CHAPTER 3

A Threat to Holocene Resurgence Is a Threat to Livability

Anna Lowenhaupt Tsing

"Sustainability" is the dream of passing a livable earth to future generations, human and nonhuman. The term is also used to cover up destructive practices, and this use has become so prevalent that the word most often makes me laugh and cry. Still, there is reason to dream—and to object—and to fight for alternatives, and that is the purpose of this volume. Rather than criticize the word, then, I'll take it seriously, repurposed as a radical argument in the face of hegemonic practice. This chapter argues that meaningful sustainability requires multispecies resurgence, that is, the remaking of livable landscapes through the actions of many organisms. Most scholars of sustainability focus only on human plans and programs. In contrast, I argue that where human ways of life are sustained across generations, it is because they have aligned themselves with the dynamics of multispecies resurgence. The converse is equally true—and an urgent message for our times. Where resurgence is blocked, more terrible ecologies take over, threatening livability. Using the term *plantation* in its largest sense, I point to simplified ecologies designed to create assets for future

A.L. Tsing (✉)
Department of Anthropology, University of California, Santa Cruz, CA, USA

Department of Anthropology, Aarhus University, Aarhus, Denmark

M. Brightman, J. Lewis (eds.), *The Anthropology of Sustainability*,
Palgrave Studies in Anthropology of Sustainability,
DOI 10.1057/978-1-137-56636-2_3

investments—and to knock out resurgence. Plantations kill off beings that are not recognized as assets. They also sponsor new ecologies of *proliferation*, the unmanageable spread of plantation-augmented life in the form of disease and pollution. In contrast to what I am calling resurgence, proliferation threatens life on earth. This should be a subject of concern not just for biology but also for anthropology, which is needed to track the cultural histories in which such more-than-human social relations come into being.

What Is Resurgence?

Disturbances, human and otherwise, knock out multispecies assemblages—yet livable ecologies come back.[1] After a forest fire, seedlings sprout in the ashes, and, with time, another forest may grow up in the burn. The regrowing forest is an example of what I am calling *resurgence*.[2] The cross-species relations that make forests possible are renewed in the regrowing forest. Resurgence is the work of many organisms, negotiating across differences, to forge assemblages of multispecies livability in the midst of disturbance. Humans cannot continue their livelihoods without it. The dependence of human livelihoods on resurgence is particularly obvious in considering hunting and gathering: If animals and plants do not renew themselves, foragers lose their livelihoods. But, although both scholars and modern farmers are prone to forget this, such dependence is equally insistent for agriculturalists and keepers of animals—and thus, too, all those who live on their products. Farming is impossible without multispecies resurgence.

I first saw this dependence when studying shifting cultivation in the Meratus Mountains of South Kalimantan, Indonesia, in the 1980s and 1990s (Tsing 2004). Meratus Dayaks cut down trees to make small farms in the rainforest; after two years of growing grain, they allowed the forest to regrow amongst vegetable and tree crops. Within ten years, tree trunks as wide as a person's thigh filled former fields. Wild animals, herbs, and fungi joined this regrowing forest assemblage; after 50 years, old-growth species had arrived and begun to replace pioneers. The forest was a place for Meratus hunting and gathering as well as for the making of renewed new fields. Forest regrowth thus allowed Meratus to maintain the farming–foraging combination of their late twentieth-century livelihoods.

Meratus shifting cultivation embraces the forest; in contrast, fixed-field agriculture is often imagined as the antithesis of the wild. Perhaps it was this imaginary that led to my surprise to find that peasant farmers are equally dependent on forest regeneration.[3] In my more recent research on

commercial mushroom collecting in northern temperate forests (Tsing 2015a), I found an equally intimate relationship between farmers and forests—at least in those areas where generations of peasants had created a longue-durée pattern of farming that might have any chance of being called sustainable. Peasant farmers need forests for many reasons. Their animals feed from forest plants; the forest fertilizes their fields; forest plants and animals meet farmers' everyday needs. The interplay of forest and field is essential to intergenerational livability for humans and their domesticates as well as other species. In what follows, I will call this interplay *Holocene resurgence* to point to its development over the last 10,000 years as well as its dependence on post-Ice Age species agilities. To see how this kind of resurgence contrasts with *Anthropocene proliferation*, let me turn to these ways of parsing ecology and time.

Holocene and Anthropocene: Indicators for the Human Condition

In the past few years, geologists have taken public thinking by storm by suggesting that a new geological epoch be named after the massive changes to climate and sedimentation caused by human activities. This proposed epoch is the Anthropocene. A lively debate has ensued about whether such an epoch should exist at all, and, were it to be established, when it should begin. Archaeologists have called for a "long Anthropocene" that charts the effects of human activities at least since domestication (e.g., Smith and Zeder 2013). But most other natural and human scientists have preferred to use the term to mark the overwhelming force of modern human projects (e.g., Lewis and Maslin 2015; Zalasiewicz et al. 2015).[4] At the heart of these modern projects are a combination of plantation ecologies, industrial technologies, state and imperial governance projects, and capitalist modes of accumulation. Together, these have moved more soil than the glaciers did and changed the earth's climate. They have done this by allowing investors to engineer large-scale projects across long distances for converting places to plantations. Meanwhile, extinction rates have rocketed. Anthropocene, then, is an epoch in which multispecies livability has become endangered.

Naming the modern as "Anthropocene" invites us to look back at the previous geological epoch, the Holocene, to see what it might contribute to knowing sustainability. About 12,000 years ago, at the end of the Ice Age, the earth's climate warmed and stabilized.[5] Humans spread, and they

increasingly began to use new modes of living involving crops and domestic animals. Many species were disadvantaged by the spread of humans, most dramatically those large animals whose extinction followed the late Pleistocene and Holocene expansion of humans. In comparison to modern environmental destruction, however, it is possible to think of the Holocene as an epoch in which human farming managed to co-exist with a wide variety of other living beings. If there is any meaning to the term sustainability, we must look for it in Holocene ecologies—including those that have managed to hang on in the contemporary world.

How did farming maintain its longue-durée viability during the Holocene? Holocene farming privileged the same resurgence processes and forest species assemblages as the multispecies expansion that followed the Ice Age, including both local succession and the long-distance travel of plants.[6] Plants had to travel to survive: The cold and drought of Ice Age glaciation pushed out many species. Spaces where those species wiped out elsewhere continued to thrive became *refugia*. When the glaciers retreated and the world became warmer and wetter, living things spread out from refugia, remaking forests, wetlands, and meadows. In temperate lands, after the first wave of ruderal (or weedy) plants, forest-forming trees came to occupy once frozen places. Trees are mobile—and thus they can respond to farming. In their spread from refugia, plants showed the lively initiative that has helped them survive human disturbances. Holocene farmers cut back forests, but every time farms were abandoned, forests took back the land. Mimicking their post-Ice Age spread, forests kept returning. Meanwhile, both crops and domestic animals depended on nutrients gained from forests. Farming not only cut but also impoverished forests, and yet forests bounced back.

Holocene farming might be said to have encouraged the continual enactment of post-Ice Age successions. In their advance, both glaciers and farms push back earlier ecologies; in their retreat, both tap multispecies agility in ecological renewal. Luckily, such agility is not gone. Holocene modes of existence, in this sense, are still part of the contemporary world, although pressed by powerful modern alternatives. To recognize this continuing importance, I need a specialized usage: In this chapter, Holocene and Anthropocene will not offer a singular chronology but instead point to diverging ecological modes that entangle and co-exist across historical time, even as they make histories. To preserve livability, we will need to conserve Holocene ecologies—and to do so, we need to pay attention to them.

Plants don't just automatically occupy places; their assemblies are formed in cross-species negotiations. In the rest of this chapter, I use the relations between fungi and plants to stand in for the many kinds of multispecies relations through which Holocene resurgence, on the one hand, and Anthropocene proliferation, on the other, emerge. Fungi are important actors in landscape making; they are also little noticed by most of us—and thus a good ambassador for the many hidden worlds that make the sustainability of human livelihoods possible. In what follows, I consider two distinctive fungal ways of life, which we might consider "hunting" and "farming."[7] My fungal hunters are decomposers. They locate vegetable prey and settle in to feast upon it. They make forest succession possible by culling stressed trees, and by providing nutrients for newcomers. My fungal farmers form symbiotic connections called *mycorrhiza* with the roots of trees. Like human farmers, they care for their plants, providing them with water and nutrients. In turn, plants provide them with a carbohydrate meal. Both modes of life are important to Holocene resurgence, but I focus on mycorrhiza. I turn then to decomposers to show how the plantation blocks resurgence and generates unmanageable proliferation.

Matsutake Enables Holocene Resurgence

My recent research has followed ecological and commercial connections involving that cluster of related mycorrhizal mushrooms called matsutake (Tsing 2015a).[8] Matsutake have a powerful and distinctive smell, and that smell has made them a gourmet treat in Japan. Prices rose spectacularly in the 1970s and 1980s as the domestic supply of matsutake from Japan's forests sharply declined. Matsutake have never been successfully cultivated. But it turned out that forests around the northern hemisphere support matsutake, and since the 1980s a lively trade has brought mushrooms to Japan from forests in North America, China, North Africa, Nordic Europe, and other regions.

Matsutake grow in nutritionally challenged forests; where rich soils are available, other fungi displace them. In East Asia, they are associated with peasant forests—and they depend on farmers' disturbances, which open the forest in ways that advantage them over other contenders. Here I stick with matsutake in Japan, where admiration for the mushrooms has encouraged a great deal of research and reflection. How do matsutake make Holocene resurgence possible?

Most of Japan's central island, Honshu, was not covered by ice in the last glaciation; still, the climate was cold and dry, and conifer forests covered most of the land (Tsukada 1983). As the region warmed at the end of the Ice Age, broadleaf trees moved in, and conifers retreated to the high central mountains. The only conifers in the hills and valleys (that is, outside of the central mountains) were those that could grow interspersed with broadleafs, such as *sugi* (*Cryptomeria*) and *hinoki* (Japanese cypress). In the first part of the Holocene, humans seem to have managed trees but not to have made extensive clearings in the regrowing broadleaf forest (Crawford 2011). Then, several thousand years ago, farmers started cutting down trees for intensive agriculture. Suddenly, pines, which had disappeared from hills and valleys since the end of the Ice Age, were back (Kremenetski et al. 2000: 102). Pines' partners in this return were matsutake. Together, they answered the need for ongoing resurgence.

Japanese peasants on Honshu have long cultivated a distinctive village landscape, enshrined as traditional practice (Takeuchi et al. 2003). Flat valleys are spots for rice paddies, vegetable fields, and houses. Irrigation channels slow down scouring mountain streams as they also water the rice. Since the nineteenth century, timber plantations of sugi and hinoki have become increasingly common. Yet the heart of the village landscape is the anthropogenic woodland on surrounding steep hills, the *satoyama* forest. Satoyama forest is intensively used. It may be cleared for timber and shifting cultivation; trees are also regularly cut for firewood and charcoal. Forest products such as wild vegetables, fruits, and mushrooms are gathered. And fallen leaves and humus are raked for green manure for the fields. The satoyama forest is an essential part of village life, supplying everyday needs and fertilizing the fields.

Farming depends upon forests—and forests require the resilience of resurgence. Matsutake shows us repeated beginnings of this process. Pines colonize bare mineral soil, laid bare by peasant practices, through their partnership with matsutake. Matsutake make nutrients available for pine from the mineral soils; pine give matsutake their carbohydrate fix. As pines and matsutake rehabilitate bare land for forests, broadleafs follow. If farmers did not continue disturbing the area, pines would eventually die out. But farmers' continuing use of the forest repeats the need for pioneering succession again and again. Pine and matsutake oblige. This is the opening act of Holocene resurgence. If Japanese peasant landscapes might be said to be "sustainable"—and indeed they have had a long viability—it is because of

their relationship with pine, matsutake, and forest resurgence, which enables farming as a way of life.

In recent years, satoyama forests have declined. Some have been replaced—by suburban development, on the one hand, and by timber plantations, on the other. Others have transformed through multispecies responses to farmers' abandonment. During Japan's late twentieth-century economic boom, many farming families moved to the city, leaving their farms in the hands of the elderly. Meanwhile, those who stayed on the farm replaced green manure with chemical fertilizers and replaced firewood and charcoal with fossil fuels. Without human disturbance, a different successional process overtook the satoyama forest: Evergreen broadleaf trees moved in from the south, smothering pines and even deciduous broadleafs. Another forest emerged, one that no longer supported farming. Matsutake were missing from this new forest, and along with them a suite of flowers, birds, amphibians, and insects.[9]

Such transformations bring us to modern farming's efforts to disengage with forest resurgence. Let me move directly to the plantation and the new forms of biological movement it engenders, which I call proliferation. My example is another fungus, this one a decomposer: a hunter that is killing ash trees across Europe.

Ash Dieback and Anthropocene Ecologies of Extinction

In the early 1990s, a strange dying was reported among ash trees in Poland. A rapidly spreading fungus—something new that had not been reported—was shown responsible, *Hymenoscyphus pseudoalbidus*. Since then, the fungus has spread across almost all of Europe. In many places, more than 90% of the trees are infected by the fungus, which causes leaf spots, cankers, wilting, and tree death. In Denmark, one field study of 39 trees found only one with less than 10% damage (McKinney et al. 2011). At first, mycologists thought the fungus might be a new and virulent mutant of *Hymenoscyphus albidus*, an inoffensive saprobe of ash leaves on the Eastern European forest floor. But subsequent detective work has suggested that the fungus is a recent Asian import (Gross et al. 2014). Its Asian cousins are the same species, yet they do little harm to Asian ashes, remaining in the foliage rather than infecting the tree (FAO 2014: pt. 53). In Europe, a new fungal life cycle has been initiated in which the fungus grows from the leaves into the stem of the tree, eventually causing death. Annual obligate sexual reproduction, requiring a new host, has spread the fungus rapidly and kept it

flexible in dealing with the responses of the genetically heterogeneous population of European ashes (Gross et al. 2014). This disease is spectacular and seemingly unstoppable. It is possible that Europe will lose most or all of its ash trees. Like matsutake in Japan, ash is culturally significant: In Nordic mythology, it is Yggdrasil, the tree at the center of the world, and its death means chaos. Ecologists point out too that ashes are keystone species, supporting much more life than just themselves. There are insects, lichens, fungi, mollusks, and birds that are entirely dependent on ash trees. As one group of researchers puts it, "The loss of a high proportion of ash trees is likely to have a cascade of ecological effects on ecosystem services and biodiversity" (Pautasso et al. 2013: 41).

How did ash dieback develop? It is hard to separate its rapid spread from the industrialization of the nursery trade in Europe. Ash is a common tree throughout Europe, and it thrives as a companion to human settlement. There has been no need to import it. Yet hundreds of thousands of young trees were shipped for replanting programs, both public and private, in the very places that ash is common. Here is how the situation in Europe is described in an FAO report (2014: II, 7–10):

> Until 40–50 years ago, horticulture trading was done mostly at local level. Nurseries raised plants close to where they would be planted. … From the 1970s onwards, however, the industry changed rapidly. … From that time, seedlings or cuttings were produced by specialized nurseries, transported to other nurseries as "liners" for potting into two or three litre containers, then taken from that stage into larger pots. … The development of international trade in plants largely followed from the widespread uptake of containerized transport: the availability of space in container ships, some capable of carrying over 18,000 standard-sized containers means that tens of thousands of plants can be shipped by sea, reaching their intended distribution points within days to a few weeks. … Inevitably, plant production condensed. … Young plants were often supplied by nurseries in regions where employment costs were lower, initially Central and Eastern Europe, then beyond Europe, as far as Asia, Africa, and North and South America.

Managers see industrial tree production and long-distance shipping as economical and efficient, but this view takes for granted the very hegemonies anthropologists might want to open up. The industrial nursery trade is an instance of the reorganization of the living world into assets, that is, resources for further investment. This is the principle behind what I am

calling the plantation. Plantations discipline organisms as resources by removing them from their life worlds. Investors simplify ecologies to standardize their products and to maximize the speed and efficiency of replication. Organisms are removed from their native ecologies to keep them from interacting with companion species; they are made to coordinate only with replicas—and with the time of the market.

Plantation simplification intentionally deprives organisms of their ordinary ecological partners, since the latter are imagined as hindrances to asset production. On the one hand, then, almost identical organisms are packed together; on the other hand, they are alienated from all others. This is a strange ecological form—and it has consequences not just for the asset organisms but also for their predators. Imagine the feast for "hunter" fungi: an endless meal of helpless and identical prey.

Plantations are incubators, then, for pests and diseases, including fungal pathogens. Plantation ecologies both create and spread virulent microorganisms. Plantations are long-distance investments, and markets spread their products globally and with unprecedented speed. Through the industrial nursery trade, for example, soil, with its microorganisms, is gathered from around the world to transfer everywhere. Nor is the spread of pathogens limited to other plantations. The borders of plantation and forest have blurred: Because ash trees grown in nurseries are mixed into self-seeded landscapes, ash dieback spreads into the forest. Ironically, this spread seems an instance of the very movement of fungi and plants I celebrated in discussing Holocene resurgence—but speeded up unrecognizably. Speed matters. Plant pathogens have always attacked plants; but when this process happens slowly, landscapes recover. The speed of multiple attacks is something new, and a product of the dominance of the plantation form. That the attacks come even at those trees that have stood up to human disturbance is particularly frightening: The death of those trees threatens the resurgence on which we depend.

Plantations do more than spread pathogens; they also cultivate them. The proximity of so many purified and identical asset bodies—meals to pathogens—both augments pathogenetic abilities and also sometimes changes them entirely. In the rub of many bodies, fungal reproduction may take off with a new vigor, making use of otherwise minor abilities, such as alternative forms of reproduction. Furthermore, the plantation economy offers opportunities for fungal pathogens to meet close relations from other regions and to discover new prey. In this feast and family reunion, new virulent forms that leap from one prey species to another are

formed. It seems likely that this was the situation for ash dieback. And the feast goes on and on, never lacking for new dishes. In more ordinary ecologies, pathogens become less virulent over time, as they adjust to the population dynamics of their prey. In the plantation, however, the supply of bodies is constantly refreshed. There is no reason for pathogens to reduce their virulence.

Welcome to the Anthropocene, in which alienated and disengaged organisms, including humans, multiply and spread without regard to multispecies living arrangements. Such proliferation makes no adjustments for previous residents and shows no signs of limits. Ash dieback is one of many products of the plantation economy, set loose into the world. These feral biologies block Holocene resurgence—and threaten the livability of multispecies landscapes.

Consider ash dieback, then, through its spread through containerized shipping, a floating plantation. This has not been a casual introduction, an ordinary result of travel. The thoroughfares for the fungus are the nodes of industrial plantation exchange: from really low-cost nurseries in Asia to still low-cost nurseries in Eastern Europe; from Eastern Europe to the Netherlands, the center of industrial nursery shipping; from the Netherlands to the rest of Europe. This has been the route for a reason: the organization of the industrial nursery trade. The FAO report I quoted continues: "Once in the EU, the plants are considered 'clean,' having passed the border inspections, even if not inspected. Further trade within the EU ensues, with huge numbers of plants shipped to countries other than the initial importing state" (FAO 2104: 21). In 2012, UK journalists reported that local nurseries relabeled their imported ashes as "British," hoping to please customers (Gray 2012). Ash dieback has spread by bringing the plantation into the forest.

In his celebration of ash trees, British botanist Oliver Rackham put the problem as follows (2014: 8–10):

> The greatest threat to the world's trees and forests is globalisation of plant diseases: the casual way in which plants and soil are shipped and flown around the globe in commercial quantities, inevitably bringing with them diseases to which the plants at their destination have no resistance. This has been subtracting tree after tree from the world's ecosystems: if it goes on for another hundred years how much will be left?

A Time for Anthropology

Anthropologists, on the whole, have not taken threats to livability very seriously. In part this is because our ethnographic methods predispose us to notice success in livability, even where people are struggling with environmental challenges. To study encroaching unlivability, we need longer histories than fieldwork usually allows as well as attention to far-flung and difficult-to-trace connections. In part, too, anthropologists distrust the arrogance of experts, and we want to show them that local people know more about the situation than scientists allow. We reject generalizations about environmental destruction, especially where they involve accusations against poor and marginalized groups. We think of ourselves as radical critics of the authorities. But in the process, we have ignored the radical claim being made by environmental scientists: Business as usual is killing us. This chapter argues that we cannot continue to shut our ears—and certainly not if we care about sustainability.

The encroaching unlivability of Anthropocene arrangements could be an exciting challenge for anthropological research. Anthropocene natural scientists have been the first to admit that, given their training and methods, they cannot tackle these problems alone. We need to understand the semiotic *and* material nature of Anthropocene ecologies. We need to track back and forth between ethnographic observations rooted in particular communities, on the one hand, and broad histories and connections, on the other. We need to understand the human–nonhuman sympathies that make Anthropocene arrangements possible as well as the more-than-human historical trajectories that come together in both terrible hegemonies and patches of hope or resistance. These are tasks that anthropologists have trained themselves to do. A new field is waiting for us—and it demands urgent attention.

To appreciate Anthropocene challenges, however, we need to pay more attention to the cross-species socialities on which we all depend. As long as we block out everything that is not human, we make sustainability a mean and parochial concept; we lose track of the common work that it takes to live on earth for both humans and nonhumans. Besides, it does not work: Investors' attempts to reduce all other beings to assets have engendered the terrifying ecologies I have called Anthropocene proliferations. While my example showed the death of ash trees, I could have focused on those human pathogens similarly born in plantation-like ecologies of simplification.

To get to know other organisms, however, is a new challenge for anthropology. Yet we have what it takes: We know how to learn about social processes and about places and those who live in them (Tsing 2013). We merely need to expand our repertoire of the "people" we might meet to include other living beings. We can learn about them using all our skills: There is no reason not to combine what we learn from observation, indigenous cosmology, scientific reports and experiments, political mobilizations, and written and unwritten histories. Each of our sources must be assessed, of course, in relation to its methods for knowing and "doing" the world. But there is no reason, I argue, to throw any of these out on first principles, even if they do not fit together neatly.

This lack of unified sources might be exactly what we need to understand a patchy and fragmented ecological scene, part Holocene resurgence and part Anthropocene proliferation. The distinctive ecological modalities I signal with the terms Holocene and Anthropocene co-mingle in our times; they do not add up to a single whole. We need tools particularly to follow this patchiness. When pieces do not fit together seamlessly, a variety of ways of knowing can be of use. Indeed, this refusal to add up is an argument for anthropology's usefulness. Anthropology is one of the few disciplines that can identify patchiness and show its importance. Identifying those patches where Holocene resurgence still runs strong may be critical to our survival at every level.

This chapter has argued that sustainability is a multispecies affair. If we have any dreams of handing a livable world to our descendants, we will need to fight for the possibilities of resurgence. The biggest threat to resurgence is the simplification of the living world as a set of assets for future investments. As the world becomes a plantation, virulent pathogens proliferate, killing even common plants and animals. I can only repeat botanist Rackham's warning: "if [this] goes on for another hundred years how much will be left?"

Notes

1. *Disturbance* is a comparatively quick change in ecosystems conditions; it is not necessarily bad—and not necessarily human. Unfortunately, humanists often misunderstand the term as a way of criticizing humans; without this (mistaken) implication, it could be a useful term for an anthropology of a world always in motion. See Tsing (2015a, Chapter 11). Meanwhile, there is no implication here that post-disturbance ecologies are the *same* as those they replace.

However, they are also not randomly different. Post-disturbance resurgence dynamics are studied as *succession*.

2. Resurgence thus forms part of a cluster of words concerning ecological health that includes *resilience* and *remediation*. I chose resurgence because it is not narrowly defined for quantitative exactness and thus retains its polysemy, with poetic overtones. The term forms part of my effort to expand the terrain in which natural scientists, humanists, and social scientists might engage in open-ended discussions without allowing demands for philosophical correctness, on the one hand, or quantitative models, on the other, to block creative work together. See Tsing (2015a, b).
3. I use the term "forest" in the American sense to mean a landscape with trees. My usage is synonymous with English "woodland."
4. Each of the citations in this paragraph offers quite different start dates for the Anthropocene, from 12,000 BP to 1945. The open-endedness of current debate is my excuse for an alternative use of the terms in this chapter: Holocene and Anthropocene here are used to refer to ecological modalities that can co-exist in particular times.
5. In official geological discourse, the Holocene epoch begins 11,700 years ago, following the Pleistocene.
6. Vegetation change in the Holocene followed different patterns in different regions. The spread of vegetation after the retreat of the glaciers in the northern hemisphere is particularly clear. In contrast, in other regions climate change followed more locally particular patterns. For example, the increased humidity of the Holocene allowed forest vegetation to recolonize Ice Age deserts. However, it seems to me that the label Holocene (and worse yet Quaternary) privileges the global north, and some serious rethinking about earth processes needs to be done from the perspective of the south.
7. These are not essences; as with human "hunters" and "farmers," their descendants may change. In explaining these ways of life, I make acquaintance but do not imprison them in fixed identities.
8. My research formed part of the work of the Matsutake Worlds Research Group. See Matsutake Worlds Research Group (2009). "Matsutake" here refers to a cluster of related species, with special attention to *Tricholoma matsutake* and *T. magnivelare*.
9. A Japanese citizens' movement, concerned that this landscape no longer makes the connection between multispecies resurgence and human livability, has emerged to bring back satoyama forests. See Tsing (2015a, Chapter 18).

References

Crawford, Gary. 2011. Advances in Understanding Early Agriculture in Japan. *Current Anthropology* 52 (S4): S331–S345.

FAO (Food and Agriculture Organization of the United Nations), Regional Conference for Europe. 2014. The Impact of Global Trade and Mobility on Forest Health in Europe. www.fao.org/docrep/meeting/030/mj554e.pdf

Gray, Louise. 2012. Gardeners Sold 'Native' Ash Trees Grown Abroad. *The Telegraph.* http://www.telegraph.co.uk/news/earth/earthnews/9649565/Gardeners-sold-native-ash-trees-grown-abroad.html

Gross, Andrin, Tsuyoshi Hosoya, and Valentin Queloz. 2014. Population Structure of the Invasive Forest Pathogen *Hymenoscyphus pseudoalbidus. Molecular Ecology* 23: 2943–2960.

Kremenetski, Constantin V., Kam-biu Liu, and Glen M. MacDonald. 2000. The Late Quaternary Dynamics of Pines in Northern Asia. In *The Ecology and Biogeography of Pinus*, ed. David Richardson, 95–106. Cambridge: Cambridge University Press.

Lewis, Simon, and Mark Maslin. 2015. Defining the Anthropocene. *Nature* 519: 171–180.

Matsutake Worlds Research Group (Timothy Choy, Lieba Faier, Michael Hathaway, Miyako Inoue, Shiho Satsuka, and Anna Tsing). 2009. Strong Collaboration as a Method for Multi-sited Ethnography: On Mycorrhizal Relations. In *Multi-sited Ethnography*, ed. Mark-Anthony Falzon, 197–214. London: Ashgate.

McKinney, L.V., L.R. Nielsen, J.K. Hansen, and E.D. Kjær. 2011. Presence of Natural Genetic Resistance in *Fraxinus excelsior* (Oleraceae) to *Chalara fraxinea* (Ascomycota): An Emerging Infectious Disease. *Heredity* 106 (5): 788–797.

Pautasso, Marco, Gregor Aas, Valentin Queloz, and Ottmar Holdenrieder. 2013. European Ash (*Fraxinus excelsior*) Dieback—A Conservation Biology Challenge. *Biological Conservation* 158: 37–49.

Rackham, Oliver. 2014. *The Ash Tree*. Dorset: Little Toller Books.

Smith, Bruce, and Melinda Zeder. 2013. The Onset of the Anthropocene. *Anthropocene* 4: 8–13.

Takeuchi, Kazuhiko, R.D. Brown, I. Washitani, A. Tsunekawa, and M. Yokohari, eds. 2003. *Satoyama: The Traditional Rural Landscape of Japan*. Tokyo: Springer-Verlag.

Tsing, Anna. 2004. *Friction: An Ethnography of Global Connection*. Princeton: Princeton University Press.

———. 2013. More than Human Sociality: A Call for Critical Description. In *Anthropology and Nature*, ed. Kirsten Hastrup, 27–42. New York: Routledge.

———. 2015a. *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*. Princeton: Princeton University Press.

———. 2015b. Aura's Openings. *More than Human: AURA Working Papers.* Vol 1. http://anthropocene.au.dk/more-than-human-aura-working-papers/

Tsukada, Matsuo. 1983. Vegetation and Climate During the Last Glacial Maximum in Japan. *Quaternary Research* 19: 212–235.

Zalasiewicz, Jan, Colin N. Waters, Mark Williams, Anthony D. Barnosky, Alejandro Cearreta, Paul Crutzen, Erle Ellis, Michael A. Ellis, Ian J. Fairchild, Jacques Grinevald, Peter K. Haff, Irka Hajdas, Reinhold Leinfelder, John McNeill, Eric O. Odada, Clément Poirier, Daniel Richter, Will Steffen, Colin Summerhayes, James P.M. Syvitski, Davor Vidas, Michael Wagreich, Scott L. Wing, Alexander P. Wolfe, Zhisheng An, and Naomi Oreskes. 2015. When Did the Anthropocene Begin? A Mid-twentieth Century Boundary Level Is Stratigraphically Optimal. *Quaternary International.* doi:10.1016/j.quaint.2014.11.045