved around to where it's more cost-efficient. Here, prescribed burning stands out. The burning done by Parks and Wildlife is a public service. It is organized locally and regarded officially as a response to a communal need.

Chapter 6—Taming and nurturing heterogeneity

At every one of the Parks and Wildlife offices I visited in the southwest—which was nearly all of them—I would at some point, usually not long after I arrived for the first time, be shown maps. At prominent places in important rooms enormous maps often covered most of the wall. They showed patchworks, the district sliced into blocks, squares, and slivers, often in different colors. One common kind of map would show the district in question in a neutral-looking light blue, a typical map color, but with various shapes drawn onto it in red sharpie to mark where there had been fires in the current season. This map would be interacted with as more and more red shapes were added in an unpredictable distribution throughout the fire season. Another map I usually encountered in the district offices was the fuel age map, a colorful patchwork where squares, blotches, and other shapes had different colors to indicate how long it was since they were last burned. We would stand, point, and discuss; myself and the fire managers I was there to meet. For them, it was clear that these maps were a key element in making sense of fire in the southwest. They would allow fire managers to tell me about what they had achieved in their burning in the recent years and where they needed to focus in the coming years. Sometimes the maps were catalysts for worry. In Blackwood district, for instance, the maps were far more monochrome than what the fire managers would like, dominated by the same beige color that represented all fuel ages of 6 years or more. Fuel ages from 1 to 5 years each had their own color, subtly suggesting that uniformity happens by itself if they leave the forests unburnt, but also that fire danger is heightened after only a few years. One fire

manager I interviewed put it like this: “you don’t have to be indecisive for very long before a mosaic becomes a continuum.”

This fire manager is part of quite an unusual kind of management entity, one where people don’t seek to simplify and impose order, but that actively and explicitly embraces certain kinds of heterogeneity. Uniformity can be dangerous; heterogeneity is both appealing and critical. Fire managers are fascinated by the possibilities that lie in certain heterogeneous forms—especially a whole-of-forest mosaic of fuel ages, within-burn patchiness, and what I will call “favorable adjacency”—but also driven by worry about what the absence of such heterogeneities can bring. To produce certain kinds of heterogeneity is certainly not an innocent project, as other kinds can be excluded or downplayed in the process. But a managing body that seeks to manage through heterogeneous forms is nevertheless quite notable.

Fire managers constantly engage with patchiness and heterogeneity, on maps and plans, in practice, and in the landscape. Figures of heterogeneity were always one of the first things they would mobilize to make sense of the region. And even when I wasn’t around, I imagine the imposingly large maps would be a reminder in the everyday. They represented a freeze frame of something continually changing. But they also embodied visions for the future—the beige monochrome was an imperative, it represented urgency, even while the other colors were threatening to become beige if fire managers didn’t continually keep up their efforts. Here, instead of the century-long cycles of sustained yield forestry, forest managers think with shorter durations,

for instance of leaf litter accumulation on the forest floor. But in both cases, futures and cycles are in focus—in both cases people think with landscapes that are important above all for the futures they can make possible. In part, fire managers have inherited thought tendencies from forestry—about landscapes that embody future states and heterogeneity as an emergent state that can be produced—but their thinking is also affected by the lively forests they encounter.

Whereas a beige monochrome would represent an urgent imperative to act, a balanced multi-colored map patterned in favorable ways would represent a future-oriented "projective landscape." It would be a representation of a landscape that in a very real way would promote certain futures and constrain others, a landscape that in its variety of spatial patterns would embody and project the potential for future fires of certain kinds. I think of projective landscapes as places where futures are materially anticipated in the landscape itself. Such landscapes are in turn materially and imaginatively anticipated in maps and other elements of the burn planning process. Burn planning is a practical knowledge framework that seeks to balance several kinds of heterogeneity in order to initiate and maintain landscapes that embody safe futures with mostly small low intensity fires. Above all, this practice must be continually maintained, or else fire managers have to confront the dangerous futures they see in monochrome maps and in uniformity of times since last burn.

Heterogeneities come through in assumptions and in policies, as we have seen, but it is also one of those points at which distinctions between 'how forest managers think', 'how forest managers shape forests', and 'what forests are composed of' are not

always very meaningful to maintain. Forest heterogeneities involve all of these. A 'mosaic of fuel ages' for instance—one of the forms of heterogeneity we'll encounter in this chapter—involves a certain pattern of thought, a pattern of practical interventions with landscapes, as well as something that is a feature of a landscape independently of forest managers. Many of the fire managers' practices involve linking and connecting these three—thought, practice, and the forest—not by realizing visions in the landscape once and for all, but in order to keep them always suspended in the process of being actualized.

Burn planning as engagement with heterogeneities

The area planned to be burned in the Mullalyup burn completely surrounded the property where one of the senior fire managers in Blackwood district, Paul, lived, and a few in the office suggested that Paul had nudged this burn further ahead in the planning process because he was keen for his property to be protected. It was just a joke, of course, and what was more important for the prescribing officers—who happened to be Sarah and myself—was that Paul's office was only three doors down, and a place where a lot of local knowledge could be found.

The first day we worked on the Mullalyup burn was spent by the computer. Over a few hours on a sunny February morning Sarah toggled back and forth between a GIS software, the Department's online burn planning software, and various maps and lists of planned burns while I looked over her shoulder and slowed the process down with questions. The so-called burn unit, or burn shape, was partially a legacy, inherited

from previous times they had burned this area. Mullalyup forest block had been burned in roughly the same shape several times before, and it was therefore recorded in the software with a single fuel age: 12 years. While leaves fell steadily from the jarrah trees in the forest area we called Myllalyup in the years following the last burn, the sharp-edged hour-glass-like shape of its map outline changed color on Parks and Wildlife's enormous maps. Now, it had been beige for quite a long time. Pretty much the same shape had been burned the time before the last as well: a spring burn in 1991. In both '91 and '04, sticky notes and hand-written comments on old prescription documents stored in a filing cabinet out in the hall recalled that they had both been "patchy" burns. Past patterns of what had been burned and what had been left behind lingered in dusty filing cabinets while they had unknown effects in the forest.

Safeguards and formalized common sense

In the morning, we set to work populating boxes in the section of the prescription titled "Plan Actions." Populating the plan actions section involved checking a very long list of issues against registers, maps, field observations, and different Parks and Wildlife staff, and for most of the issues, we could check the registers and shape files using the GIS software. The burn had about half a dozen different maps associated with it which had already been prepared by another colleague in the office. One map was the vegetation map, which showed in a brightly colored overlay which

"vegetation complexes"[93] were present in the area. The vegetation types, in our case the Kirup vegetation complex, the Hester complex and the Balingup complex each snaked and blobbed around in shapes with rounded edges, looking roughly like they had a relation to watercourses. Outside, not far from the office we sat in were trees and tree groupings that the "complexes" would allow us to see in particular ways. Each of our vegetation types were subcategories of "Northern Jarrah Forest" and each came with a short description: the Balingup complex for instance was "open jarrah forest with marri." At first that morning, we worked with forms that prompted us to think with a heterogeneity of qualitatively distinct and enduring features.

We went on to populate boxes for "stakeholders." The burn was in state forest that had been harvested in 2004 and one of the stakeholders was therefore the Forest Products Commission. Other stakeholders included the volunteer Bushfire Brigades, private property owners, and the Shire. We also populated a box for "aboriginal values." To do this, Sarah pulled up an overlay on the GIS software that showed aboriginal sites such as artifact and scatter sites, scar trees, and mythological sites. None of these were inside our burn area and we filled in the box with "no action required." If something like a scar tree had in fact been present in our burn site it wouldn't mean that the burn could not go ahead. Instead, what they'd like to do in such cases, Sarah explained, was to have the crews go in with a rakehoe and remove

[93] The vegetation complexes—several hundred different ones for the southwest forest region—were defined by Department affiliated researchers Havel and Mattiske (2000).

litter fuel around the tree or even spray some retardant around it to make sure it wouldn't be damaged in the burn.

We continued, now populating boxes about "conditional burn areas"—such as areas to be protected for biodiversity or silvicultural reasons—and boxes about suppression constraints—whether there might be anything in the area that would make suppression of an escape difficult. Parts of Blackwood, unlike most of the other districts in the southwest, have plenty of steep sections and slopes and these can make it more challenging for fire fighters. Sarah knew this well, of course, as did all the others who worked in the district, who had driven and walked up and down many steep forest tracks. But it needed to go in our boxes nonetheless. More boxes, shapefiles, and registers taught us that there were no harvest operations planned in the near future, that the area was under a pending mining exploration license, and that there didn't seem to be any flora and fauna values that needed particular consideration in addition to what they usually do on a burn. Sometimes, if there is a certain wildflower or other rare kind of plant in the burn area, they are required to get an "approval to take," Sarah told me. Even if they're not taking the flower in the same sense as a wildflower picker would, it amounts to basically the same thing with a burn: in the short run, the flower won't be there anymore.

Other boxes concerned settlements nearby. We populated boxes with Kirup and Mullalyup, with a school, camp sites, roads, and one or two local events that were coming up, such as the annual apple festival in Donnybrook. Boxes for "sensitive industries" and "sensitive neighbors" followed. The former could be wine growers,

tourism, or mining, among others. The latter would typically be property owners that were opposed to the Department's burning practices for environmental reasons. A "sensitive neighbor" (who probably wouldn't call himself that) had interfered with a burn earlier in the season by being inside the burn area on the morning of the burn. The department were forced to call it off. Stakeholders are included in the burn, explicitly invited through circuits involving boxes and registers; but this is also one of the places where stakeholders are managed, defined, and contained.

We scrolled on to boxes about infrastructure, water, power, gas lines, and Telstra equipment. It was starting to get a bit tedious, we agreed. The forest felt far away. I felt like we were formalizing common sense and local knowledge. Sarah told me that a lot of it was about accountability, of having a record of making checks if anything were to go wrong. Many of the checks and their formalization were a result of inquiries following the Margaret River fire in 2011, a fire that started as an escape from one of the Department's prescribed burns and caused significant property damage. We had worked quite quickly with the boxes. Sarah indicated to me that if she was doing this by herself boredom might have compelled her to take more breaks. It was very clear that what she *really* felt to be important didn't lie in populating boxes. In a sense, the whole purpose seemed to be to get past the box ticking and on to later stages. The filling of boxes, then, was inhabited by other desires, and above all the desire to shape the landscape, to create heterogeneous forms, which is what fire managers are truly motivated by. In the impatience with formalized common sense lies desires for the more important things, for those interventions that are geared

towards keeping the landscape lively and heterogeneous, for creating the emergent kind of state that lies in a good combination of forms of heterogeneity. All of this would come later.

The rectangular boxes in the burn planning software are also a circuit for certain forms of thought. Just like a timber harvest, a burn embodies certain assumptions about diversity. When we worked with the boxes, what we were working on was ***safeguards***. Expressed through safeguards against harm, the burn is assumed to be something potentially harmful and we have to go through checks to ensure that as little harm as possible is done. And it is not just that a burn is harmful if it were to escape, it is potentially harmful in itself, for instance to particular kinds of flora and fauna, to aboriginal sites, or to growing crop trees (though this is given less emphasis than it used to in earlier years). A burn here would potentially compromise a sum kind of heterogeneity, in which a wildflower for instance is something to be maintained, one flower, an end in itself, which in relation to a single burn can do nothing other than be lost. It is also a conception in which the harm done to a house and the harm done to a wildflower seem remarkably similar. It doesn't matter that one of them is likely to grow back, or perhaps even spread (depending on the wildflower and the time of the burn) after the fire and the other one is not, or that one can conceivably go extinct, whereas this is not a notion that makes sense for the other. In this part of the planning process they are placed on the same level as elements to protect and keep under control. As a unit in planning, the burn is both socially and ecologically complex, but as elements at risk controllable by safeguards, this

complexity is undifferentiated. Here, we thought with patterns that made the forest a place of distinct elements to be protected. But soon, our frameworks shifted.

Favorable adjacency, within-burn patchiness, whole-of-forest mosaics

Going through all the plan action boxes set us up for doing a "complexity analysis" and for determining the "success criteria," the "burn objectives," and the "criticality of burn." For each of the issues that arose in our action points we could now assign low, medium, or high complexity. Most of our points were low or medium in complexity, but we paused to talk about the "criticality of burn." This prompted a different way of thinking about heterogeneity. Together we strove to wrap our heads around the notion that the criticality of burn was not something that was high, medium, or low, but something to which we had to assign a high, medium, or low level of complexity. In other words, it was not a matter of whether the burn was critical or not, but to what extent the criticality was complex. A burn with a highly complex criticality, we reasoned (though we weren't entirely sure we had interpreted it as was intended), would be a burn where a failure to undertake the burn was likely to cause complications for further planning and other burns.

We confront burn areas here in their relation to adjacent areas and areas adjacent to those again. An area of forest is relationally defined—in this instance by adjacency, rather than by its place in a whole-of-forest patchwork. This is a bushfire risk-oriented spatial distribution above all related to what is known to be the most dangerous winds. Northerlies tend to be dangerous as they can be associated with

surface troughs in the summer, and the most extreme fire weather often involves north-westerlies in particular. This kind of heterogeneity (based on adjacency and a constant—wind) is different from the spatial distribution expressed in forestry's sustained yield policy. Here, you want to "stack" burns from south to north, with blocks that build on each other, taking advantage of burns that are made safer by their proximity to low fuel areas, and patches that together compose low fuel "corridors" that aim to slow down fires driven by northerly winds. A burn with a highly complex criticality would be a burn that a lot of other burns would be reliant on.

Fire managers encounter adjacency in the field all the time. The Ross burn, for instance, a spring burn I took part in, was next to a fire scar only two years old. We could see it across one of the dirt roads that acted as the boundary for the burn—jarrah trees with the almost fur-like appearance given by epicormic shoots along their stems, plenty of bracken fern in the understorey, and not much leaf litter on the ground. It filled the fire managers with a sense of calm, a confidence that they could easily put out an escape. *Un*-favorable adjacency has an equally affective pull on those who burn, making them instead tense and apprehensive, perhaps evoking memories of near-misses or even times when things have gone awry. A continuous area with a lot of litter fuel is, for fire managers, a kind of landscape that anticipates or projects dangerous fires.

Many fire managers also have a spatial awareness of their district, so that they can stand in one place and be aware of their vicinity according to how long ago it was burned. I know this from many comments like "we have two-year-old to the north,"

or “there’s some scruffy 40-year-old to the east,” or comments about places made dangerous by their surrounding areas. Wes, for instance, told me he would be terrified to live in Denmark, a small town on the southern coast surrounded by many long-unburned patches of karri. Experiences in the forest is inhabited by knowledge that comes from studying maps and work with maps is inhabited by experiences of how fire behaves in the forest. Fire managers can stand in their districts and be affectively pulled by an awareness of a variable propensity to burn.

We also had to define the “success criteria” for the burn. This seemed to be a tricky one on paper, but a simple one out in the field. One thing, Sarah said, was that as far as the prescription goes, it has to be something measurable. Hence, they often write something like “at least 70 % of the area burned, but no more than 90 %, and no more than 60 % of the area with crown scorch.” The paradox is that they hardly ever measure these things. In earlier years, the criteria would tend to be something like “patchy” or “mosaic” but today numbers are favored, something measurable, even if it won’t ever be measured. I asked Sarah how these success criteria numbers are decided, and she smiled and told me that it was basically up to us right there and then. More often than not, though, it ends up being a matter of putting in the current “stock standard” and that was what we did. I had seen plenty of these kinds of patchiness when I had been out on burns. In some places, the fire would go out when it got to creek lines or to patches without much leaf litter, and other times we would get crown scorch from what fire managers refer to as “junction zones,” areas where two fire fronts combine and intensify each other, and often the drops from the aerial ignition

"took" in what seemed like random patterns. This ***within-burn patchiness*** was a heterogeneity that would inevitably happen in some way, but that could be swayed by how the burn was carried out.

We employed the standard phrases for "burn objectives" as well. The vast majority of prescribed burns has at least two out of three objectives: "risk management" "biodiversity," and "silviculture." Other objectives are possible too, such as "community interest," "research," and "water catchments," but these are far less common. Our burn had "bushfire risk management" and "biodiversity" as its objectives and each of them were articulated with a sentence or two. A common articulation of the biodiversity objective during my time in the southwest was something like this: "to protect, maintain and enhance biodiversity values and ecological processes by applying fire under prescribed conditions to achieve a mosaic of fire intensities and burnt and unburnt areas at both a landscape and local scale." I can't say for sure what these phrases made fire managers think about, but for me, biodiversity values and ecological processes could bring to mind small marsupials that have declined in the last couple of decades, such as quendas, numbats, and woylies; or animals that are exceedingly rare, such as the white bellied frog which is only known to occur in a small area near Margaret River and is given special attention during burns. Or I might think about black cockatoos roosting in hollows of older trees. Or perhaps orchids—more than 130 species of caladenias, or spider orchids, are endemic to the southwest—and what I had heard about "orchid friendly burns," which would ideally happen late in spring. Or about ecological communities

that could need extra care when burning, such as peat swamps. The stock standard formulation for risk management was similar to the one for biodiversity, but also emphasized strategic protection of infrastructure and dwellings. It brought to mind what I had seen when driving through the small town of Yarloop, where more than a hundred buildings were destroyed in the Waroona fire in 2016. But "burn objectives" toned down (but in no way erased) affect and experiential connections. "Objectives" and "success criteria" may be seen as part of desires towards a certain kind of scientificness, and a certain kind of management aesthetic, desires that are sometimes, but not always completely, shared by those who burn and those who write prescriptions.

With the burn objectives and success criteria we encountered once again (through convoluted management-ese) assumptions about heterogeneity, and a different kind than in our action points checklist. Both of the objectives, for risk management and biodiversity, are goals that no one burn can achieve on its own. One part of risk management, for instance, is the "stacking" of burns. Such a form of diversity is reliant on a between-burn patchiness, a kind of heterogeneity that a single burned patch will contribute to depending on the state of other patches of forest across the landscape. This is what comes through in a complex criticality. To contribute to risk management, a burn must be involved both in a kind of ***favorable adjacency***, and in a ***whole-of-forest patchwork***. Bushfire risk management, in other words, combines at least three kinds of spatial heterogeneity: a whole-of-forest mosaic of different fuel ages, a clustering of areas based on adjacency and relation to winds, and a zoning

based on proximity to built-up areas. A similar thing goes for biodiversity where there are three levels on which a burn must involve and be involved in patchiness—within a burn, between burn areas, and in relation to intensity of fire. With measurable figures that essentially express a vaguer patchiness, success criteria are vehicles for assumptions about good and achievable heterogeneity within a patch. With burn objectives, the prescriptions condense several kinds of spatial heterogeneity both within and between different burns. Moreover, some of those are kinds of heterogeneity that a single burn can contribute to not by virtue of any feature of itself, but by virtue of its relation to all the other burns and fuel ages across the forest. These are emergent kinds of heterogeneity. And in combination they can create a regime, a state which cannot be seen anywhere in particular, that lies in any one burn area, but only because of their relation to forms created by many burn areas together.

Pyro-variability

Preparing the prescription for Mullalyup also involved a few trips out to the site. Our first trip was mostly for reconnaissance. We found what Sarah said was a complicated boundary, steep in sections, narrow in others, and with several twists and turns, made out of dirt roads that looked like they could become slippery in wet conditions. Sarah was getting an overall sense of the area, but she was also noticing *with* patterns of thought. Some of our action points from back in the office could be reconciled with the landscape, some of our stakeholders were there and some of our risks. We found a powerline that cut across a part of the burn area, a Water Corporation tank just outside the northern boundary, and part of a disused railway line on the very edge of

the burn. Sarah also made note of some sections that could cause trouble if they were to get a hopover there, and she noticed that there seemed to be a lot of ground fuel in the part of the burn that bordered a pine plantation which could be a good thing because it meant that it would be easier to get in a good edge. In principle, many of the things we were looking for in the field could conceivably be found on maps. But forest managers' work with various kinds of maps consists of a constant making and remaking. Their maps are treated as a process that requires periodic visits to the field.

Our second trip out to the burn site a few weeks later was for the purpose of taking fuel measurements. We had prepared a map with approximate locations of where we wanted to do our measurements before we went out. We ended up doing seven lines, in places that covered all the three different vegetation complexes in the burn area. For each line, we walked about 25 meters in from the road, then we took measurements at ten spots, one every ten meters. For every spot, we measured the depth of leaf litter using a small wooden instrument which required us to place a small rectangular piece in between the leaves on the ground which would push up another part of the instrument so that it showed the difference in height between the top of the leaf litter and the ground. Later, we would look up a table in the Forest Fire Behaviour Tables (the so-called Red Book) to convert litter depth in millimeters into litter weight in tonnes per hectare.

The Forest Fire Behaviour Tables are inhabited by semi-solid patterns of thought and they affect what we see in the forest. They prompt us to look for things that contribute to the "rate of spread," to parse observations and measurements into "available fuel,"

to look at bushes and scrub, little trees, flowers, and plants, and see something that can approximate one of the "scrub types." Scrub types differ by understorey species, density, and whether it is denser near the ground, in a middle stratum, or higher up; and from a scrub type we can arrive at a correction factor that can tell us how much we can expect the understorey to contribute to the fire's spread. The fire behavior tables also allow us to emphasize small variations in moisture and dryness, and to see in which parts of the landscape such variations could make a big difference in a fire. These are often variabilities that are subtle from most people's points of view, but magnified when observed with a view to how the forest will burn. If a fire can magnify these variations, fire managers must also try to do so for themselves.

The forms echoed methods from field ecology—such as the transect—but they also revealed a history of approaches myopically interested in how vegetation will burn. The tables employ simplifications about the forest—it is assumed for instance that a certain rate of spread is correlated with a certain range of scorch heights—but doesn't hide the fact that they are simplifications. Through the Fire Behaviour Tables the forest is opened up for us as a place that is dominated by a small number of processes: the daily and seasonal drying and moistening of leaves, soils, and understorey; the rate of spread of a fire; and the rate at which litter accumulates on the ground after a fire or burn.

A tricky thing out in the field was deciding on the exact spot to do a measurement. In many places moving the instrument just a few cm over to a slightly different spot could give a very different reading. Every quantitative reading, then, involved a

qualitative discernment, as we strove to place our little wooden apparatus in a place that would seem roughly representative for the given spot. Fire managers are not as committed to a kind of randomness required of statistical sampling as they are to the utility of getting a sense for the site. We used methods heavily inspired by natural science, but in a very pragmatic way, more to create a useful than an accurate depiction of the forest, to direct and inform ways of intervening. At each site we also took note of what we reckoned was the average tree height and the average scrub height, as well as other features of the site such as slope, aspect, and dominant tree species. Our form also prompted us to assess the scrub for density, with an S, M, or D, for sparse, medium, or dense. Our seven sites were quite varied. Most were relatively open with a grassy understorey dotted with spiky low growing zamia palms, and grasstrees with their halo-like spread of spikes on top of their black stems. Other sites were fairly dense. At one spot we practically fought our way in through a tall thicket of parrot bush, a prickly shrub with long branches which we had to duck under, step over, and push out of our way.

At this stage in the planning process variability is both magnified and contained. Variety is turned into averages, singular sites into types; representative spots flatten diversity. But through these ordering techniques another kind of variability is magnified, and this is what we might call ***pyro-variability***—the kind of variability relevant for how the forest will burn. This kind of variability is brought out, a figure against a ground. Fire managers engage with the landscape through a particular mode of discrimination, one that distinguishes between more or less flammable and

different ways in which elements may burn. As we look at the forests, we actively imagine possible kinds of fire. But it is also a mode of discrimination from which something new emerges. Our field trips contribute to a new whole, as an image of our burn site as a pyro-landscape is formed. This is, among other things, where leaves and scrub become fuel, a potentiality for fire, a proclivity to burn.

Later, when we transferred our measurements to fuel assessment sheets, they were transformed, by way of correction factors and flammability measures, into a number representing "total available fuel" per hectare for each of our seven sites. In our case it ranged from 5 tonnes per hectare to 10.9, which was overall somewhat less than we had expected. Our sheets also contributed to a certain image of spatial variability—a spatial *pyro*-variability—of places to be aware of, certain spots that were more flammable than others, spots and patches that stood out for how they might burn. This image is a mixture of elements that are different based on how they burn or how they may burn in the future, a pattern composed of parts that are expected to burn in one way and parts expected to burn in another. This is a heterogeneity which is subtle to most who encounter the forest, but here it is a quality of a site that is magnified to become an awareness tool. Our burn site was flammable throughout, but not uniformly so.

Meanwhile, it was the height of trees that was the main basis for arriving at prescribed weather conditions for the burn. When we were out in the field, we took note of what we thought was the average tree height, not with any precise instruments, but by looking and comparing with our (mostly Sarah's) past

experiences. The prescribed conditions were based on what we decided was an "acceptable scorch height" for our burn, a height which was usually a third of the average tree height in a spring burn and a little bit more in an autumn burn. Based on acceptable scorch height we could derive a prescribed Fire Danger Index rating (FDI) for the burn. The FDI is a number representing expected rate of spread in meters per hour of a fire given current weather and fuel moisture. It considers the surface moisture content, temperature, relative humidity, and wind speed, and it is calculated in each local district office every morning of the fire season. It is one of the main things that go into answering a question that fire managers ask themselves: is this a good day for this burn? On a day with an FDI rating of between 24-34, then, which was the range we prescribed for Mullalyup, one could expect a fire that was lit in jarrah forest with 8 tonnes of available fuel per hectare to burn at a rate of 24-34 meters per hour and with a scorch height of 7 meters in spring and 13 meters in autumn.[94] Of course, no fire manager would be very surprised if the fire didn't burn exactly as calculated—a fire is also in many ways a phenomenon with its own dynamic and its own emergent behavior—but one would not usually expect a fire lit under our prescribed conditions to burn in dramatically surprising ways.

Initially I was perplexed that our fuel measurements weren't directly connected to what conditions we prescribed for the burn to be conducted under. In theory, it

[94] Note that scorch height is not the same as flame height, which would be significantly lower. The reason scorch height is higher in autumn given the same FDI is mostly that the soil is drier, and the main reason they can allow a higher scorch height in autumn is that there is little risk of reignition close to the wet winter season.

seemed like the only thing we needed to know in order to decide what would be a suitable day to conduct the burn was the average tree height (it would also depend on wind and soil dryness, but these would be independent of our fuel measurements[95]). But the fuel measurements are above all an awareness tool. Fuel assessments gave us a predicted rate of spread range given that weather and moisture conditions were within the prescribed range (in our case we could expect a rate of spread of 32-38 meters per hour). They were a way to double check our prescription against the actual measured fuel level in our forest patch, and a way to give an image of what might happen in this part of the burn or that part of the burn—an image of within burn pyro-variability, a spatial variability in propensity to burn.

Our field trips helped us specify what kind of days with what kind of weather would be suitable for our burn, but for that task, field trips were not absolutely crucial. Prescribing weather conditions could have been done in the office, and in this regard field visits acted more as an assurance that we didn't prescribe something altogether unsafe. More importantly, however, field trips and fuel assessments were exercises in creating awareness of pyro-variability, of getting to know a site as a variably flammable landscape. And in this sense, they were among the most important things we did. Asking of the forest: 'how will you burn here? and how will you burn here?' creates for fire managers a kind of variability that is foregrounded at the expense of other kinds of diversity. And this is a kind of questioning that lies not just in the

[95] Commonly, in northern jarrah forest, they will not burn if there is a higher wind speed than 20 km/h. With regards to soil dryness, and with some exceptions, they will not burn when it's over 600 on the soil dryness index in spring, and they require a drop of at least 400 points from the max in autumn.

measurements themselves but in walking through the forest, in touching leaves and making our way through the understorey.

Fire managers engage in a dialogue with the forest by thinking and acting through figures of heterogeneity, semi-solid habits of thought that are expressed and carried on through material circuits—such as the map form, the fire behavior tables, and the partition of the forest into blocks and compartments—and impinged on by the forest itself. The figures lie both in fire managers' habits of thought and in patterns in the landscape as they are experienced and as they impinge on what fire managers think and do. They are also embodied in things, such as folders, maps, and planning documents; and they live in practical routines, such as the way a burn is carried out, or the way fuel measurements are done. Some of these heterogeneities are kinds that will almost inevitably occur to some extent, but that can be swayed, others are of a kind that can be produced or attained, and others again are the kind that must be teased out, nurtured, or brought into focus. Burn planning is not primarily about managing something heterogeneous that is out there and that can be made manageable. Fire managers manage heterogeneities that are not apart from themselves, but rather something they are involved in creating.

A piece of state forest on rotation

A few more weeks had passed when Sarah and I sat down with Mitch, the district fire coordinator in Blackwood district, to go over our prescription. Mitch seemed a bit stressed, I knew he had a lot on his plate, and he periodically had to leave us to

answer phone calls. The district had had a challenging season with an escape from one of their spring burns, and a complicated situation with wine growers putting pressure on the Department to delay their autumn burns because they were worried that smoke would taint the grapes. This left very few opportunities to burn, which complicated their planning process and gave the district an overall stressful sense of being behind. We would also be reminded of the situation by huge—and far too monochrome—maps on the back wall. Our Mullalyup burn, however, seemed to be refreshingly simple, like a hint of how things used to be back in the day.

Mitch finished his lunch wrap while Sarah got her laptop connected to a large flat screen display at the end of the room so that we could all look at the same thing and when it was all set up Mitch asked us casually what we had found. Sarah did most of the talking, I took notes and chimed in now and then. She started with some of the basics. The boundary isn't very good, Sarah reported. Mitch asked if it's "dirty," and Sarah answered that the fuel load isn't very high, except in a few areas. She mentioned a few of the patches we had found, the area with dense parrot bush, a patch with quite a lot of grass trees, and a couple of others. Here, our awareness of pyro-variability was starting to be transferred to others in the Department. Our list of stakeholders offered no surprises, neither did our plan actions. When we got to the success criteria section Mitch asked us to make a small change. We had initially written "no more than 40 % scorch" as one of our criteria and Mitch suggested at first that we should change it to 50 %. He turned towards me to explain that the Department are currently talking about doing away with the scorch criterium

altogether. This is in large part, he said, because they are not so much managing for productivity anymore, so the concern that scorch will damage crop trees isn't really a concern. "You could almost say 5 % defoliation acceptable," he said evoking in my mind images of flames that licked the tops of 30-meter-tall trees, before changing his mind again and deciding that we might as well take away the scorch entirely from the success criteria section. We kept the numbers that expressed patchiness. Neither Mitch nor Sarah seemed incredibly invested in what exactly the document ended up saying. Instead of writing success criteria to would guide action, it seemed almost to be a matter of making them reflect what we knew would be done on the ground regardless.

We spent some time talking about the risk register and the context statement. These are both important at a higher level of the organization. The context statement, for instance, a one or two paragraph summary of what's important to know about a burn, will likely be one of the parts of the prescription that is read by those higher up in the organization who endorse the burn. The context statement among other things, explains why the burn is important. In our case, we emphasized both that it provides "strategic protection" for a few nearby townsites and that, together with adjacent burns, it will form a larger "strategic buffer" against fires coming from the north. Here, an awareness of the burn existing in adjacency and between-burn heterogeneity is set to percolate upwards to the regional level and the corporate level. The risk register is also a part that will be read by those higher up in the department. It is a section of the prescription where different risks are rated according to severity of

consequence and their likelihood of happening. One of our risks was “smoke over the Southwest Highway.” Mitch wanted us to give it quite a high consequence rating, and he was prompted to justify it when Sarah noted that it would be right below the rating we would have for deaths. If they were to get so much smoke over the highway that they would have to close it for several hours that would be pretty serious, Mitch reasoned. It would be an inconvenience, many would lose money on it, and it would probably be a big media affair. It could have both legal and political ramifications for the department. But thankfully, we were also able to give this particular risk a low likelihood. These points of the prescription are decision making aids for those in the Department that are formally accountable. Most of it seems elementary, Mitch explained in my direction, and everyone knows that things such as smoke, deaths, and loss of houses are risks involved with burning, but they have to identify them as risk nonetheless.

Again, I sensed the impatience fire managers have with box checking and other kinds of necessary formalities. They even seemed curiously passive in relation to some of these things, as they applied “stock standard” phrases that had usually been decided by someone else and would not make a big difference for how a burn was carried out or for the patterns in which burns were planned across the landscape.

Mitch started to move us along more quickly after a while, saying that unless there’s anything unique we can move on. We copied and pasted most of the contingency plan—the plan for what to do if there’s an escape, which would be the same for most burns. Our complexity register had many points of low complexity and some of our

mediums Mitch said we could put down to a low. After roughly a week spent working on the prescription, in sum, we could present to Mitch a burn of mostly low risk, low levels of complexity, the usual stakeholders, and close to the standard amount of fuel. As Mitch put it with a smile: "just a regular old piece of state forest on rotation." It was almost ready to go—the burning itself, it seemed, would be the least complicated part of the process. It felt almost as if the burn was virtually finished already. The gap between aspiration and practice had nearly been closed.

Rotational burning and zoning

The majority of the CALM estate in the southwest, the land managed by Parks and Wildlife, is at any point given in some stage of the burn planning process. Before a patch of forest is burned, it has usually been part of Regional Fire Management Plans, which at the most synoptic level involves "a planning horizon with landscape scale objectives" (Department of Environment and Conservation 2012: 1). It will also have been present in the three-year rolling burn plan for at least a couple of years before making its way into an annual burn plan where it is provisionally allocated to either spring or autumn of the year in question. Many burns will be "pushed" to the next season or the next year often because suitable weather conditions don't occur as often as fire managers would like or because of some other constraint. The prescription for a burn is sometimes prepared the season before, but often earlier.

When Mitch said our burn was like a piece of state forest on rotation, he referred to a fire management model developed by the Forests Department from the 60s onwards.

Department researchers working in the 60s, 70s, and 80s (notably George Peet and Rick Sneeuwjagt) estimated based on measurements in the northern jarrah forest that if there is more than 8 tonnes of leaf litter and other kinds of ground fuel per hectare then it is likely that if a fire were to start it would burn so intensely that fire fighting would be extremely difficult and very dangerous. They also found that it takes about 6 years (in typical northern jarrah forest with 50 % canopy cover) for 8 tonnes per hectares of fine litter fuel to accumulate after a fire or burn[96]. So, if such areas are burned every six years, it's likely that they would burn less intensely if wildfires should occur and fire fighters are more likely to be able to contain the fires. Then, if you burned 15 percent of the forest every year, it would take six to seven years until you came back to burn the area you started with, and you would be able to keep the entire forested area below six years, or 8 tonnes per hectare. As McCaw and Burrows puts it, "The period between successive fires, or burning rotation, is therefore primarily based on the rate of fuel accumulation in the forest" (1989: 327). If you then distribute areas to be burned evenly in space and time, the theory goes, no wildfire would ever have the chance to burn very far before it runs into a patch with very low fuel, and many ignitions would happen in low-fuel areas, in which case the fires might only barely get started before fire fighters arrive.

This is the theory of "rotation." If there were no other considerations or concerns involved than fuel reduction, fire managers might have liked to keep nearly the entire

[96] Similar measurements were later made for the karri forest where the assumptions are that 15-19 tonnes per hectare is the threshold below which they ideally want the majority of the forest and that it usually takes 3-10 years for this to accumulate depending on canopy cover (cf red book).

forest on a rotation that ensured that fuel levels would never exceed the critical threshold above which fire fighting is drastically more difficult, which was assumed on average to be 6 years in the northern jarrah forest[97]. The similarities to the model of sustained yield in forestry are very clear. In both cases, the ideal model is an even temporal distribution—in sustained yield so that one can harvest evenly each year in perpetuity, and in rotational burning so that one will be required every year to do more or less the same amount of burning in order for the whole of the forest to be kept below safe fuel levels. They each represent a diversity along a single dimension—the age of trees for sustained yield and the number of years since last burn for rotational burning. Both are also infrastructures for the future. In the case of rotational burning, it is aiming to create landscape that make small and mild fires more likely and large and intense fires less so.

A similar more recent iteration of a model for distribution of fuel ages is a negative exponential curve[98]. This is a model that expresses the ideal of keeping the majority of the forest in a stage of few years since last burn, but still with areas that are long unburnt. In other words, that an exponentially greater portion of the forest is recently

[97] Climate change and other changes to the forest is having a slightly destabilizing effect on these assumptions. For instance, a 5:1 wind ration (meaning that wind speeds within the forest would be a fifth of what they are outside) used to be considered normal, but with changes to forest structure tending towards lower density forests with less canopy cover, a 4:1 or 3:1 has become more common. Another change, related to both canopy cover and a drier landscape, is that it may take longer for litter fuels to accumulate in the forest than it used to. The "standard fuel" in jarrah forest—8 tonnes per hectare after 6 years—may not be the most common anymore. These two changes point in opposite directions then—less canopy cover gives a forest where more wind is allowed to propel the spread of a fire, but it is also associated with a forest where there may be less leaf litter.

[98] An early paper that theorizes the negative exponential curve for distribution of post-fire stages of growth is Van Wagner (1978).

burned than long unburnt, but that all sorts of times-since-fire are nevertheless present in the forest. The negative exponential curve model might remind us of sustained yield with retention safeguards for biodiversity; with most of the forest on rotation, but certain areas excluded from burning. There are currently about 80-90 so called Fire Exclusion Reference Areas (FERAs) in the southwest, small patches scattered across the region where fire has been excluded for a long time. These patches are meant to be representative of a wide variety of vegetation types and are kept as reference areas for research. Some of them haven't been burned in 80 years, but all of them are surrounded and crowded out by forest with significantly younger fuels. I saw a handful of these FERAs in different places in the southwest, and once I knew what they were, I could clearly see features that made them stand out, details such as grasstrees with excessively large grassy skirts and large jarrahs with no sign of scorch anywhere along their stems.

Rotational burning and the negative exponential curve are, of course, just models, and models moreover that no one has ever aspired to implement in such simple forms. For one thing, there were always differentiations between parts of the forest. "Zoning" was applied to fire management at least as early as the 1930s. At first, zoning was based on what parts of the forests were afforded fire protection, which at that time meant protection of the timber stock from bushfire. In annual reports from the 1930s, 40s, and 50s, they sometimes refer to the "protected zone," as opposed to the forest that had not yet been brought under fire management. Elsewhere (e.g. O'Donnell 1939), we can find references to zones A, B, and C, which differed according to how

valuable the forests were from a timber production point of view—ranging from zone A forest which was forest that had been regenerated and was to be protected by low fuel buffer strips surrounding the compartments to zone C forest which was "sub-marginal forest" which was to be burned as often as possible, and where summer bushfire were only to be suppressed when they caused drift smoke to obstruct visibility from fire towers or when the fires were "threatening to endanger more valuable forest land" (O'Donnell 1939: 16).

Ever since rotational burning became the objective of fire management in the 1960s, the Forests Department operated with at least two kinds of differentiation—one in relation to silviculture and timber production (where in the harvest and regeneration process a forest block found itself at any point and whether a patch of forest was considered to be high or low productivity forest), and the other related to a forest block's proximity to settlements. Somewhat later, they also came to approach zoning based on fuel accumulation rates and in 1989 McCaw and Burrows write with reference to the jarrah forest that "burning rotations are normally 5-7 years in more productive forests and 8-10 years in the less productive forests of the lower rainfall eastern zone where fuel accumulation is considerably slower" (McCaw and Burrows 1989: 327). In some form, all of these three principles for differentiation are still salient in fire management today. In the karri forest, for instance, new patches of regrowth are not burned for about 20 years after planting. In other words, they are protected from fire for the time it takes the young trees to grow to a size where they can withstand a prescribed burn. Proximity to settlements is also a major

consideration when it comes to burning today, and for planning purposes any part of the forest can be categorized as either Land Management Zone 1, 2, or 3, according to how far from townsites and settlements they are situated. Zones 1, 2, and 3, in other words, have nothing whatsoever to do with crop trees and the timber resource, unlike zones A, B, and C from the 30s. Our Mullalyup burn was in zone 1 due to its proximity to three small towns. Officially, zone 1 burns are given a higher priority because it is seen as more urgent to keep fuels low around townsites, but in practice they are often more difficult to carry out than more remote burns, precisely because of complications associated with being close to townsites, people, and infrastructure. I also experienced consistently that weather, rather than official priority, determined which burns could go ahead at any one day.

We can see, then, that the theoretical image of the entire forest on a six year rotation is complicated by the existence of several bases for differentiation: there are zonings that would prescribe different rotations on the basis of fuel accumulation (longer rotation in low rainfall areas where fuel accumulates slower), proximity to townsites and infrastructure (shorter rotation close to townsites and longer in remote areas), and on silvicultural requirements (patches that are kept out of rotation when they are in an early stage of regrowth or burned at specific times in order to regenerate). Here, in other words, while the form of heterogeneity is a kind of rotation similar to sustained yield, the dimensions for diversity are multiple.

Additionally, more recent kinds of differentiation—a new set of dimensions for diversity—concern biodiversity, species requirements, and ecological communities.

Not only is the ideal that different fuel ages are present in the whole of the forest, but that *each* major ecological community has a diversity of fuel ages at any given time. During my fieldwork I rarely saw this being a direct guiding principle for decisions on where and when to burn, but I know it sometimes to be used as a measure (rather than a goal) in official reporting. [99] Lifecycles and vital attributes of particular species—for instance threatened species of special concern (such as the critically endangered white bellied frog or the western ringtail possum) or species thought to be indicator species—are also principles for differentiation of the forest, principles on the basis of which one can prescribe rotations. Some species and ecological communities might need to be kept outside of rotation (such as peat swamps). For certain others, it might be suitable with a specifically designed regime. In a couple of trial projects, the Department have tested out systematically varied kinds of rotation. The theory behind these projects is that for ecological diversity the ideal might be to vary spring and autumn, to vary time between burn, to vary intensity, and to vary patch size—and to vary all of these aspects not just between blocks but within them as well. In many cases, these kinds of variation might occur by default or as fortunate side-effects of complications, but a more systematic approach has been tried in a couple of projects over the last decades, for instance at the Tone-Perup Nature Reserve east of Manjimup, where burning patterns have been planned with a focus on

[99] In the current Forest Management Plan, Key Performance Indicator 6a concerns distribution of times since fire in the whole of the forest, while indicator 6b is about distribution of times since fire in the major Land Management Units.

promoting the kind of habitat preferred by small marsupials such as tammar wallabies and woylies.

Landscape flexibility, sought-for outcomes, and welcome side-effects

It all seems to get quite complicated. There is a coexistence and partial overlap of many different principles for zoning, at the same time as all the different zonings coexist with several other forms of heterogeneity: an image of an integrated whole-of-forest patchwork biased towards low fuel ages, retention of selectively distributed ecologically representative patches, a strategic spatial distribution based on adjacency and wind, a pyro-variability that is magnified through the prescription process, and a within-burn patchiness that is inescapable (not even the Waroona fire burned uniformly) but that can be swayed. And of course, all of these visions of distribution and heterogeneity have to be implemented in strenuous negotiation with the patchiness created by the hundreds of bushfires that burn irregular and unpredictable large and small areas of the southwest every year. Burn planning is an act of balancing principles, but it is also a dialogue with the forest.

And yet, with all of this complexity, "a regular old piece of state forest on rotation" was a way to express how simple our burn was. For one thing, any one single burn can be quite simple even while an immense complexity lies in the ways in which it takes part in many overlapping and incomplete wholes. Complexities aren't necessarily in the burning itself, it rarely lies in the lighting up of a line or in the hosing down of a smouldering log. More often it lies in something distributed,

relational, in something which cannot be found in any one place in particular. But in part, the complicated coexistence of many versions of heterogeneity and principle of zoning is also made simpler by two assumptions held by many, if not most, fire managers in the Department, both of which involve a kind of diversity that has more in common with the integrated, emergent, and relational form that characterized sustained yield than with such things as zoning and retention. As noted, forms of thought and action that come from a forestry that has now almost disappeared persist today in prescribed burning.

The first assumption is what we might call the 'pyro-diversity begets biodiversity'-assumption: "A basic tenet of fire management is that diversity in fire regime promotes biodiversity" (Department of Environment and Conservation 2012: 18). This assumption points towards an integrated and relational view of the forest, as a place where heterogeneity can be attained and promoted. By creating pyro-diversity—a diversity of times since fire, of fire frequencies, intensities, season, and scale—prescribed burning can create a wide variety of "habitat opportunities" (Department of Environment and Conservation 2012), a structural diversity of "interconnected post-fire seral stages characterized by a variety of vegetation structures and composition" (ibid.). Through the notion of habitat opportunities, then, a heterogeneous fire regime is assumed to be a practical infrastructure for other kinds of diversity, and biodiversity itself in the southwest comes to be regarded in part as "fire-induced." If you don't burn, and you somehow keep the forest from being burned, the assumption goes, you foreclose a lot of habitat opportunities. The flames

themselves, moreover, both destroy and create, as every event kills some flora and fauna even while they invariably create new habitat opportunities.

Burning then is assumed to be at once necessary and not necessarily harmful. It is necessary in order to create enough different habitat opportunities, but only if done in a way that involves diversities—of intensity, season, patch size, and time between burns. Fire managers acknowledge that "it is impossible to achieve optimum conditions for all species of plants and animals in one area at any one point" (Christensen 1982: 8), but they believe it's possible, in principle if perhaps not in practice[100], to create, through heterogeneity in time and space, a burning regime that accommodates all species: "a fire for all reasons" (Burrows 2000). Without spatial and temporal heterogeneity, they assume, burning would be harmful. To abstain from burning would also be harmful—to abstain from burning would give a non-diverse burning regime and a non-diverse landscape—which is one of the reasons why burning is regarded to be necessary, the assumption being that to abstain from burning leads to more homogenous understorey compositions where some species might not find habitat opportunities.

The second assumption is the notion of a low fuel regime as something that enables flexibility, a rule that enables for exceptions to be tolerable. Bruce was one fire manager who articulated this idea to me quite explicitly. Bruce had told me about

[100] Forest Department researcher Per Christensen wrote in 1982 that the ideal, "an infinite mosaic of different small burns burnt on different rotations at different seasons" (10) is "a pipe dream" because of the state of the forest and a number of practical constraints.

how the burn planning process can successfully create safer forests, for instance through stacking of burns. “Find a good boundary, and that’s gonna be our burn’s shape,” he said, indicating that a good way to stack burns is to start from a natural boundary such as a creek or a river. “You wanna be north of the creek … west of the creek,” so that if a northwesterly wind comes then you’ll have that natural boundary. And after working with a physical boundary, you can stack your burns, working with fuel differentials as your next boundaries. If you are able to do this you can create a safer landscape, he explained. But then, Bruce continued, with a shift in tone, “there are those who come along saying ‘what about the bloody orchids?’” But these people have got it all wrong, Bruce assured me, because in a low fuel regime, he said, he can light fires that take the orchids into account, he can light fires in the summer, he can light fires whenever he wants. “When you get to that [stage], all those flexibilities become real.”

There are two types of flexibility Bruce is referring to. One is flexibility through resilience, the other is flexibility through ease of intervention. The former expresses the assumption that a low fuel regime is related to a more resilient forest and that one can therefore do things that could otherwise be harmful, such as burning in summer, which the forest would be able to withstand because of the low fuel regime. The latter kind of flexibility points to both a practical flexibility—interventions will be safer and easier to undertake in a low fuel regime—and a kind of landscape malleability. The forest is experienced as more malleable in a low fuel regime, because with the fire managers’ tools and techniques it is easier to make changes when the forest is in this

state than it would be if there were a preponderance of older fuels across the landscape.

These two assumptions are also what allows fire managers to explicitly manage mostly for bushfire risk—that is, to have decisions about when and where to burn be mostly influenced by the aim of attaining the kinds of heterogeneity that contribute to lowering the risk of large bushfires, such as strategic adjacency, zoning based on proximity to townsites, and a whole-of-forest low fuel regime close to a negative exponential distribution. One can manage with these things as the primary drivers because of the assumption that a pyro-diverse low fuel regime is good for biodiversity by default. The kinds of diversity and distribution most suitable for managing bushfire risk, it is assumed, can also lead to suitable habitat opportunities for maintaining and promoting biodiversity, as a kind of fortunate collateral outcome. A fascinating twist is that some fairly recent Department publications express the idea that fire management planning can be done by first creating a burn plan based on ecological considerations (such as lifecycles and vital characteristics of flora and fauna from which one can derive a suitable model for the distribution of times since fire) and that such a plan will then "provide some treatment of bushfire risk as a collateral outcome" (Department of Environment and Conservation 2013: 24). One can manage with biodiversity as the explicit objective and achieve landscapes that are safe for people as a collateral outcome, a welcome side effect. This is almost a perfect reversal of what I found to be actually happening in practice, where risk management is the driving concern and it is assumed that a good risk management regime—a

patchy low fuel mosaic—promotes biodiversity as a welcome side effect. But in principle, if the assumptions of fire managers are correct, it wouldn't really matter which is the explicit guiding principle and which is the fortunate collateral outcome. In other words, it wouldn't necessarily make a difference whether "fuel management" has "habitat management" as its fortunate collateral outcome or vice versa.

If this seems reminiscent of the idea that a type of forestry that promotes structural diversity is a management principle that is also suitable for almost all other kinds of use—recall that in the priority use forest policy moment the Department expressed the assumption that forest production was a use that was commensurable with most other forest uses—then that is not a coincidence. As ways of reasoning, they are structurally similar and both join together similar forms of heterogeneity. Forest managers are familiar with a pattern of thought involving sought-for outcomes and welcome side-effects, which are, in some cases, interchangeable. We might regard this as an element of their "thought style" (Fleck 1935) or as a "method" that they can replicate and apply in different circumstances (cf. Miyazaki 2004; 2013). Practically, these assumptions help make burning more easily thinkable and doable, they settle certain questions that could become complications, and they enable interventions.

"Issues district"

Yet a few weeks later, our Mullalyup burn was briefly brought up in Blackwood district's annual burn planning meeting. It didn't play a major role that day. Mostly, it contributed to a multitude of burns that the district had to deal with at roughly the

same time. Many here felt like they had fallen severely behind schedule in the last few years and this season had only made it worse. As the ten or so people attending the meeting got settled around a large oval table in a meeting room there was talk of how well Perth Hills district had done this year, and how rough it had been for Blackwood. Perth Hills, someone said hyperbolically, must have almost "nothing left to burn." For Blackwood, on the other hand, it had been a frustrating autumn season and it seemed like many here were prone to cope with it through dry witty remarks. Autumn had started out looking promising with good weather conditions early on, but after they had finished the Camballan burn and two small sections in Nelson it had been, as Mitch put it, "all sour grapes from there." Everyone knew painfully well what this referred to. This year, due to an unfortunate confluence of factors, wine growers' concern with smoke tainting their grapes had been an unusually big issue. It had been an early autumn, where good weather for burning had come several weeks before the grape harvest was finished (more commonly, suitable conditions for burning only occur after grapes have ripened and been picked). On top of that, a very recently elected state government were reluctant to make hasty decisions either in favor of grapes or in favor of burning. The wine growers' lobby seemed strong and unreasonable from some fire managers' point of view, others were more sympathetic to their quandary, and others thought the government, in calling off so many burns, were being overly cautious in relation to the grapes, and at the same time overly reckless in allowing fuel to keep building up by not letting the burns go ahead. Some were worried that a precautionary approach that favored wine growers would set a

dangerous precedent for coming years. It had all resulted in several weeks with a lot of "hurry up and wait," as some of the guys in the crews put it, and a lot of negotiations for those further up. As a district with a large number of vineyards, including the well renowned Margaret River wine region with more than 200 wineries, Blackwood was especially affected. In sum, a lot of work had gone into the 2017 vintage of wine grapes, Jay noted dryly from the end of the large oval table.

Needless to say, there wasn't much to talk about for the first post on the agenda, autumn achievements, and we quickly moved on to discussing which burns could be postponed and for how long. If they were to carry over everything from this season just to the next, they would end up with about 80 burns for next year, which everyone agreed would obviously be ridiculous. So the task for the day was also to distribute the burns over the next few years.

We all had in front of us a long a list of burns where Beaton was the first one. Beaton had access issues. It had 30-40-year-old fuel right next to "a shitty old karri belt." But the prescription had been approved on the corporate level, so they conclude to roll it over to next year. Andy was in charge of the maps we had projected onto a large screen, but otherwise people chimed in with the knowledge they had. The prescriptions for each of the burns had been written by different people in the room and here was one of the instances when knowledge about burns spread through the department and where an awareness of a district-wide pyro-variability was being formed.

Two different burns in Bramley forest block were next. “We’re not gonna touch that until we get the other ones done,” Jay said, referring to a couple of adjacent areas that were also coming up. There’s a pine plantation up against the Bramley burns too. A popular mountain bike area. And Jay knew about two big karri stags that they’d convinced main roads to keep as habitat trees. This burn is a roll over too. Immediately, I was seeing the fire managers thinking about burns through forms of heterogeneity. Bramley was involved in what they hoped would be a sequence of adjacent burns, and it was involved in strategic adjacency in relation to the pine plantation. Meanwhile, the pine plantation and the adjacent areas coming up contributed to building a sense of landscape pyro-variability. Here were adjacent areas with older fuels. At the same time, we could see in them a potential low-fuel buffer.

Jalbarragup was next. Burns came in rapid succession. They got close with this one this season. There was some “local angst” about roosting sites for cockatoos, someone said, conjuring unspecified members of the community and transforming them into a manageable “issue.” A complicated shape. A high risk burn. Another roll over.

Jolly. It should have been a silvicultural burn, but we’ve “missed the boat on that one,” and it won’t be covered by the funding program for silvicultural burns anymore. It didn’t matter too much, Jay said, since he figured there was a realization in the FPC that they’re probably never going to get in there and harvest ever again.

A third Bramley burn. An “easy picking” that we missed this season. “What’s the landowners like?” The volunteer brigades were keen to get it done, but there was also some talk of ringtail possums. Greenbushes. A dispute with a railway company is holding up this one. Barrabup. A carry over. But there’s a complication with people who use the river for recreation. What if we have a big smouldering marri down by the river’s edge? Yalingup. We ought to take away the expectation that we’ll be doing the area of the burn that is heath. The local contact person in the shire is okay with not doing the heath, he “can think of nothing worse than looking at a black hill every time he’s driving into town.” There’s also some interest “from Canberra”—the unspecified Canberra that stands for a faraway federal government—about “some bird in there.” Decisions about Yalingup might have to be made at a higher level of the organization.

The forest affects decisions and nudges thought. What it means to burn next to a pine plantation, to have a smoldering marri by the river, or to get fire to stay within the bounds of burn that has a “complicated shape,” involve forest proclivities that fire managers know from embodied experience.

Upper Capel—a carry over. A portion of the burn has been completed. It was … “well treated,” a euphemism for a burn that might have been a bit too hot. Boranup. A carry over, but it has to be a spring burn. There’s a particular population of frogs in there. The report from the nature conservation people in the Department will be available soon. It’s separated into several little cells that should be done at different

times—on account of the frogs. They wanted to avoid burning the entire area at the same time so as to not put too much strain on the whole frog population.

Mullalyup is next. They joke about Paul's house in the middle of the burn with a dirt road running around it, saying that the landowner is a difficult one, "very sensitive to smoke." But it's an easy burn, they keep it on the plans. Another Yalingup burn. We're waiting for the flora surveys. Spring would be best, after the orchids have flowered. Helms. Part of the burn is for silvicultural purposes. Can it go on the silvics funding program, P 42? Or will it have to be a P 73, the program for bushfire risk management? The FPC has had an issue with the change of government and they put a temporary hold on work to upgrade boundaries. There's "a cockatoo lady." She might "kick up" in spring because of nesting. Has she got some kind of direct line to someone up high? Mitch wonders. It's complicated, says Jay. She's using Parks and Wildlife funding from the Cockatoo Recovery Program to release cockatoos in Helms forest block, so it might look bad if they then went ahead and pushed over some of those trees. The question is, "is this lady a show stopper?"

By chance or by the long barrage of constraints and complications the room, for a moment, exhales in a brief pause. "This should be called issues district, not Blackwood," Mitch says with a resignedly frustrated smile.

But we were far from done. After having pushed some burns to later seasons, we now had 70 burns and a total of 182 000 hectares for the coming year. It was still so clearly too much that it provoked anxious laughter. They started looking for burns

that could be pushed even further. Gradually, they started assembling a good distribution in time, one that seemed feasible in any one of the seasons, but also one that at any one point gave a landscape that projected good future landscapes. Which ones are safest to postpone? Perhaps Happy Valley? It was 16 years since it was last burned, and it would be the second to last block of a large east-west buffer. What are the adjacent fuel ages? It seems tolerable. Mullalyup, in passing, gets pushed back two years. There are three different burns around Greenbushes. They are all similar, fuel ages are almost the same: "either old or bloody old." They can't be done in May because of the Fun Run, Maggie interjects. But it's important to get the areas around the town "back in rotation." There's quokka habitat to consider too. They push them back 12 months. Treeton can be pushed back further as well. What's the condition like in spring? "Boggy" says Alex in such a way as to suggest that it's really, perhaps prohibitively, boggy. Witchcliffe has frogs in the southern part of the block. Hamelin is near the coast close to a popular tourist road. Is it ever going to get burned? Henry wonders. One of the boundary roads could use an upgrade. Or perhaps it's not really necessary. There are already people using it to go out to the coast, and if they fix it up "you'll have bloody Subarus and everything going out there." Maybe it's better if it stays, as Henry puts it, "self-regulating."

The forest enters our meeting through experiences and recollections, expectations of what could happen in similar circumstances—of knowing what it might be like to find yourself in situations with a steep section next to old fuels, of struggling with boggy tracks, or recollections of having seen certain trees in certain places.

There are three burns around Margaret River. One can be pushed back, it currently has 8-year-old fuels. “I don’t like single digits,” Jay says, and everyone laughs. We all know it’s not by choice that so much of the region has fuel ages in the double digits. Scott River has a complicated boundary. It can be pushed back three years. Balances are sought between what seems feasible, what is ideal, and what we can tolerate. Kerr has some steep parts, a plantation on one side and private property on the other. “I can’t see any sense in having a crack at that,” says Henry. It’s pushed way out. A few burns are switched around to “stack them properly.” From south to north, because of the winds.

Eventually we zoom out and sit back for an overview. Andy moves the map on the projector around so we can see the entire district. It’s a pretty god mix, they all agree. A much better balance than when we started out this morning. Burns have been spread out over the coming years, and distributed in space as well. They think aloud about the townsites. “Kirup’s alright,” they say, in the present tense, almost as if the burns had already been carried out and not just placed on maps and plans. The other towns look fairly good too. “Nannup’s gonna be just about the best protected town in the southwest!” Now, the plans are looking good, even if nothing has changed in the landscape itself. They’ve thought and discussed, and mobilized visions of adjacency, rotation, pyro-variability, stacking, and a wide patchwork across the entire district. Now, on paper and on maps, the district exhibits the right kinds of heterogeneity. And many of the burns are ready to go. The gaps are closing, between imaginaries of a heterogeneous landscape and the landscape itself. Real and practical connections have

been established. The maps and the lists anticipate a projective landscape, one that embodies potentials for future forests and future conditions for management.

Attaining heterogeneity, maintaining the regime

The planning process seems to give managers a sense of taming issues so that burning can freely go ahead. A good kind of heterogeneity in the district does now have a certain kind of existence. It's more than an imagined, virtual existence, but of course not yet a feature of the landscape itself. It is anticipated in maps and plans, and made more real by the existence of practical arrangements—routines for burning—that are continually maintained and continually performed. But the good kinds of heterogeneity can also never be *only* a feature of the landscape itself—it will always be both, but never simply one or the other.

The planning meeting, around the large oval table in Kirup, was a point when fire managers no longer had to check boxes and formalize common sense, but could engage in something they found both meaningful and urgent, namely to distribute anticipated burns in time and space, a crucial step in realizing forms of heterogeneity in the landscape. It is clear that management is a very local kind of affair, and one in which fire managers tinker both with the landscape and with social and political issues. The actual state of the forest—whether, at any point, an area is burnt or not—is often related to what a small group of fire managers in a meeting room "reckons" is the best—or at least the most tolerable—solution. But it's not just about tinkering. They also balance principles, they work with shared patterns of thought, and they re-

assemble and reiterate the sought-for landscape forms they have in common in dialogue with each one's experiences out in the forest. Reaching tolerable solutions involves working with the heterogeneities they would like to actualize in the landscape, the complications they want to keep away from landscape-shaping practices themselves, and the lively forest as it impinges on what they can think and do. It involves taming some heterogeneities so that others can be nurtured.

Complexities aren't necessarily in the burning itself, but often elsewhere, distributed, and harder to locate. It might lie in the choice of season to conduct a burn, or the choice of day, it might lie in a structure of responsibility and accountability through which certain complexities can be spread out, and it lies in the prescription process. But there's also the sense that there is a lot of stuff in the prescription process that doesn't have much importance for the actual burning, that doesn't have a direct connection to the state of the forest; things like complexity ratings and risk assessments, about awareness of the social and political context of the burn. It's not only that many of the complexities aren't to be found in the lighting up of a line, the dropping of incendiary capsules from an airplane, or in the hosing down of a log, it's also not necessarily to be found in the work that a sector commander does—such as making sure a 100 meter deep edge is put in on a boundary before the plane lights the core ignition and patrolling for hopovers—and sometimes not even at the OPS level, the level on which the burn as a whole is overseen. Sometimes the complexities are distributed and to be dealt with by many in part but no one in particular, and many non-humans are mobilized to help, such as maps, software, models, indices, and

standards. It requires a lot of work, of distribution and delegation (cf. Latour 1992). Certain kinds of complexity, "issues" especially, are being contained in the prescription and planning process. The stability of the burn routine makes the forms of heterogeneity that fire managers assemble around large oval tables in meeting rooms—with maps, lists, experiences, judgments, and shared patterns of thought—even more consequential, even more real.

Much of the planning process, then, can be seen as a way of ordering and containing issues, of keeping issues as far as possible away from the burning itself; to make sure issues affect their work, but do not affect the forest, and to leave other forms of heterogeneity for the landscape itself. The planning process involves lengthy engagements with issues, formalities, safeguards, boxes—but only in order in order to move beyond, towards the work of assembling and initiating forms of heterogeneity. Assumptions and thought patterns order a mess of heterogeneities. Planning keeps issues in line, under containment. But these practices also embody urges to reach the work that they truly feel to be important, the practices involved in actualizing forest heterogeneity. When issues are being contained—in the perpetually ongoing planning process—other heterogeneities can be initiated, partially attained, as something between aspiration, action, and actuality—in a simultaneous existence where such heterogeneities must always be kept. This is the work involved in creating landscapes that anticipate and project safe and good futures.

I began this chapter with a beige monochrome map that caused worry and inspired ongoing action. I end at a moment when Blackwood district have managed to create

an anticipation of a projective landscape. But they all know burning and planning has to be kept up. Burn planning is a way of mediating the patterns of thought and patterns in the forest, ultimately in order for the right kinds of heterogeneity to be kept always in the process, for *the regime* to be sustained. Burn planning is not just a matter of bringing the virtual and the actual forest together, it is also about holding them apart, keeping them at the right distance. The maps play the role of a keystone, or perhaps a hinge, in this apparatus of management, as a link between the forest, aspirations for the forest, and actions and routines carried out. The maps are an important part of the system that can attain and sustain the regime. For fire managers, what requires care, maintenance, and stewardship is not "nature," it's the regime—the forest in an ongoing emergent state created by a combination of valued forms of forest heterogeneity, a projective landscape that they are intimately involved with.

Fire managers are constantly reminded of mosaics, variation, and alternating patchiness. They live and engage with heterogeneities. On maps, plans, in thought, and in the forest, heterogeneities are endlessly sought, but never completed. The fire regime and the mosaic exist inevitably and inescapably in between aspiration, action, and actuality, where it *must* be kept if the regime is to be maintained.

Chapter 7—The Regime

On Wednesday I saw the Leach burn from the ground. From beneath the forest canopies I could see small flames slowly making oval shapes in the leaf litter. I could see crews putting in generously spaced spot fires (we were in "woylie territory," where a small endangered marsupial was known to live, and had been told in the morning briefing not to "cook it"). In sector C, where I spent most of the day, our focus was on creating good, continuous, and deep edges to be on the safe side before the aerial ignition in the afternoon. We had our attention directed towards the dry leaves and understorey vegetation on the edges. With our eyes and with fire itself we were inquiring of the vegetation how it might burn. But we were equally focused on what was outside the burn area. We were always on the lookout for any "hopovers." The patch bordering our burn on the west side was burned only two years earlier, which gave the fire managers a sense of security, an expectation that if they had a hopover in that area it wouldn't burn too intensely or spread very fast. But to the southeast there was a patch that hadn't burned in 48 years, and this was something they knew to be extra aware of. Later, I saw how the edges were "pushing in," and while we were having lunch, I saw the grey-white smoke lines from within the core of the burn started by the capsules from the aerial ignition. Later still, we were focusing on trees along the boundary roads that were still emitting smoke. Sometimes we would go in and touch parts of trees with hollow stems to see if they were still hot. If they were not completely extinguished, they could continue to be a source of fires later in the season or they could fall over and be a danger to people who use the

forest. Some of these trees could be put out with more water, and one or two had to be "pushed" by a front end loader. Finally, I saw the fire at night, when everything was pitch dark except for the thousands of little spots of glowing embers through the forest where we had lit the edge a few hours before. Where in the daytime you would have to look for little signs of white smoke, at night the remnants of fire shone at us bright and clear. It seemed to be alive, a pulsing glow on the ground and in in the trees, in nooks and hollows of tall jarrahs and in spots along their stems, in smoldering logs that seemed to radiate heat from their core.

On Friday, I saw the Leach burn from the sky. In Barry's two-seat, single-propeller Super Cub we climbed steadily above the trees. At first, there seemed to be vast expanses of forest in every direction. But pretty soon, with more altitude, I could see gravel pits down to my left, and a few small paddocks and farms, interspersed between the green expanses. And the forest itself was laced with thin lines, straight and curved, made by logging tracks, fire roads, and other dirt roads. There was smoke in the air, but it was white and thin, a subtle tinge. They weren't supposed to be flying if they had less than 8km of visibility, Barry explained, and it was just on the right side of that today. The smoke was coming mostly from the Leach burn. Barry circled over. For the most part he was looking for any sign of smoke coming from outside the burn boundaries. If he had seen any, he would have radioed in a smoke report to the office in Collie. Barry showed me how to tell, from this point of view, what had been burned and what hadn't. He told me to look for signs of scorch on the trees, since it was easier to see the patterns of scorch than it was to see the color of the ground

beneath the canopies. He also pointed out short thin lines here and there along the forest floor, and told me they were trees that had gone down during the burn. We circled around the whole burn area and as we were flying over the boundary to the north-east, he pointed to creek lines that hadn't been burned. We could see that the vegetation was more dense, with fewer trees and more green shrubbery, no sign of scorch. Outside the burn boundaries, the forest stretched out with only slight changes in the color scheme. Had we climbed even a little bit higher the patches would have merged to continuity.

For a week or so in October, the Leach burn came into view for fire managers, crew members, spotter plane pilots, and an anthropologist, from certain positions. For a little while, the burn stood out, but only so it could be woven back into the future-producing fabric of mosaics and the regime. In the Leach burn, we could indeed see and feel fragments of the fire regime. But none of us were in a position from which we could see the regime completely.

A burn never reaches the end of the planning process. A burn is never really complete. Even after it has gone through check-points and safeguards in prescription writing, after having been established as a pyro-variable place through field visits, and after having its position in relation to other burn patches, wind, and settlements negotiated in meetings—even then, the short respite when the forest is actually burning both embodies and propels an ongoing cycle. The brief moment of burning anticipates and echoes, it is inhabited by future and past fires and burns. The burn is projective because of its place in larger relational, and never-completed, forms. Any

burn is always envisioned within several forms of heterogeneity that must be continually maintained. Most importantly, it is always part of a whole-of-forest mosaic of different fuel ages, favorable adjacency of burned areas oriented in relation to each other, to wind, and to towns; various kinds of zonings, and a forest with enough fine-grained within-burn patchiness. The combination of these forms of heterogeneity, when they are within the process of being continually upheld, is "the regime."

On a Monday in May, seven months later, I saw the Leach burn again. This time on maps and lists. This time, it didn't stand out. It had receded from focus and back into the fabric, where it was important as part of larger wholes. Here, around a horse shoe setup of tables in Wellington district's burn planning meeting, Leach was now one of many burns that contributed to a feeling that things were going well and that the district was in a good place. Wellington was in a very different place than Blackwood district, just to the south. "Everything's programmed or burnt," Andy said, as we were coming to the end of the meeting. This was a very good thing. Lance tweaked the mapping program we had on the projector so that the burns planned for each of the next six seasons were shown in a different color, and the district filled up with small and large shapes of yellow, red, blue, and so on. As we were looking over the six seasons, someone said, "hardly anything on there as far as hectares go," referring to the fact that each of the seasons had what they found to be a quite modest amount of burns. Andy quickly chimed in: "means it's healthy." It means, as I now

understand Andy's assessment, that the regime is considered to be in place, and that its maintenance is felt to be feasible.

An anticipatory map may be the closest fire managers get to having a sense of seeing "the regime" as such. The map anticipates a landscape that projects futures—it is a preparation for a landscape that can ease certain kinds of fire and inhibit others. As such, the regime lies in the maps and mapping practices as well, as these are practically involved in realizing and maintaining forest patterns. Otherwise, fire managers see the regime in its effects, and they feel it in the affective pull of adjacency and near-adjacency—of feeling safe in the vicinity of 2-year-old fuel and more concerned when close to a 48-year-old area—and in the comfort of feeling like everything is within the plan. They see the regime every time they burn, but they never see the regime as such.[101] The regime lies above all in the futures it projects.

In the previous chapter we saw how fire managers tame and contain some kinds of complexity so that they can nurture and produce others, and that they attempt to keep desired forms of heterogeneity—such as a whole-of-forest mosaic, within-burn patchiness, and favorable adjacency—always in the process of being actualized; in between aspiration, practice, and the forest itself. A lot of this work happens in

[101] I will talk a lot about seeing in this chapter. My approach to sight parallels my approach to knowledge. Seeing is a situated embodied seeing, a kind of seeing that always occurs from somewhere, seeing that can involve all the senses and the entire body, and seeing that involves knowledge frameworks. This is a kind of seeing that involves all the things fire managers know to go into accessing and bringing fire in the forest into view. This is a non-ocularcentric seeing, if you will, but it is still meaningful to call it seeing. Seeing is still one of the most salient ways in which fire managers engage with fire and forests.

offices and meeting rooms, where maps, graphs, and calculations play an important role. A lot also happens in the forest where fire managers never stop confronting and attempting to re-shape the landscape's variable propensity to burn. The regime and the mosaic are figures of continual effort, not something that can be achieved once and for all. In this chapter I dive deeper into the regime, the main overarching state that fire managers try to maintain for the landscape, and I ask, what can happen if the landscape slips from the fire managers' grasp? In other words, what happens if the forest slips out of the regime?

The regime is a suspended state, an ongoingness of practice, aspiration, and the features of the landscape. It is an ongoing projection of spatial heterogeneity that give fire managers a sense of being able to manage fire and the forest. "How will you burn?" fire managers ask of the forest when they plan and when they burn. With climate change comes more and more moments when the forests answers in ways that fire managers are not accustomed to. With climate change and associated processes come more moments where the regime and mosaics are disturbed, moments that poke holes in the regime's exceptional time, when the regime slips from fire managers grasp, where expectations are stretched, where the links between aspiration, action, and the forest are made more tenuous. This happens both by landscapes becoming sparser, flatter, and more certain; and by becoming more erratic, unpredictable, and unknown. In the first case, landscapes tend towards a decisive ruination. These would be situations where the forests cease be to be forests (we saw how forest managers confront this possibility in chapter 3 and 4). In the latter, the links between the present

and the future become more uncertain, and the past becomes a less reliable source of expectations. This chapter explores this latter kind of development, where climate change can enliven fires that act in more fiery ways.

Part I

The regime is ongoing, emergent, future-oriented, real, uncertain, and normative.

There are clear connections between the concepts of 'regime' and 'prescription', not just in the context of fire management. Jordheim writes: "Coined in fourteenth-century France, 'regime' designated a kind of medical treatment, a particular course of diet, exercise, medication, and so on, *prescribed* or adopted for the restoration or preservation of health" (Jordheim 2014: 509, my emphasis). The regime is what is prescribed to preserve a certain state. In the case of fire regimes, the regime lies in the patterns of burning prescribed to the landscape to keep it in a certain state—the "mosaic" expresses a crucial aspect of this state—but in fire regimes, what the forest and fire themselves do are also central elements of the regime—perhaps like it would be if the concept of a medical regime also included the body as an active and independent doer. It's as if fire managers acknowledge that it is the forest itself that burns, that it will always burn in some way or another, and that their contribution is to sway it, or persuade it, to do its burning in certain patterns. The regime concept points to an *ongoingness*, and the ways in which something must be continually upheld and maintained. Moreover, in the regime, time and space are allowed, in a sense, to become denser. As a practical project, a regime makes and defines itself as a figure

with temporal coherence—a dense ongoing form that stands out from what by contrast is made to appear as a more neutral passage of time, a background duration of more ordinary time. For fire managers, the fire regime is meant to endure while elections come and go, independent of things passing in and out of fashion, of changes in regional economy, of organizational changes in the Department; even, ideally, of the changing climate. This way of creating exceptional time is also a feature that can characterize regimes of the political kind. Soviet Russia, as Yurchak (2006) argues, was in a sense outside of time: it was a state where "everything was forever until it was no more" (Yurchak 2006). Regimes can create for themselves a duration that seems to exceed, or be independent from, the normal passage of time.

The regime is *emergent*. The regime lies in the patterns of thought and practice associated with burning on rotation, those involved in seeking to maintain a mosaic of different times-since-fire across the entire forest, and the practices that stack burns and place low fuels areas in favorable places of the landscape. But it doesn't lie in any of these alone. Rather it lies in the emergent condition that a combination of good kinds of heterogeneity can produce. The regime is a state where these heterogeneities are always in the process of being actualized and at any one moment balanced in a good way. In both its ongoingness and its quality of being emergent, the regime has certain similarities with the "plateau" as articulated by Delezue and Guattari. They write, with reference to Bateson, that a plateau is "a continuous, self-vibrating region of intensities" (p. 22) which never comes to a climax.

The regime is stretched out in time and space. Above all, it is *future-oriented*. The regime lies not so much in the way a landscape exists in the present as in the kinds of futures it enables. A fire regime is not a presentist phenomenon where "immediacy alone has value" (Hartog 2015: xviii) but instead something in which fire managers see possible futures. A present forest eases and inhibits future fires of certain kinds. The fire managers' ideal regime also lies in a situation where practices and elements are aligned such that this kind of state can be kept going. It lies in producing an emergent state in the forest, and in being able to maintain that state. The combination of several sought-for forms of heterogeneity make the forest a "projective landscape," a landscape in which foresters see several possible futures, but also a landscape whose material composition projects future states and future ways of burning.

The regime is *real*. The regime is significant for fire managers *only* insofar as it has effects that are real, felt, and tangible for them—such as effects on the ways the region burns in wildfires, effects on how dangerous it is for fire fighters to engage with the flames, and effects on the extent to which the region has habitat opportunities for most species. The regime is real for others than humans too. The regime is real in a similar way to Timothy Morton's "hyperobjects" (Morton 2013).[102] Hyperobjects and regimes alike are "real whether or not someone is thinking of them" (Morton 2013: 2). They are also real things that one can only ever see pieces or fragments of at any one time. They are distributed, they "outscale" us (Morton 2013:

[102] I'm not arguing that the regime *is* a hyper-object as Morton describes them (i.e. has every single one of the qualities he associates with hyper-objects), only that some of the elements of hyper-objects can highlight the way in which the regime is real.

12). The regime and the hyperobject are both real things that are partially "withdrawn from humans" (15). The regime also contains other hyperobjects—real things that we are inside of, that outscale us, that are massively distributed, and that we can only apprehend in pieces—such as climate change. When you experience a wildfire you are experiencing climate change and you are experiencing the regime—perhaps as manifestations of the difference that they both make, or alternatively, to paraphrase Morton, as ghosts of themselves that they emit for our perusal (74)—but you can never see either of them directly or completely as such. As one fire manager told me about climate change: "we can't see big enough." The same goes for the regime.

The planning process we saw in the previous chapter, as well as the burns themselves, are among the things that allow forest managers to look at the at trees, scrub, leaves, and soil and see something that can be established and maintained as a regime. The notion of a regime must point at the same time to some feature of the landscape as well as the knowledge frameworks and practices that allow fire managers to apprehend and shape the landscape as such. But the answers forest managers get from the forest are also part of this framework—the way the forest burns, the way it responds to their expectations and assumptions, and the ways it defies them, the ways it tugs and pulls at their patterns of thought. The regime, then, is also *uncertain*. It is about patterns and it is about uncertainty, about management practice and experiences with fire in the landscape. Certainties lie, for the most part, *outside* the regime.

The regime is *normative* in the sense that it involves judgments and assumptions of what is good and bad for the forest. The regime and the mosaic express desired kinds

of diversity and desired futures, and inevitably exclude certain other futures. They express the value of a forest that is manageable, diverse and variable, but massively biased towards what is experienced as mild and manageable for fire managers. Mosaics, patchiness, and adjacency express the conditions that are seen to be necessary to realize this good kind of forest.

The regime, as a form of relationality, has quite a lot of similarities with 'the state'[103]. The points I've made about the regime in this section are not entirely new insights about formations we can call "a regime" or "a state." What I want to emphasize, however, is that this is not commonly how scholars have conceived of human-environment relations. To see ourselves and the landscape as being involved in a regime—as sharing a state—gives an environment which is profoundly *not* out there apart from us, something we can know in itself, or something for us to overcome. It is also not something that primarily consists of historical buildup of traces and form.

[103] Many have described the state as a dispersed network of people and things or as something present in "millions of banal encounters" (Trouillot 2001). The state can be a network that disperses responsibility, that sometimes can appear like an entity (cf. Carroll 2012), as well as something that has very real transformative effects. Moreover, the state can be approached as something that is continually constructed, both discursively and in practice (Gupta 1995), often oriented towards the future (Bird Rose 2004), and that creates those within it as citizens and populations (cf. Foucault 1976, 1977). Of course, there are difference as well between the state and the concept of regime as it arises from the practices of West Australian fire managers. Most of the state literature is in some way antagonistic, oriented around power, and usually from the perspective of the governed, or they are inquiries motivated by the concerns of the governed. We could perhaps see fire managers as the governors of the regime, but to see with the regime is different than "seeing like a state" (Scott 1998). Fire managers cannot with the regime force a landscape to burn in such and such ways in the future. There are certain kinds of wildness—by which I mean both a liveliness that can be violent and dangerous to them, and a sense that fire in the forest in some way or another is inevitable, fires will happen whatever they do—in fire that fire managers feel to be beyond prediction and control. Fire managers' conception of regime is less about dreaming about an order they can impose, than about living in a flexible and ongoing state.

The regime is a formation that peoples' actions are involved in attaining and eliciting—where fire managers, fire, and forests are part of something bigger and partially shared. But it is also something that *needs* to be continually performed, and something that cannot wait or be put on hold. It points to a specific form of connection where fire managers are *systematically* intertwined, as well as *bodily* intertwined. They are systematically intertwined through patterned practices; routines of mapping, measuring, observing, planning, burning, patrolling, flying, and so on. Systematic regime practices are the kind of things expressed in departmental "best practices" and "standard operating procedures," and they are the less formal procedures that go on within offices and in the field. Fire managers do tinker in specific situations with how best to keep up mosaics, patchiness, and adjacencies across the landscape, but the regime—the projected future ways in which forests will burn—is not to be maintained through improvisation. They are bodily intertwined as well, through bodies that become used to such things as the warmth of still burning hollow trees, the different tinge of burnt and unburnt stems, how far to walk between spots on an edge, and the feel of a breeze that picks up. And they are intertwined with landscapes that become more than something out there for them to involve themselves with. However, even while the regime involves systematic and bodily ties, it also has relatively little enduring solidity or momentum on its own[104]. What

[104] The regime might differ from many kinds of domestication in this regard, and not just the domestication of conventional narratives where animals and plants transit from wild to tame, and societies progress towards civilization, through agriculture; but also from more complex stories that are non-linear and involve the liveliness of many species. There's no easy way to other kinds of interrelations for a chicken if people were to stop chicken-rearing practices. But if people were to stop burning the forests would still burn.

different kinds of regimes have in common, according to Hartog, who writes about "regimes of historicity," is that they point to "mixtures and composites and an always provisional or unstable equilibrium" (Hartog 2015: xv). We are entwined with cattle, wheat, and our microbiomes much more enduringly than we are with a landscape in a fire regime. The regime has little inertia. If people stop burning, the advantageous combination of heterogeneous forms in the landscape disappears fairly quickly. And it may even be that it disappears more quickly now than it used to.

This bring me to what I call the ***threshold liable to disappear***. It is this chapters' first example of how the regime may be weakening. For fire managers, the difference between a patch that was burned two years ago and a patch that was burned eight years ago is quite significant. They are much more at ease in the vicinity of the two-year-old patch. The two-year-old patch is also a good potential building block for stacking of burns and favorable adjacency, while the eight-year-old one, depending on where it lies in the landscape, would soon be due for another burn. But the difference between a 12-year-old patch and an 18-year-old one is much smaller, and the different between a 42-year-old patch and a 48-year-old one is just about non-existent. The latter two would be expected to be equally dangerous in case of a wildfire or when adjacent to a burn. Fire managers approach ages since last burn with a much finer discrimination in the first few years.

I've mentioned the six-year threshold before (see chapter 6). It is the rule of thumb—which fire managers always treat as a simplification—that it takes about six years in jarrah forest for 8 tonnes of leaf litter per hectare to accumulate on the forest floor and

that 8 tonnes per hectare is a threshold above which they can expect a fire to be so intense that it is not safe to confront it with direct attack. In other words, a kind of pyro-uniformity begins to be introduced around this threshold. It is expressed for instance in maps that have the same color for all fuel ages above 6 (as we saw in chapter 6). Now, it seems like the six-year threshold is being destabilized. The drier vegetation and more extreme fire weather could mean that it's quite possible for extreme fire behavior to occur in forests with less than 8 tonnes of leaf litter per hectare. Researchers have suggested this possibility (e.g. McCaw et al. 1992), but it is also something fire managers feel and see in practice. In some of the recent very intense bushfires (see chapter 4) they have experienced fire that sometimes seemed almost indifferent to low fuel areas. Fire managers' fine discrimination of the first few years after a burn may now be confounded. Under certain conditions—for instance a very hot and dry summer day with high winds—it may just be that they have to consider pyro-uniformity to begin even between patches that are less than six years old. The six-year (or 8 tonnes per hectare) threshold liable to disappear is a propensity propelled by the drier weather that produces a forest where fire managers can no longer with the same confidence see a threshold below which the forest will burn in mild and manageable ways.

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In previous chapters I've tried to convey the knowledge frameworks and patterns of thought that allow fire managers to see the forest, fire, and climate in particular ways. Now, I also want to point out some things that their knowledge frameworks make it

difficult for them to see. Here I introduce two blind spots for the regime and the mosaic. I use these as access points. They can help me to further describe the contours of the regime, and specifically the contours of the particular fire regime that fire managers try to actualize in the southwest *as a regime*. The regime is, I believe, a phenomenon that fire managers can only partially see and articulate, partly because they are in the middle of it. Therefore, other sides of this figure can be illuminated by looking at blind spots and lacunas. The regime contains two spheres of uncertainty: one that fire managers deal with directly and explicitly, and another one they don't. One lies in a near future into which fire managers try to project landscapes that will burn in certain ways; the other lies in parts of the landscape that they either experience, but do not conceptually order, or do not experience at all. These blinds spots are also in part products of these same knowledge frameworks—they are shadows with a certain shape (rather than an ambient excess of all the things we don't know).[105] I've come to these blind spots not always directly—not always by what people have told me or by what I've observed them to be doing—but by a vaguer and slowly growing sense of where fire managers' confidence slips or ends. Hence, what follows has elements of speculation.

The opaque mid-level

[105] That the knowledge frameworks of the regime produce blind spot is not to be understood as a flaw, and it is not to suggest that it would be more "complete" if it didn't have these blind spots. Fire managers' regime practices are not practices aiming for representational correspondence, they are practices aiming to create patterns that channel and constrain futures. Knowledge practices shouldn't be understood apart from these practices, just as they shouldn't be taken as something apart from the forest.

Those who burn the forests of the southwest display a knowledge gap. Fire managers can speak with a lot of confidence about the very long time scale (deep time, the long durée), and the very short time scale (the scale of the event, from one burn to the next), but they cannot say very much about what's in between. Certain kinds of duration at the regime scale have become dense and opaque, whereas others—the very short and the very long—turn out sparse, crystallized, and almost translucently clear. Fire managers can readily tell you what a single burn will do—for instance that scorching will cause jarrah trees to shed leaves, that a burn will stimulate underground lignotubers and prompt the rapid growth of certain plants such as "fire ephemerals" and "disturbance opportunists," or that ground fuels will accumulate by this much annually for the years following the burn. They can also speak with a great deal of confidence about evolutionary traits and features that plants have developed over such a long time that they have come to seem immutable—like the jarrah tree's fire-resistant bark and capacity to regrow from epicormic shoots after being burned. Additionally, they know a lot about what futures can be created (in theory, if not always in practice) by burning in particular patterns. They know a lot about the ideal landscapes they would most of all like to be able to maintain. But they cannot speak very confidently about what becomes of the remnants and traces of their interventions. The regime scale, the mid-level time scale, is what they have in mind when they intervene—when they plan, and when they burn—but it also has its blind spots, relations and processes that are concealed to fire managers. We know that

when we look at the forest, we can see ripples of deep time. We can gaze into Gondwana, so to speak. But somehow, it also seems we can't see past the last fire.

Lee was one fire manager who spoke very confidently. When he told the crews what spacing they should use for the spot fires on the edging, Lee was confident that there wasn't anything here that would take harm from a burn slightly hotter than necessary. When we drove around to look at how the burn was going, he spoke confidently about seasonal patterns in burning. Many environmentalists object to spring burning, he began, as we drove very slowly along a dirt road with flames crackling in the understorey on our right hand side. This was because the spring is associated with nesting, seeding, and regrowth in many species. But there were problems with this kind of reasoning, he told me. He took the quokka, a small charismatic marsupial endemic to the region (with a large online presence[106]), as an example. If you only burn in autumn, you will burn the prime quokka habitat—vegetation along creeklines. He didn't have to explain why. He assumed that I knew autumn burns usually burn more uniformly and more intensely because there is less moisture in the soil in autumn and pretty much the entire landscape will have dried up over summer. If you only burn in autumn, he reiterated, you won't have any quokkas. But on the other hand, if you only burn in spring, you won't get the quokka habitat regenerated after a suitable amount of time. If quokkas were the only consideration to take into account when burning, he said, the best thing would be to burn first in the spring when the

[106] Quokka selfies are a big thing on Rottnest Island off the coast near Perth where quokkas are still very abundant. Taking selfies with quokkas became especially popular among tourists after some celebrity quokka selfies went viral in 2017, most notably by tennis legend Roger Federer.

creeks won't burn (because they hold more moisture than the rest of the landscape), then burn the second time also in spring when they won't burn, and then the third time in autumn which will reset the quokka habitats, as those areas will then have grown too old for the quokka's preferences.

Lee might appear to see three burns deep, but these are only three burns in succession. The principle behind his quokka example can be stated more simply: burn in spring, when the burn won't destroy quokka habitat, until those areas have outgrown quokka preferences, and then burn in autumn to restart the growth cycle. In this case, Lee sees the very long and the very short. Quokkas have unchanging preferences, and the places quokkas have preferences about stay the same. Lee thinks with processes, but the processes are constants. The fires, moreover, do not have cumulative or emergent effects on either quokka nor habitat. Nothing accretes or recedes in this duration. Nothing is transformed. Instead, what the fires do—the first, second, and third alike—is simply to either burn or not burn vegetation around creeklines. The quokkas and creeklines do what they've always done.

The opaque mid-level on the other hand is un-decided. The opaque mid-level would lie among other things in knowing that the quokka example is too simple, even if one might not be able to say exactly in what ways. Lee might be able to see details in the landscape that exceed his simple quokka example, but he might not see them as part of a medium time-scale transformation. In that case, opacity lies in not having a conceptual means to make details, features, and events meaningful as ongoing processes of transformation. Several things happen at this medium time scale, but for

fire managers these are mostly either things they are uncertain about or things they don't (can't?) even ask questions about—matters that they don't have completely insight into, matters that, for them, are opaque. The first of these two kinds—uncertain mid-scale phenomena and processes—is quite easy to exemplify, the second, is difficult to even think about. The first includes such things as interacting or "stacked" disturbances. This could be, for instance, the combined effects of logging and fire, or mining rehabilitation and drought, phytophtora and fire, silviculture, drought, and fire, and so on. Fire managers see trees, plants, and patterns of vegetation all around them that they know are likely affected in various subtle ways by these historical and quite recent processes. But in most cases, they do not order them into coherent conceptual patterns. They know something might be happening, but not quite what. The second kind includes more unnoticed transformations, and here I speculate (neither fire managers nor I can tell you with much confidence what transformations do or do not even really occur). It could for instance be the effect of rotation—what accretes and what recedes in a landscape that is burned every six years ten times in a row? Or what lasting effects does a *tendency* towards more spring and fall burns and fewer burns in summer have?

The short and long times will often stand in relation to each other as particular to general, individual instance to model. We can know that this particular fire may cause the grasstree to flower because that's what grasstrees do, part of what a grasstree *is* is to flower after a fire. We can know that a jarrah sapling will survive most fires and grow back from lignotubers, because that's part of what it is to be a jarrah sapling. In

intermediate time, regime time, in contrast, we find neither particulars nor models. Unresolved at this timescale are questions such as: at what point do events and occurrences grow to something beyond themselves, and at what point do mid-scale transformations have long term effects? Other questions that fire managers don't ask include: what even is the medium scale? Where does it start and end? Is it something that may either grow to a long-term effect or be a transient intermediate that fades back or is reset? Does the medium scale perhaps exist only ex post facto, so that we can only know that it was a medium scale build-up once it's turned into something long term? –in such a way that if it didn't turn into a long-term effect, it wouldn't ever be possible to say if it had even been a medium-term transformations, or if it had just been a succession of individual occurrences? This is the timescale of build ups, accretions, and gradual transformations. Many of them may dissipate before they turn into something that fire managers are able to notice.[107]

The short and the long time scales are where a jarrah tree does what jarrah trees do. The medium time scale is where a jarrah tree may be in the process of becoming no longer a jarrah tree as we used to know it. It is where a jarrah tree, or Jarrah Tree, flexes, pulses, stretches, shrinks. The opaque mid-level, as a blind spot, shows a bias towards thinking of—and acting out—a world where there are stable and enduring traits on the one hand and discrete and successive occurrences on the other. If we focus on the blind spots of the regime, perhaps medium time-scale transformations

[107] Could it also be the time scale of Mendelian inheritance?

can appear to us instead as the lively pulsations of the landscape itself. Pulsations which fire managers take part in, yet cannot quite apprehend.

The invisible mosaic

Those who burn the forests in the southwest sometimes surprised me with their curiosity and sometimes surprised me with their lack of it. The first test fires of a burn, or the beginnings of an edge, for instance, usually garnered very little interest, and sometimes I found myself watching carefully the flames spread in calm ovals while the others had a cup of tea or a chat about nothing in particular. Sometimes the flames would be treated as indexical signs, for instance to tell us with some certainty what kind of wind we were dealing with. But other times, I saw fire managers walk away from spot fires confident that the flames would stay put. Often, they already knew by other signs—it could be dew on leaves in the shade, or the absence of wind—that there wasn't much room for the fire to transgress. I saw them turn their back on flames that apparently couldn't tell them anything interesting or conceivably do much that would surprise them. But there are other more revealing gaps in interest, one in particular can tell us something about the nature of the regime.

Fire managers displayed a marked disinterest in the burn before the last. The last burn was always relevant for its effect on how the next one might burn, but the burn before that again didn't seem to be of much interest. The previous burn may have been very patchy or not very patchy at all, and it might have been mild or intense. In all cases, the spatial patterns of burned and unburned patches left behind by the last burn would

be direct conditions for the next. It is far less clear, to fire managers, whether the burn before the last, or the one before that again, have any lingering or cumulative effects. For practical purposes, fire managers seem to have an unspoken working assumption that an area is *reset* by a fire or a burn, even while many are silently aware that this might be a simplification. Most of the representations they surround themselves with—their maps, plans, graphs and tables—reinforce this working assumption: when an area has been burned it starts on zero, zero years since last burn, zero tons per hectare of ground fuel. You can look at graphs and trace your finger down along columns that start on zero; you can look at maps with shapes filled in with the color signifying zero years. The zero point is hardly ever qualified or specified[108]. Very few fire managers spared a thought for questions about the burns before the last. But a few ecologists did, and some of them called it the "legacy question" or the question of "the invisible mosaic."

It was at the Ecological Society of Australia's annual conference in 2016 that I first heard about "the invisible mosaic." In a grey windowless conference room, at the end of a panel on disturbance ecology, the presentation from a post-doc from the Australian National University dealt with how one can go about "reinstating" fire mosaics after a large wildfire event. She had studied landscapes in the years following a wildfire in Booderee National Park in New South Wales which happened back in

[108] One exception would be so called "haircut burns," burns in areas that have not been burned in a while that end up only removing the top layer of litter fuels. Few haircut burns are done these nowadays, however. The Department did a lot of these burns in the early days of prescribed burning when they were dealing with a lot of long unburnt areas.

2003. Now she was seeking to complicate the notion that a bushfire leaves a blank slate. Two different kinds of mosaics are present after the fire, she argued, a visible mosaic and an invisible mosaic. The visible mosaic was the patchy landscape of areas burned and unburned, and areas more and less burned, created by the wildfire. The invisible mosaic lay in the past fire history, the frequency and intensity of the different fires prior to the large fire event. The central question was whether the underlying "invisible" patterns were still having effects, or if they were basically "erased" by the fire. Were they still part of the present, something that was continuing to have real effects, or had they become past, merely something for us to record? Some elements do indeed persist, she found, such as patterns of understorey and ground cover and vegetation structure. These were elements that were not reducible to more stable underlying factors such as soil composition and terrain, but were patterns that were caused by patterns, such as a pattern of fire frequency or a certain fire intensity repeated over several fire events.

If we think of frequency as an abstraction, we miss the invisible mosaic. Alternatively, we can look at it as a real thing that exists on another level of reality, something that other beings might be able to respond to directly even if we can only apprehend it indirectly. What if it is frequency itself that quokkas and jarrah trees respond to? When fire managers in the southwest try to attain whole-of-forest mosaics, within-burn patchiness, and favorable adjacency, they are working with visible mosaics, thought of as a relationally defined patchwork oriented towards the

future. Alongside the opaque mid-level, the invisible mosaic is a lacuna at the regime scale.

What do these two blind spots reveal? Above all, they show us a future-oriented bias and a difficulty with a certain time scale. The regime conceals its own recent past[109], even as it allows managers to shape the future with confidence and optimism. Fire managers think intensely about a certain kind of mid-scale, where whole-of-forest mosaics, within-burn patchiness, and favorable adjacency together can create an emergent state. But they are blind to a different kind of mid-scale. The regime creates little build-ups in the shadow of what fire managers do to shape the forest for the future.

A "fire regime" involves, for forest managers, an apprehension of the landscape as a ***thickening of time.*** The regime is something with a duration, something that is drawn out. The regime thickens differently in two different directions—towards the future and in the non-immediate past. One of these, fire managers emphasize and think about explicitly—they bring out the future-oriented side of the regime as a figure against a ground, an exceptional kind of time. In the regime and the mosaic, the present state embodies futures. I've used the terms projective landscapes and infrastructures for the future to point to this phenomenon. Fire managers overtly create future shapes. The other direction, the accretions of the present and the non-immediate past, is downplayed and concealed. But time thickens in this way as well.

[109] In this sense, fire management has something in common with a lot of bureaucracies. Concealment is often, as Mathews (2008) has pointed out, part of the workings of the bureaucratic apparatus.

It is a non-immediate past—deeper than the event scale, but of unknown depth—that builds up, but hides itself. It is an emergent, accumulated, transformative past that fire managers have trouble apprehending and a tendency to conceal. Some of these transformations may be little things fire managers see all around them—for instance a forest with few lignotubers, or a patch of jarrah that is "locked up" (see chapter 5)—but that isn't relevant to the regime, that isn't being conceptually related to patterns of burning. Some transformations also might lie in a weirdness that they don't even see directly, as part of a landscape that happens at a plane of reality they only have partial access to, for instance one that lies in frequencies and tendencies.

The regime, in addition to being a feature of the landscape and an expression of the maintenance of a combination of valued forms of heterogeneity, is a machine for ordering time. The regime conceals the non-immediate past, but makes the future more manageable. If the regime is maintained, it can function as an infrastructure for the future, channeling (but not determining) particular futures and discouraging (but not making completely impossible) others. Ultimately, if kept up, the regime gives a forest that fire managers can almost trust. Or, perhaps rather a forest that's trustworthy only until it's not. In the blind spots we can also find the traces of a forest that does its own thing. And the fire managers' regime contributes to allowing them to not always have to confront this liveliness. But now, increasingly, with climate change, some of the things the forest does come forcing themselves into fire managers' fields of attention. Could it be that the accretions of the mid-level are where the most dramatic alterations of climate change build up?

It seems sometimes like the opaque/concealed accretions grow larger while the predictable futures that the regime and mosaic seek to produce are weakened. In the second part of this chapter I expand on apprehensions of the regime slipping. Fire managers experience a sense of partly losing the regime in a few different ways: as a more tenuous past, as more elastic expectations, and as a present that may no longer be an infrastructure for a good future.

Part II

How does the forest answer?

Sometimes, my questions and my informants' questions overlap. We're both interested in the history of the forest itself, and in the history of disturbance. We're interested in what ways the forests have burned in the past, and how they will burn in the future. And we're both interested in finding the best ways of interacting with the landscape.

We're both curious about forest history and processes in the landscape, but not always in the same ways. For fire managers, curiosity is often something implicit, tacit, in the background, largely because the fire or burn itself, and the forms of heterogeneity they are involved in, are more urgently pressing concerns. We can distinguish two kinds of noticing that are involved for those who burn the forests—an overt and explicit noticing which is pragmatic, and an underlying curiosity which

comes through at particular points. In this section, I magnify fire managers' underlying curiosity and the moments when this comes to the surface.

One aspect of our mode of engagement is how we ask questions. In that case, one could easily recognize among fire managers an unproblematic coexistence of the two kinds of engagement that anthropologists and science studies scholars typically find in science—both tinkering and a commitment to rigorous scientific methods, both measurements and calculations and a 'feeling for the organism' as Evelyn Fox Keller (1983) has put it. I could find that they tried to attune themselves to the forest, and also that they tried to see it through models in which the forest landscape was something abstract, and that they treated both of these approaches pragmatically. A calculation was never enough on its own, but neither was a touch or a sense, an observation, or an anecdote. But more interesting, I think, is the way we can see in fire managers' practices both how the forest comes into view through patterns of thought and frameworks of knowledge, and how the forest itself affects and impinges on fire managers' forms of thought. Fire managers, in this sense, are in a dialogue with the forest, a forest that is so much more than merely something out there to be grasped or known.

The main question we asked of the forest is this: ***How will you burn?*** Fire managers ask this question every day of the fire season, and often many times a day. Answers are sought for right away—how will you burn today, how will you burn this afternoon—but answers are also sought for the future—how will you burn next year, or 20 years from now? With the projective landscapes of the regime, fire managers

attempt to create landscapes that in near futures will give them the answers they want. The most interesting thing for me, however, is not how they ask this question, but rather how they make sense of the forest's answers. In addition to asking "how will you burn?" they also ask meta-questions, such as "what do your answers look like?" We can find in fire managers' practices and their styles of though a practical and dynamic theory of *how forests answer*.

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When using a drip torch, it's not just *as if* the fire is liquid. From a canister through a long metal tube with a wick at the end ignited kerosene is what drips out onto the forest floor. The kerosene quickly burns off and soon it is the forest itself that responds to the fire. Most often, we want the liquid flames to start small fires that it makes sense for us to refer to with water-metaphors, fires that "trickle" around on the forest floor.

Such were the first spots of fire we set at the Driver burn, where crews and managers gathered one mid-morning in early November. It was an unremarkable burn, but one I'm telling you about precisely because most answers from the forest come from unremarkable everyday encounters like this one. The day started with a test fire, a match that we threw down onto the leaf litter by the side of one of the dirt roads that acted as a boundary for the burn. Then we left it alone for an hour or so. Later, I followed Henry, the operations officer for the burn, as he walked in through tall scrubby undergrowth across the ground that had been covered by the test fire. We

stepped over the low flame at one end and Henry walked across to get a rough measure of how much ground it had covered since it was lit, each step arousing a puff of grey charcoal dust around his leather boots. About 10 meters per hour he reckoned was the rate of spread.

Even with such a sedate morning test fire, it was clear that this would be one of the last burns of the spring season. A surface trough—an area of low atmospheric pressure—was on the forecast in a few days, and after that the soil and the vegetation would almost certainly be so dry that it exceeded what the Department regarded to be safe conditions for burning in spring. Today's burn would be diligently kept an eye on. Every hour, Neil, another fire manager working on the burn, took weather observations and reported over the VHF radio to Henry and to the office. He reported on temperature, dewpoint, relative humidity, wind speed, including in gusts, wind direction, and cloud cover. We also took measurements of the moisture content in the leaf litter a few times and saw it drop quite a bit in the late morning hours, such a big drop in fact, that it caused some concern. Between crew leaders, sector commanders, and the operations officer there was a continuous interchange of observations about fire behavior. Sometimes they talked about rates of spread—in the early afternoon they reckoned the edges were burning at a rate of about 40-50 meters per hour—and sometimes they exchanged seemingly vague descriptors like "it's willing," or "it's goin' a bit hot," descriptors that got their meaning from shared experiences, shared assumptions of what we could expect from a day like this and about what kind of burn was desirable.

The fire managers engaged in a cooperative questioning of the fire and forest, where provisional answers were steadily emerging from the coordinated activity of field officers, crews, measurements, and standards. The fire managers engaged with the fire through standards as well as through bodies that are used to the same range of heat and intensity, bodies worn into similar patterns. When these men and women burn, they expect with their whole bodies—with ears that know the crinkling of boots on dry leaves, the crackle of a small fire and the full spectrum thunder and whoosh of a crown fire, with eyes that discern the dark coppery tinge of a burn that has picked up in intensity, with legs that recall the safe distance, and hands that remember the feel of a hollow log that might flare up again after having been put out. To see a fire as "willing" takes a habituated body, perhaps more so than a well-tried model.

At some point, the fire behavior picked up, we got crown scorch from a spot that suddenly flared up, flames reached up to canopies 20-30 meters above, the smoke made my unaccustomed eyes watery. The fire managers exhibited what I read as a particular kind of surprise. Subtle signs that conveyed that something was different than they had expected—it might have been a tone of voice, a lingering look at the flames that lasted longer than normal, or a slight urgency in their gait—accompanied evaluations and suggestions they exchanged between each other. They seemed surprised that it flared up, but not surprised by the fire's capacity to take them by surprise. Henry decided to do adjustments, to go with a wider spacing between the spots to be on the safe side. At one point I heard him say to another colleague that

“it’s fairly wooly out here, we’re coming towards the end [of the season], that’s for sure.”

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Throughout the day we ask the forest, “how will you burn?”—with measurements and with observations of flames and vegetation. The first fire of the day was a test fire, but so, in a sense, were all the other fires. And we are not just *observing* the forest and the flames, we’re intervening or interacting as a way of asking questions—it’s an inquiry with fire. But as the fire starts to behave differently, we begin, implicitly, to ask meta-questions: questions such as “What do the forests’ answers look like?” And “do we really know what this kind of fire is an indication of?” Unexpected flare-ups, sudden drops in moisture, a fire that burns faster than we thought it would, are small events partly outside of patterns. They are slight pressures that make meta-questions percolate to the surface.

At some points, the fires no longer trickle. Different metaphors appear; different sounds, different motions, different sensations. They start to flare, crackle, it gets “wooly” and “willing.” These are the moments when underlying curiosities come to the fore. Such moments are always multi-scalar points—it is a time of the day, a time during the season, and a point in the long ongoing drying trend associated with climate change. It is after logging, after forestry, after indigenous burning was excluded from the landscape, after phytophthora dieback, and after damming of most of the region’s rivers. Such moments are more than simply now. Possible accretions

and transformations come into view in these moments, they nudge themselves into our field of attention. These moments involve three interrelated but partially independent drying processes, and when they intersect, figure and ground are liable to shift, and the ground itself becomes liable to re-form. For the most part, climate is the background, a kind of context, and what's more immediately relevant for how the forest will burn are the daily and seasonal weather and drying processes. But now, we're not really sure anymore which is figure and which is ground. The forest, the burn here in Driver forest block, is no longer simply right here.

Now, the forest seems to answer in a different way—erratically, with wavering indecision, with sudden changes of mood. And pragmatically, these are the most crucial moments—we must search most of all for the kind of answers we're not sure if we're able to grasp, for the signs we're not entirely certain we can recognize. At such points, what an answer from the forest looks like is an open question, we don't act as though it's settled. It's almost an existential point of a burn, where certain flames have the potential to call into doubt several levels of knowledge—little pockets where assumptions are relaxed—about what's happening, what we know, and about what we're able to know—and where the associations of form which make up the landscape can be made and unmade. In these moments they're opening up, ever so slightly, to the possibility that jarrah trees and other things in the landscape may be becoming something else. In these moments fire managers are nudged to train their capacity to re-form assumptions.

More elastic expectations

Let me pause and talk about two patterns—or better, 'almost patterns'—both associated with the drying climate. These almost patterns are situations when fire managers are especially aware, especially sensitized to the unexpected. These are not situations in which they know that something *will* happen, nor are they situations where they know *what* might happen. They are situations in which they have a heightened awareness that something unexpected could occur. When these circumstances start to develop, fire managers can find themselves in the seemingly paradoxical situation of expecting to be able to expect less. Or at least to be able to expect with less confidence. These are quasi-patterns, forms that stand out, but only diffusely.

The first is related to soil moisture. On a handful of occasions, I heard about a new challenge that fire managers have with burning in conditions with unusually dry soil. Jim, the district fire coordinator in Frankland district, had an hour or so to talk with me after the district's planning meeting and the first thing he brought up was the experiences they'd been having in the last couple of decades with drier soil. Now, in even more recent years, they had been seeing some prescribed burns that had acted more like wildfires, burns that had been much more intense than expected. Jim mentioned one particular burn where they thought they would hardly get it to go at all, and then it ended up burning a kilometer in by itself. Adrian, in Wellington district, mentioned a burn that had done something similar during the annual burn planning meeting. At the day of the burn, Adrian told us, it had been very moist. They could only barely get an ignition, he said. The surface moisture content had been as

high as 72-75 percent[110], but the soil had been quite dry. Then later on in the day, suddenly it had been very different: then, "basically everything had caught alight." Erin, in Blackwood district, was a yet another one who told me about this challenge. In a small room with a stationary computer we sat together and perused different graphs concerning changes in soil dryness. An interesting thing, Erin said, was that in the last few years, even though the graphs made it look like the soil had been fully saturated over winter, it was sort of bobbing up and down through the season, meaning that the soil wouldn't be completely saturated for very long at a time. They were starting to see indications that this had an effect on their burns. Because the ground wasn't saturated for very long, logs and other coarse woody debris on the forest floor might not have had the chance to get thoroughly saturated in the course of the winter, and then, come spring, they would be drier than expected, and more of these logs would be prone to flare back up in summer or be unusually dry when autumn came around. There are innumerable logs, stumps, and fallen branches out there on the forest floor, and many of them are drier than they used to be. Soil and logs together now seemed to fill the landscape with elements that were too dry, that were dry for longer, and that were out of step with leaf litter and vegetation.

To be clear, what was new and unusual wasn't that the soil was very dry. What was new was that the soil was very dry at times of the year when it didn't use to be *that* dry. The expectation that Jim's and Adrian's burns would hardly ignite at all would

[110] For comparison, at the Driver burn I described earlier we had measurements of between 16 and 6 percent surface moisture content.

have been based on measurements and calculations of surface and profile moisture; that is, of how much moisture there was in the leaf litter and other vegetation near the ground. The new kind of situation occurs when soil and logs are drier than what fire managers are used to at a time when the fuel moisture is regarded to be suitable for burning—or as in both Jim and Adrian's cases, when the soil is drier than it usually is when the fuel is so moist that they hardly expect a burn to ignite at all. Of course, when it comes to fire, they know they can never take their calculations to be definitive predictions of what will happen. Rather, as Erin told me, they are more of an indication that on one day they might have to be extra vigilant whereas on another day they can relax a bit. Calculations, in this sense, are almost as much affective triggers as they are predictions. Now however, if the soil is very dry, they can get highly intense fire behavior even when their calculations are telling them to relax. There are two processes of drying and moistening—of soil and of surface vegetation—that no longer intersect as they used to. Logs and coarse woody debris follow soil, surrounding the leaves that the fire managers target and depend on with pieces that pull the fire in unexpected directions. And in these situations, with moist fuel and dry soil, fire can be dramatically exponential—turning very quickly from wet leaf litter that barely ignites into bushfire conditions. It can get quite wooly on days like that. Erin, Jim, and many others expect that these are situations in which they might have to act with less confidence in their expectations.

The second 'almost pattern' is related not to what's below our feet, but above us, in the atmosphere. Every day from early spring until late autumn a meteorologist from

the Bureau of Meteorology records a video briefing specifically for Parks and Wildlife, a weather report with a focus on fire weather that fire managers can access through their intranet. The videos all show maps and satellite images while the forecaster talks about what they expect for the next couple of days. It usually revolves around such things as ridges and troughs, models with high or low probability, disturbances and activity, wind speeds and sea level pressures. There are more elements in these briefings than what one hears about in common weather forecasts. Some of these elements reveal that the relevant world for fire managers extents above them in different levels—there are movements and processes such as "high-based activity," "mid-level disturbances," and "surface troughs." On certain days, the forecaster will also talk about something even more esoteric, the "C-Haines index." The C-Haines index differs from most of the other elements of the forecast. Fire-fighters know very well what a trough movement means and they have plenty of experiential and practical references for "gusty northerlies" or "a reasonable sea breeze in the afternoon." But the C-Haines index is more abstract.

The C-Haines index is a measure of atmospheric stability[111]. As we saw in chapter 4, one of the patterns of change meteorologists are able to see, and to see as part of climate change, is the probability of more occurrences of unstable atmospheric conditions in summer, which is associated with tropical weather systems more

[111] The Haines index was developed by meteorologist Donald Haines based on data from North America. The *C*-Haines index is a continuous Haines index and was adjusted from the American version because Australia experiences too many days with a high Haines rating. The continuous index allows for a finer discrimination within the top tiers of the Haines index.

frequently making their way down to the southwest. An increase in days with atmospheric instability in summer is one of the many things that combine to form "climate change" in Western Australia. For meteorologists there are many uncertain points about what C-Haines actually tells us, but for fire managers, high values on the C-Haines index indicate simply, as we could hear in one briefing in November, the "possibility of enhanced fire behavior." As I understood the phrase when I watched the briefing, "enhanced" pointed to something over and above what they would otherwise have expected from a day such as the one in question. In other words, the possibility that on this day it might be wise to trust their usual expectations a little bit less. Just like in the case of the drier soil, a high C-Haines cannot tell you that something *will* happen, and it cannot tell you exactly *what* might happen.

Something I found especially interesting about the C-Haines index was how little most fire managers and crew members seemed to know about it. In the week-long crew member training I underwent to become certified as a fire fighter, George, the course leader, a fire manager with many years of experience, dwelled only briefly on the C-Haines index in between things that were absolutely critical for us to be familiar with, such as through movements and the Fire Danger Index. The C-Haines index is something new, he said, it's weird and can be difficult to understand, but the important thing to know is that it's related to unstable conditions. New fire fighters come out of their basic training with a superficial, but simple understanding of C-Haines. We were given the impression that it was a weird index, and also in a way a weirdness index. One of those who know more, Lachie McCaw, one of the most

prominent researchers in the Department and an authority on fire behavior within the Australian scientific community, told me quite simply that fire managers "are not meteorologists." It is enough, Lachie said, that it's an "awareness tool," something to tell fire managers that if it's a high number on the index, "you might find [the fire] behaves more erratically than you expected." To reiterate, it's interesting that fire fighters and fire managers know little about the C-Haines index because it shows us how purely it functions as a trigger for a certain disposition: the expectation that they can expect with less confidence.

In both cases we can see a particular (perhaps peculiar) way to think about one's expectations. They are treated as elastic, or at least conditionally elastic. Expectations are more elastic—not abandoned—in patterned ways, they are prompted to stretch in certain situations. But fire can confound our expectations even outside of patterns, even outside of what is merely *almost* patterns.

A more tenuous past

There is a video clip that almost everyone who learns to be a fire fighter in the Australian southwest has seen. The clip is from a research project in the late 90s and early 2000s into fire behavior in high intensity bushfires and it is used now as a tool to create awareness within the Department about the dynamics of forest fire. I saw the clip a few times in pre-season training sessions I attended to become certified as a fire fighter. It consists of a single grainy shot seemingly in the middle of the forest. At first, low flames are burning calmly, a slow trickling oval shape. But we've been told

to pay attention to what happens when the wind direction changes. Sure enough, it changes. The fire starts to burn towards the camera, it picks up, then picks up violently. Within seconds, it moves fast, flames become erratic long tongues, then the flames fill the entire frame, the trees now black outlines in fire. Figure and ground seem to shift again, from a fire in the forest to a forest within flames. The time stamp clock in the corner is the only thing that's regular. And then we're told: expect that it can happen even when you least expect it.

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A fire can have a volatile relationality, where small differences in the landscape and the weather can be dramatically magnified—even without unusually dry soil and a high degree of atmospheric instability. A fire can be emergent and exponential, very large fires even affect the weather conditions to which they respond. A fire is linear and predictable only until it's not. With fire, the forest answers in the ways we can expect, only until it doesn't, and we should expect that this shift can happen even when we least expect it.

When learning to be fire fighters, and later, when actually working with fire, we are taught to *expect* something we cannot always fully apprehend. We're taught to expect answers from the forest that look different from what we expect. We're sensitized to these moments that pry open our assumptions. These are moments that make the link between the past and the future less certain. I like to think of them as moments that turn models into tenuous precedents. The past can no longer tell us what will happen

in situations such as these, but only what has happened in other situations. The drying climate affects the future, but it can also alter the past.

Such moments are also what larger wholes and patterns, such as climate change stories, are made from. The parts that make up these bigger stories are a kind of everyday indeterminacy, a mundane volatility which is part of fire itself, but also part of climate change. What's brought to attention is at the same time the ordinary and the exceptional—the everyday volatility of fire along with fires burning the way they do because of climate change. What sets them apart is *not* volatility, indeterminacy, intensity, and sudden shifts; this is something that the ordinary and the exceptional fires have in common.

In the southwest of Australia, the many answers we get from the forest build to certain kinds of big—but not simple—stories. These are stories made from many answers to the question "how will you burn?" a question which often also implicitly involves the question "what do your answers look like?" Climate change patterns, for those that burn the Australian southwest, are made of the same kind of moments that have the potential to unmake patterns. But these are also moments that are rather mundane when it comes to fire. They could fit within the regime, but also be signs that the regime is slipping. And these days, such moments come more frequently.

The question "what do the forests' answers look like" is an ontological inquiry into forest fire, and into forest fire as something at once local (as it responds to leaf litter, understory, and soil), emergent (as it creates its own dynamic, and exceeds the

linear), and widely distributed (as it is connected to jet streams, storm patterns, drying trends, and carbon in the atmosphere). To see climate change through the flames, we must be attentive to moments that can pry apart assumptions and associations, and moments where new connections can be made; moments where the ontological seeps into the pragmatic. Moments that can make us doubt whether we're still in the regime. We might think about what creates and inhibits access to those moments. What makes them visible to us and what could make us miss them. In my case an important factor is the pragmatic urgency of fire. It gives for a method that actively searches for the signs and processes we cannot quite grasp.

I think it's fair to say that most people most of the time assume some kind of common ground in our relation to the world. We assume that the landscape can elicit the forms of knowledge that we as observers are able to have. Fire managers can't assume that there's always a common ground—or rather they use the common ground as a point from which to be surprised. They can't assume that signs and observations come in any of the forms that they can make sense of. When burning the southwest forest these days, we are people learning more ways in which we can be wrong, experiencing more ways in which the past can be misleading. We're making patterns, but not with the sense of making a pattern that we assume we can rely on.

Fire managers in the Australian southwest are in an intense dialogue with the forest. But not always in order to cumulatively build up more knowledge about its history. The past, in fact, can lead them astray. In this sense, forest history is not erased or

ignored, and it is not forgotten[112]. But it is meaningful in a different way: for fire managers to tell themselves stories of how their expectations can lead them astray. For these people, the things they can safely rely on their noticing about are the least important things—for instance the morning test fires we left alone for an hour, and other fires that fire managers had what was to me a striking disinterest in. The things that fall into a pattern are the stuff that shouldn't ever be completely relied upon. Fire fighters are aware of the potential for a cumulative knowledge of the past, and for confidence in such knowledge, to be counter-productive in catastrophic ways.

Burning without the regime?

The accumulation of more and more moments that are unexpected may be, or may gradually become, associated with a sense of the ground being swept away from under one's feet. A more tenuous past, more elastic expectations, and thresholds liable to disappear are all related to the risk of losing the regime. What does it mean to lose the regime? It means not to be able to continue to create good projective landscapes—to no longer be connected to the forest in processes of continual emergence of heterogenous forms. It means that your interventions are no longer tied to the emergent state that lies in a combination of forms of heterogeneity. You could still burn, but the burns would be more dislocated from one another, and dislocated from larger formations that embody future ways in which the landscape may burn.

[112] This is not, for instance, about "how modernity forgets" (Connerton 2009).

Several things drive and enable the maintenance of the regime-practices that fire managers are involved in. Several things motivate fire managers to keep burning. One of these is a set of dispositions that doesn't precede, but is emergent from, the relationship between forests and fire managers. Fire managers are motivated and enabled to burn and work with heterogeneities in burn planning in part because of something that arises from an embodied and ongoing relationship with fire and the forest, by something that lies in the whole body that expects, in thought patterns that are affected by the lively forest, and in patterns and stories created from their interpretation of countless of the forest's answers to the question, how will you burn? In part fire managers burn because they have been shaped by fire. And the forest burns the way it does in part because it has been shaped by fire managers. And I make this point without meaning to glorify this as some kind of especially virtuous or beneficial more-than-human relationality. Similar kinds of relationality can be found in many others places where people are bodily and systematically intertwined and seek to create conditions that project what they regard to be good futures.

That the regime slips means that these emergent ties are weakened or even broken. It brings the notion that you may be burning like before, but that it's not part of the regime in the same way anymore. We can lose the regime and only get seemingly subtle signs from the forest that this is what is happening. I've shown some of these signs in this chapter—for instance little hints from dry soil or the atmosphere that our expectations may have to be stretched, and little signs from seemingly normal burns that we may no longer trust what we have experienced in the quite recent past—but

there are doubtless many other signs which I didn't have enough experience to be sensitized to. There are doubtless many signs that fire managers cannot quite apprehend either—flourishing in the thick time-scales of invisible mosaics and mid-level transformations.

Fire management—a task without completion, the never-ending work of burning the same patches over and over again, of laboring with landscapes that can erase one's efforts in as little as 5-6 years—might seem to require a rather peculiar frame of mind. One of my beginning hypotheses about this kind of fire management was that the best possible outcome would be an absence, the absence of large and damaging bushfires. It has been suggested to me that this kind of burning seems almost Sisyphean—like the mythical Sisyphus who had the pointless task of pushing a boulder up a mountain over and over only to have it roll back down again. I've gradually come to realize, however, that the outcomes of prescribed burning are also strongly felt, affectively as well as in their effects, and that fire management involves not just avoiding something, but creating real projective forms in the landscape, and in creating conditions that make it possible to keep the processes of the regime going. What is produced is the regime, which fire managers feel and see affectively, in its effects, and in their practices of anticipation and future making. However, if the regime is disappearing, burning might start to seem absurd. I never experienced any fire managers expressing any notion that they felt burning was pointless. But there may be kernels of this sensation within their experiences of the regime beginning to slip and in sensations that their emergent ties of bodily expectations are being

weakened. And in this, there may be something we can learn more broadly, as people living in today's world. These are examples how people deal with being in situations where it's uncertain if we're losing grasp of the situation or if we may still be able to manage.

Conclusion

In conclusion, I would like to briefly reflect on what it means to "manage" forest fire today and in the future, and tentatively, what it might mean to manage other environmental phenomena with which people are systematically, affective, and bodily intertwined. A vocabulary of "management," as we have seen, is ubiquitous in the discourse and practices of fire managers. "Management," "to manage," and to be "managers," are central to how these people know themselves, the forest, and their role in the region. But how should we think about kinds of management that deal with something that seems to be turning wilder?

Let me start by drawing attention to two different meanings that "manage" can have. Manage can be to handle, direct, oversee, or be in charge of on the one hand, and to cope, make do, and survive on the other. Towards the end of my story, and especially in the last chapter, we arrived at moments and situations where it seems like we must consider both of these ways of looking at management. Now, fire managers more often slip between the two, finding themselves in a curious borderland. If fire managers usually have thought of themselves as handling and directing the forested landscape through fire, more frequently in recent years they might find themselves slipping towards coping and making do. This is where the regime is lost, when you slip from creating good projective landscape to merely trying to cope.

Ultimately, what is most urgent and concerning for fire managers about the drying climate and its associated processes is that these come with the possibility that they

might be losing hold of the regime. Climate change threatens their ability to make good projective landscapes. This occurs often in subtle and muted ways, and it is these small changes in what they can expect and what they can accomplish, rather than in extreme events like the Waroona fire, that the most serious changes of the present and near future lie. The regime is slipping, I have argued, in situations where fire managers feel like they should think with more elastic expectations, in situations where the past becomes a more tenuous precedent, and in feelings of no longer being confident that they can create landscapes that project safe and healthy futures. Collapse of the regime, in such cases, doesn't necessarily come in dramatic and catastrophic once-and-for-all events, but instead, as I have argued, with ambiguity, in situations where people are affectively pulled by their experiences in the forest to consider collapse along with the possibility of something quite different. In situations where they are drawn to think that it might be neither useful nor wise to conclude on whether or not they are experiencing something qualitatively and drastically new.

Fire managers in the southwest of Western Australia are not sure if they can manage in the future. Fire managers are not sure if they will still be able to create landscapes that give safe forests. Fire managers are not if they can keep themselves connected to the forest in good ways. Moreover, in their case, there are no patchwork solutions, there is little faith that new technologies can fix fire management or make sure we stay in control, and there is no way for them to look away and pretend that it will be ok.

Fire managers confront the question: Are we losing control or can we still manage? This question may be the same questions that people face in other situations around the world. It might be with rivers that are flooding more often, sea walls that we may not be able to trust anymore, or it may be farmers who experience drought or other landscape changes that may make the practices they are used to less tenable. These would be situations where people have been intertwined for some time, and where changes come not as something utterly alien, but as slowly widening gaps, and loosened expectations, and as a push to consider the past in a different way. This is not quite the environmental change we see in mushroom clouds, disappearing islands, and flammable tap water. Instead it is the environmental change people see—and *gradually learn* to recognize—in situations they have been familiar with, and often closely interconnected with. *Regimes* and patterns of interconnections are what may end in these situations, not nature and not worlds.

What can we say about these kinds of situations? At this point, I believe we can point to some concrete things, patterns from the southwest of Western Australia that we may be able to see in other cases as well. These are patterns that happen in a kind of time period that deserves more systematic attention. So much of climate change discourse works by jumping ahead to a catastrophe that will come so as to potentially correct things now. Fire managers bring our attention to the texture of the work and struggle that happens in between. When one is bodily and systematically intertwined, the most concerning changes may come in subtle and ambiguous ways. They come in cases, for instance, where one is pulled to consider both resilience and collapse in the

forest. They come in cases that evoke quite different precedents. To be interconnected in these ways makes people more attentive to and tolerant of ambiguity. In these situations, expectations lie in bodies and in systems, and these are also good places to look for change. Bodies worn into ways of seeing, walking, feeling, burning—bodies that have expectations embedded in them—confront feelings of change by allowing their expectations to be more elastic in certain situations, to disconnect themselves from the landscape in almost-patterned situations where a wild world has taught them that weird things can happen. The past changes as well, along with expectations, becoming tenuous precedents instead of models, something they can rely on less strongly. Such pasts seem to concern landscapes that are progressively drifting away from the present.

Change also happens in the systems with which people try to create landscape regimes. These are networks involving skills and routines through which people have been used to being able to accomplish certain things. I have shown many of the parts of this system in the preceding chapters—from the prescribing officers taking fuel samples and ticking boxes, to the burn planning meetings where burns are distributed over the coming years; from the contexts and frameworks in which fire managers come to understand themselves as managers and the southwest as manageable, to the burning itself and the patrolling and checking up that follows. The agency of systematic and distributed routine activities—the long and ongoing process of planning burns and burning—is liable to weaken. Fire managers are no longer as confident that they will be able to create regimes that embody mild and manageable

forests. Their systematic ties may not have the same kind of efficacy that they used to.

To bring these processes into view, we need ways to recognize and emphasize both wildness and interconnections, liveliness both in a world that affects, and indeed one that withdraws from us, as well as in knowledge practices. Strong description is the label I have used for a set of strategies and sensibilities for capturing both forests and forest knowledge, and what happens in between. This is how I have tried to capture regimes, the ways in which they are created, and they ways that they are weakening. Strong description can work by being attentive to landscapes always along with the practical knowledge frameworks that bring them into view and direct how people engage and intervene with them, and by being attentive to knowledge always along with the ways in which a lively world affects and impinges on ways of knowing and thinking. Strong description can help us tell climate change stories that capture ties and interconnections as well as how such ties can be lost.

Ultimately, this may give for stories that are different from those scholars of science and technology and human-environment relations have been telling so many of in the last couple of decades, as well as different from the most commonly told stories of climate change more broadly. It's important that we're able to tell a variety of climate change stories. It's important that we learn to recognize a variety of patterns of environmental change. And it's important that we do so in careful and systematic ways. These are not stories of moderns that try to purify and disambiguate and complexities that nevertheless seep through the gaps. These are not stories of

something that appears to be simple and dualistic, but if you look closer is more complex; not of people who present dualistic facades that only conceal a lot of messy and complex work. This is not a story of a nature that violently kicks back against people's attempts to order it and place it in containers. Instead, it is a story of landscapes that may gradually slip away from people who cultivate systematic and careful ways to create interinvolvements with it. These are stories of emergent states that people create in concert with lively landscapes, and about what happens when those people are no longer sure if they can keep these states going. The crucial changes occur not to a forest that forest managers' knowledge no longer matches well, but with interinvolvements—which is in part where the forest lies when in the regime—that are loosening. These are stories of changes in what bodily and systematic interconnections amount to—changes in regimes. These are stories of slowly weakening ties, gradual apprehensions of widening gaps, changing pasts, bodily expectations that become less trustworthy, changes that arrive along with opposite possibilities, and systems that may no longer have the same kind of ability to affect outcomes that they used to.

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