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In the midst of disturbance: symbiosis, coordination, history, landscape

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Abstract: "Symbiotic anthropology" has both metaphorical and material objects, and this paper addresses both in drawing attention to botanical symbioses as these create landscape assemblages, on the one hand, and scholarly collaborations, on the other. Honoring the legacy of Raymond Firth, I show how field observations can be the basis of theory building—including the creative transdisciplinary exercises necessary to rethink the human within multispecies worlds. Firth's legacy can take us, too, to formalist-substantivist debates in contemporary biology, in which neoDarwinism and "ecoevodevo" contest the meaning of symbiosis as "rational choice" or "symbiopoiesis," respectively. Such debates challenge us to watch symbiosis in action, as it assembles more-than-human socialities. Drawing on Matsutake Worlds Research Group fieldwork in the anthropogenic woodlands of southwest China and central Japan, I conjure landscapes in the friction of symbiosis, coordination, and history. Landscapes are social-natural enactments of world-making. Following their emergence opens a symbiotic anthropology that builds theory from the details of everyday life.

What would it take to build an anthropology of more-than-human livability? The terms in my title have been tools in my attempts to answer this question. Each term holds its own possibilities. I'll begin with symbiosis, which will then take me into what one might call "substantivist biologies." That allows me to try to bring *landscape* to life as a story protagonist. This is challenging; it requires new genre conventions, and this essay explores some. During most of the essay, I'll stick with lively landscapes in which humans are part of mutualisms that make many ways of life thrive. We need multispecies mutualisms to survive. I end briefly with the terrors of broken coordinations and landscapes of non-livability: this concern, too, needs anthropology.

One: Symbiosis requires something extra

The invitation to address "symbiotic anthropologies," the theme of the 2015 ASA meetings, was an offer I could not refuse. I have been working on

biological symbioses, particularly between fungi and trees, for a number of years (Tsing 2015). I understand that in the ASA theme symbiosis was understood metaphorically, through questions of collaboration, but that only made the offer more inviting. I'm directing a program involving collaborations between humanists and natural scientists, so transdisciplinary mutualisms have been important to me too.[1] And the topic of our collaborations is the multispecies mutualisms that make a livable earth—so this is another metaphorical symbiosis. Symbiosis has been a topic too close to my heart to refuse.

When the offer was converted to a lecture in honor of Raymond Firth, it only made the opportunity more inviting. I remember when I first read Firth's *Malay Fishermen* (1975), along with Rosemary Firth's *Housekeeping among Malay Peasants* (1966), when I was preparing for my graduate exams in Southeast Asian studies. These books were so rich with ethnographic detail! I was in awe—and inspired to pay attention to ethnography. To this day, I continue to think ethnographic description is the most important gift of our discipline. Long after the theoretical frameworks we are so proud to invent have gone to the rubbish bin, the ethnographic description lives on. The "something extra" in those descriptions—beyond theoretical argument—inspires new thought, and new argument. Despite all the pressure on us to become instant philosophers, the something-extra legacy is one, I believe, we must struggle to preserve.

Something-extra is key to symbiosis. Since mutualism sounds so good, many people who haven't thought about it assume it's easy—as if God just intended things to be that way. Actually, dealing with others, whether human

or nonhuman, is often brutal, hierarchical, or both. When mutualism develops, it's a small miracle, and nothing to take for granted. And it's rarely planned. In unexpected historical conjuncture, symbiosis develops; it emerges from the situation as unplanned bits fall into new coordinations. It's the something-extra that makes this possible. Unexpected capacities develop. This has been key in the evolution of biological symbioses. We are all the something-extra of bacteria, who have played with many ways of continuing themselves and do well with multicellular symbiotic extensions. It is equally key in the metaphorical symbioses I mentioned—collaborations across knowledge traditions, on the one hand, and livable multispecies landscapes, on the other.

In my project of bringing together anthropologists and biologists, then, I don't start with rules and plans, but rather with the something-extra that emerges—sporadically and at its own pace—from common commitments and common readings. Both the biologists and the anthropologists in the group care about empirical observation and fieldwork, and this makes a difference. Through such techniques, we each notice things happening, and in all the noticing, when we are lucky, mutual concerns arise. The project emerges from the noticing, not from requirements of a unified philosophy.

The historical conjuncture that makes this possible is our shared concern with the decreasing livability of the earth, as more and more of it is reduced to resources for industrial processes and capitalist accumulation. One way of signaling this worldwide industrial simplification, with its lethal side effects, is to speak of the Anthropocene, the proposed epoch in which the environmental impact of humans exceeds that of the retreat of the glaciers, which identified the previous epoch. Concerns about the Anthropocene make new

conversations possible between natural scientists and humanists, and these can interrupt a previous era of closed doors between the sciences and humanities. I understand the concerns that closed those doors; I was schooled in that era and participated in the critique of science. But now, I think, something else is possible: a new mutuality based on common interests in livability.

To develop this mutualism, however, anthropologists might have to give up our admittedly well-earned defensiveness in dealing with natural scientists. We are used to either rejecting natural science for its philosophical mistakes, or, alternatively, watching it like an insect under glass. We have forgotten how to find allies. When it comes to environmental scientists, we shake our fingers at them: "You are just apocalyptic," we say. In the process of distinguishing ourselves from natural scientists, then, we have become environmental conservatives. It's time to change. If we care about the livability of the earth, we need to learn not just how to criticize environmental scientists but also to look for allies who might help us transform business-as-usual. Allowing something-extra into our conversations about life on earth is a key step. For anthropologists, this might begin with the recognition that humans are incapable of surviving without other species. We are beings within ecological webs not outside them. Multispecies landscapes are necessary to being human.

Landscape: most often we use this term to imagine a backdrop to human action. If we care about livability, however, we are going to have to figure out how to make landscapes lively protagonists of our stories. The problem is not just the so-called agency of nonhumans. That formulation generally leads to

stories of human-nonhuman dyads. So far, so good, but no human-nonhuman dyad goes far enough in making mutual livability for a whole suite of organisms, which we need to survive. We need landscapes, spatialized enactments of livability. Geographer Kenneth Olwig's formulation of the genealogy of the term "landscape" is useful here (1996). In Northern Europe, Olwig reminds us, landscape was defined by the moot, the meeting in which people offered debate and made common cause. My landscapes are multispecies moots, enactments of the possibilities of living together.

Landscapes are working assemblages of coordinations within a dynamic history. But I have just introduced two more key terms for the project of thinking livability as symbiosis: *coordination* and *history*. By history, I am referring to the tracks and traces of humans and nonhumans, as these create landscapes. One of the projects of noticing anthropologists and biologists can do together is to watch landscapes becoming through human and nonhuman tracks and traces. Coordination is a lens for watching organisms interact with each other. Symbiosis—like competition, predation, and other interspecies relations—requires coordination. Paying attention to the temporalities of landscapes allows us to notice their interstitial dynamics.

One more term before I move into another story line: *disturbance*. Humanists, amongst whom I include social anthropologists, too often imagine that "disturbance" singles out humans for bad behavior. But for an ecologist, disturbance is mainly nonhuman, although humans can do it too—and it is not necessarily bad. Landscapes come into their histories through disturbance. Following stories of disturbance is one way to make landscape a dynamic

protagonist and an enactment of multispecies coordinations. But, first, something a little different.

Two: The old formalist-substantivist debate has returned—in biology

Giving a lecture in honor of Raymond Firth reminded me of the old formalist-substantivist debate in anthropology, in which he was a key participant. By the time I got to graduate school, the formalist-substantivist debate was hardly being taught, mainly because the substantivists had won in anthropology, although in the rest of the social sciences, formalism reigned—and continues to reign. I imagine most of my readers have only a vague recollection about it. Let me refresh your memories.

Formalism refers to that set of assumptions we know best from neoclassical economics: individuals maximize costs and benefits to their interests, and, in the process, aggregate effects are formed. Margaret Thatcher famously articulated one particularly strong version in 1987: "[W]ho is society? There is no such thing! There are individual men and women…"[2] This is not Raymond Firth's formalism, which required attention to culturally specific goals and norms, and, indeed, offered such rich ethnographic context for imagining individual interests that formalism and substantivism begin, usefully, to merge. I'll come back to this. But let me stay first with Thatcher's vivid caricature, which helps explain why my teachers thought they had something distinctive and useful when they taught me anthropology as substantivism: I learned that individuals only emerge, when they do, as an effect of social processes. "Interests" are ephemeral cultural products emergent from particular historical conjunctures, rather than essential properties of the autonomous units Thatcher called "individual men and

women." Rather than being the basic units of analysis, individuals and interests are effects of relation-based society. To maximize one's interests only makes sense then within cultural and political scenes in which interests emerge as well as interest-bearing players. By the time I was trained, the emergence of social worlds, rather than the playing out of interests, was the stuff of social and cultural anthropology. This line of thought is still hegemonic in our field today.

I bring this line up not to challenge it but to use it to show you a parallel debate that is energizing the field of biology. No one calls it "the formalist-substantivist debate." But the parallels are there—and they can help us as anthropologists to appreciate that field beyond the stereotyped dismissal of "science" as a unified object. If we want to find allies, we must get to know debates. Consider first the formalists: in biology, these are called neo-Darwinians. This perspective came together in the 20th century from the merging of Darwin's evolutionary theory and the apparatus of genetic inheritance. Recall that Darwin did not know about genetics. It took the early 20th century rediscovery of Mendel's pea experiments to begin to establish a mechanism for heritability. This opened what became known as the modern synthesis. Evolution and heritability were combined through attention to the genetic basis of evolutionary selection. The key discipline at the heart of this approach is population biology. To the best of my knowledge, population biology formed independently from neoclassical economics, but the same climate of utilitarian philosophy shaped each. The parallels are strong. The analysis requires autonomous, interest-bearing units. In contrast to economics, biologists imagine these units at varied scales, from populations,

to individual organisms, to genes. However, at each scale, autonomous units compete to maximize their interests, in the process creating aggregate effects, including who lives and who dies over the long run. Richard Dawkins' "selfish gene" is exemplary (Dawkins 1990). Fitness, measured by who leaves the most heirs, is an outcome of competition among autonomous units.

This was the hegemonic line in biology through most of the 20th century. In the 21st century, however, several contrasting approaches have been suggested, and these come together in making what I think I can call a "substantivist" intervention. Thus developmental biologists have increasingly found that individual organisms are *not* autonomous. At first they thought it was just a few organisms—but increasingly it is appearing as if *all* organisms may need other organisms for their proper development, and in many cases, organisms of other species. The Hawaiian bobtail squid has been a poster child for this approach because it develops a light-organ that helps it elude predators (McFall-Ngai 2008). But the light organ only exists when the squid encounters a particular kind of bacteria in the seawater; the bacteria and the squid, working together, develop the light organ. The more biologists look, the more common such necessary mutualisms appear to be. The large blue butterfly in England requires ants to raise its larval children.[3] Even humans, once so proudly independent from "nature," are now understood as symbiotic partners to bacteria that enable human bodily processes, such as digestion. As one group of developmental biologists put it, "we have never been individuals" (Gilbert, Sapp, and Tauber 2012). They argue that evolution selects for *relationships*, not individual units, at whatever scale. Symbiosis is not an odd freak of nature but a basic feature of evolutionary process. This is

a substantivist biology because it shows us organisms *emerging* from relations, rather than pre-existing them as autonomous individuals with pre-made interests. These biologists are aware that they are attacking the basic premises of the 20th century modern synthesis and neo-Darwinism. Their starting place, however, is not cosmology but the empirical findings of how organisms develop. Their approach is "eco-evo-devo": ecological, evolutionary, developmental biology (Gilbert and Epel 2008).

In the eco-evo part of this world, but without the devo, another approach is gathering steam: niche-construction theory (Odling-Smee et. al. 2013). Niche-construction theory argues that organisms work as ecosystems engineers, that is, they change habitats to make them more advantageous. Beavers construct dams and lodges, remaking water and land. Earthworms perturb the soil and recycle its components. Pretty much all organisms, it seems, remake the worlds around them. These remade worlds, in turn, become the habitats in which both their conspecifics as well as other species take up their lives and reproduce. Evolution, niche-construction theorists argue, works through these continually remade environments. By reshaping habitats, organisms shape the evolution of other organisms, including other species. Rather than autonomous interest-bearing units of evolution, here we have relationships creating multispecies landscapes. Some good examples involve people. For at least 400,000 years, hominid foragers have modified their landscapes through fire (Smith 2011). Plants and animals that do well with fire have thrived, and their subsequent evolution has taken place in fire-altered landscapes. This is a substantivist ecology: landscapes emerge in

historical processes; the interests and individuals that may come to play in them are effects of multispecies landscape formation.

My label of these developments as "substantivist," however, draws attention to a distinction between these narrative practices and those developed under the substantive label in anthropology. Biologists, however substantivist, do not reject genes, organisms, and populations as players in evolutionary history. The ones I call substantivist want to see how genes, organisms, and populations emerge—and, then, how they negotiate survival and historical continuity. This is a substantivism that returns us to predation, competition, and extinction. Mutualisms do not exempt us from these dynamics; rather, they show us how they work. There is no cosmological holism emerging from such scenes. Perhaps the ethnographically rich formalism Firth advocated is a useful predecessor to the substantive ecologies of our times.

With and beyond Firth, I am arguing that substantivist biology produces good allies for social and cultural anthropologists. As long as we are open to including multispecies relations in the social and cultural worlds we study, we have a lot in common. Both eco-evo and eco-evo-devo have been great for opening up my research and thinking. To illustrate the possibilities of alliance, then, let me move to fungi—and the forests they help make. I've been studying a member of that large group of fungi that makes special connections to tree roots. Ectomycorrhizal fungi wind in sheathes around the roots of receptive trees, and they send their hyphae between root cells. Together, tree and hypha make a new organ, distinctive to their collaboration; it's called a Hartig net, and it's neither tree nor fungus alone but rather both. Tree and

fungus transfer nutrients through the Hartig net; furthermore, the fungus can extend the nutrient transfer across many separate trees. Some trees, such as pines, have special roots that only develop when they encounter appropriate fungi. This is a classic example of biological symbiosis. Organisms *become* only in relationship.

The symbiosis also has an extraordinary effect, a feat of ecological engineering and niche construction. Forests, according to researcher Lisa Curran, are effects of mycorrhizal fungal-root connections (Curran 1994). Did you ever wonder why some trees, such as oaks and pines, form forests while others, such as apples, are stand-alone individuals unless you plant them close together? Forest-forming trees have ectomycorrhizal fungi, which allow them to outcompete other plants, forming, together, wooded stands. Once a forest comes into being it forms a habitat for many other species, including animals. There is shade, and food, and modified weather patterns, not to speak of fruits and nuts, and all of these influence the evolutionary trajectories of species who come to live there. This is niche-construction as well as symbiosis. Forest landscapes are emergent within multispecies relations.

Humans can be part of multispecies relations in forests. (And here, with all the awkwardness of an American writing for an English audience, I switch terminology. So far, I have used the word "forest" to refer to tree-and-fungus based *ecosystems*. Now I am going to use the word "woodland" to refer to *landscapes* that include trees. For Americans, everything with trees is "forest," but English forest means something different, involving rights. I want woodlands then.) Until the introduction of chemical fertilizers, human farmers depended on woodlands to provide nutrients for their fields, whether by letting

their animals graze in woodlands and transfer manure to fields, as in Europe, or by using green manure or charcoal directly on fields, as in various parts of Asia. Woodlands were also sources of many livelihood needs, including firewood and those fruits and nuts I just referred to. Peasants were concerned to keep woodlands and fields in a relationship. But it seems to me less accurate to say that peasants produced sustainable woodlands than to say that woodlands produced sustainable peasants. The continual regeneration of woodlands allowed peasants to farm, to feed their livestock, and to find things they needed. When fields were abandoned, woodlands expanded, regenerating peasant biodiversity. Woodlands gave peasant ecosystems their *longue durée*. This is the kind of landscape symbiosis that I mentioned at the beginning of this paper as one of my objects. Woodlands represent a multispecies landscape in which humans are one part of the multispecies coordinations and the disturbance regimes through which woodland assemblages continually create livability. Let me turn then, with the help of eco-evo and eco-evo-devo, to making landscapes into lively protagonists of our stories.

I return to my title: "In the midst of disturbance: symbiosis, coordination, history, landscape." I'll work the three kinds of symbiosis that are the topic of this paper: first, biological symbiosis, here between tree roots and fungi; second, collaborative thinking between natural sciences and humanism, here in intertwined human and nonhuman histories; and, third, the emergence of landscapes of multispecies livability.

Three: Peasant woodlands maintain livability through assemblages of coordinations.

In this section, I draw from an article I am writing together with artist Elaine Gan, in which we explore coordination as a principle of woodland assemblages (Gan and Tsing, n.d.). Our article presents a Japanese *satoyama* woodland as a diagram of coordinations. Satoyama refers to the traditional peasant landscape as understood by contemporary advocates, who would like to preserve and restore the countryside for aesthetic, ecological, pedagogical, and livelihood reasons. Satoyama includes rice fields, paths, gardens, irrigation canals, and planted forests as well as woodlands. But the woodland, understood as an assemblage of both human and nonhuman ways of life, is the heart of the concept. Woodlands are threatened in much of Japan from the abandonment of the countryside since Japan's rapid economic growth. Satoyama advocates would like to bring urban people back to the countryside to restore the lively ecologies they associate with earlier eras of peasant livelihood.

Figure 1. Satoyama woodland, Kyoto Prefecture. Photograph by the author.

Because satoyama is a concept for mobilization and restoration, it has a certain strategic essentialism at its heart. Advocates compare actual wooded landscapes to ideal satoyama, and they work to restore characteristics of the ideal. There is something of the diagram in satoyama—that is, the simplified sketch with parts that fit together. It is this feature of the satoyama that inspired me to work with Gan to represent satoyama coordinations through a series of ink drawings. For Gan, the use of the diagram draws in her reading of philosopher Gilles Deleuze. We both thought the diagram might help convey the liveliness of the assemblage by showing satoyama as a set of moving elements, each creating possibilities for living for the others.

The drawings Gan made show key elements in our analysis as follows: She began with photographs from my fieldwork in Japan, and she picked out the parts that informed our story through black-and-white ink lines. (See Figure 2.) I had initially imagined the coordination among multispecies ways of life as like a fugue, a musical composition in which each part represents an independent melody and listeners must track moments where these parts create an effect with each other. In contrast to the unified heartbeat of rock and roll, the fugue teaches us to listen to separate melodies played together. Gan's drawings, then, are a kind of musical score, in which we work to notice how the temporal juxtapositions we call coordinations work. We emphasize the collaborative work of four major players: pines; matsutake mushrooms, a symbiotic associate of pine; deciduous oaks; and human farmers. These four build an architecture for satoyama woodlands in which many species can thrive. Satoyama advocates stress the importance of other plants enabled by this architecture, such as spring wild flowers, azalea bushes, and flaming

maples. They also care about the animals that do well in this assemblage, including rabbits, foxes, frogs, and birds. The four we have chosen have a special role, however, in making this multispecies assemblage possible. Let me introduce them.

Figure 2. Pines in the satoyama woodland: a diagram. Drawing by Elaine Gan.

We could start with any one, but we begin with pine, making it the first violin, if you will, in our fugue. In central Japan, pines are creatures of disturbed woodland spaces. They require sunshine and mineral soil to germinate, and they do not do well in closed canopy broadleaf forest. They thrive with human disturbances, such as fire, clearing, and even erosion. When timber is cut, leaving “bald” hills, pine is the first tree to repopulate those hills. But pine can only do the work with fungal associates, which help the tree find water and nutrients even in denuded soils.

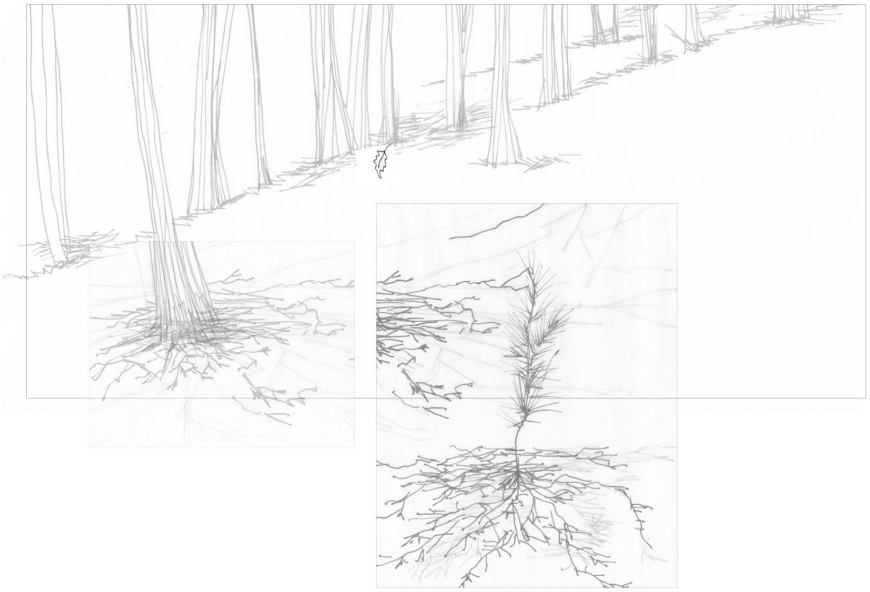

Figure 3. Mycorrhizas are joint organs of fungus and tree. Pine seedlings with mycorrhizas are more successful. Drawing by Elaine Gan.

This is biological symbiosis in the strict sense of the term. Pines form special root structures called “short roots” for mycorrhizal fungi; if they encounter no fungi, the short roots abort. Fungi need the trees as their source of food. Together, pines and fungi define and strengthen each other, and they make the expansion of the woodland into denuded spaces possible.

My attention was drawn particularly to matsutake mushrooms, a much valued mushroom—to humans—in central Japan. Matsutake might be the cello in my fugue. Matsutake grow with pines in peasant woodlands. Matsutake secrete strong acids that dissolve minerals and thus aid the pines in their nutrition. In central Japan, especially where humans cut a lot of trees and thus pines spring up everywhere, matsutake is perhaps the most common pinewood fungus. When it was most plentiful, matsutake became the generic word for mushroom in the Kyoto region. Matsutake is valued for its pungent “autumn aroma.” For some time, it has become a gourmet treat, worth so

much that, as I will explain in a few minutes, managing woodlands is economically worthwhile just from the sale of the mushrooms.

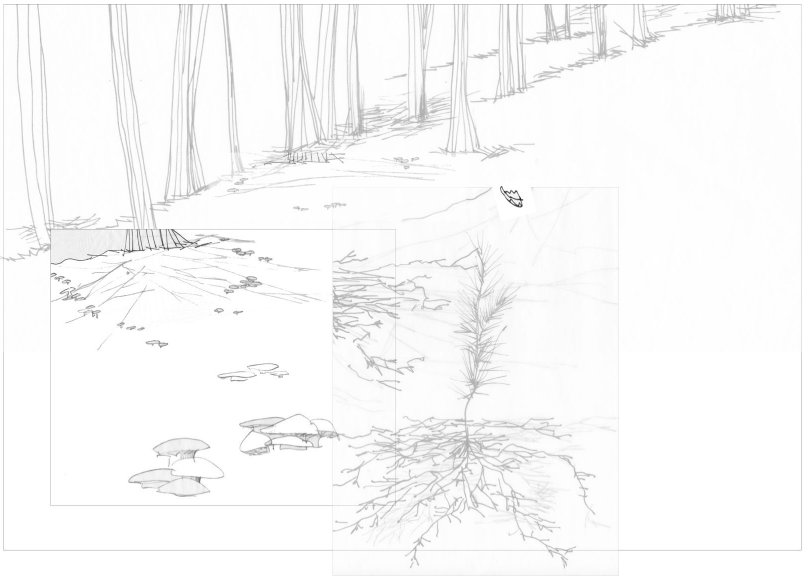

Figure 4. Matsutake spread and sustain pine woodlands. Drawing by Elaine Gan.

Human farmers are also a key player in making this ecological assemblage possible. Pines disappear from central Japanese woodlands without human disturbance. Without the animals that served European peasants as sources of manure, Japanese farmers until the mid-20th century used the nutrients of the woodlands to fertilize their fields. They cut small trees, grasses, and herbs, and they raked the humus, using this green manure for their fields. Raking and simplifying the woodland advantaged pine and its partner matsutake. Together, farmers, pine, and matsutake sustained pinewoods. Farmers are the violas in my fugue; violas: the sound of the human voice.

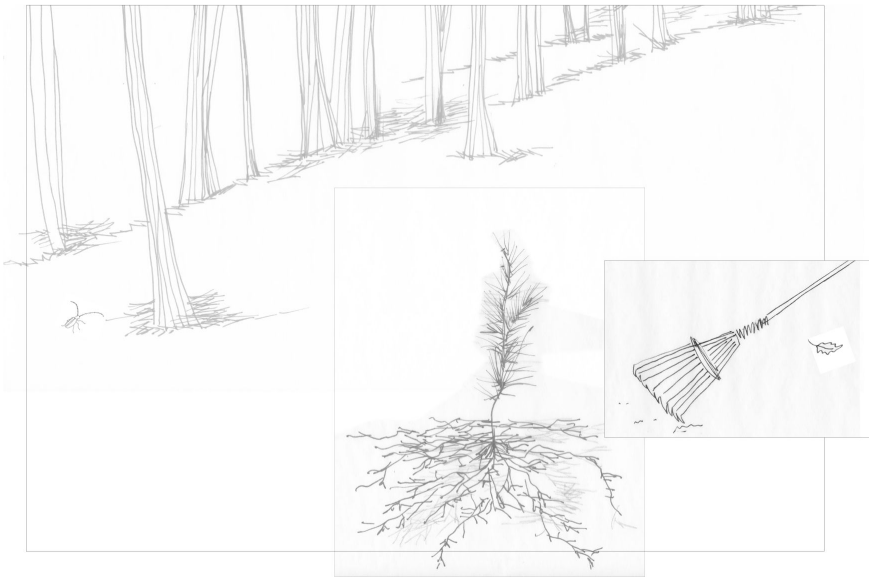

Figure 5. Raking advantages pine and its partner matsutake. Drawing by Elaine Gan.

Oaks are also key players. Oaks burn slowly and evenly; they make the best firewood and charcoal. Peasant farmers cut oak for its many uses. But oak has some special properties that pine is missing. When you cut it, it comes back. If you cut it at the base, this is called “coppicing”; if you cut the branches, this is called “pollarding.” In both cases, new stems emerge from the roots and the trunk. A many-stemmed oak is one that has been cut. Coppiced and pollarded oaks are stable elements in the woodlands. They live for many years, and, when they are cut, they come back more quickly than new seedlings can establish themselves. They help establish what I am calling the architecture of the woodland—the characteristics that make it hospitable for many, if particular, forest species. Japan has two kinds of oaks, deciduous and evergreen. Deciduous oaks were particular valuable to peasants, and they formed a key element in the architecture of the satoyama woodland. Because they lose their leaves in winter, they leave bright spaces for an understory of wildflowers, herbs, insects, and birds. They also co-exist

with pines, although pines sometimes take bright ridges while oaks take hillsides. Oaks and pines work together to form the satoyama woodlands; they are the two violins in my fugue.

Figure 6. Pollarded oaks join pines in forming the architecture of the satoyama woodlands. Drawing by Elaine Gan.

Oaks, pines, matsutake, and human farmers: together they create the multispecies livability of the satoyama woodland. In their overlapping niche constructions, they make space for many kinds of life. Thus too they shaped the historical emergence of landscape in central Japan. In contrast to a score for a piece of music, this landscape constantly changed even as these players continued their fugue-like entanglements. Big transformations sometimes made the satoyama. The industrialization of Japan in the 19th century caused vast forest denudation. But pines sprung up and oaks joined them; the early 20th century, as a result, is often considered the model period for thinking about satoyama. History makes satoyama.

Yet more recent developments have challenged it. In the 1950s, many farmers moved to the cities, abandoning the countryside. Even where they

stayed, chemical fertilizers replaced green manure, and fossil fuels replaced firewood and charcoal. The satoyama woodland became less important to livelihoods, and it was left without earlier practices of disturbance.

The woodlands changed. Evergreen oaks and laurels grew up thickly once deciduous oaks were no longer coppiced. Moso bamboo, once carefully harvested each year for its tasty bamboo shoots, became an invasive weed. The bright and open satoyama woodland became dense and shady; neither pine nor matsutake could survive. Without oaks, pines, matsutake, and farmers, a whole suite of plants and animals began to disappear, from birds and understory flowers to frogs and ants.

Figure 7. Moso bamboo has become a weed. The satoyama woodlands becomes shady and dark. Drawing by Elaine Gan.

Symbiosis, coordination, history, landscape: In the symbiotic connections and coordinations of oak, pine, matsutake, and farmers, a livable landscape emerged, the satoyama woodland. Satoyama has been a protagonist of the 20th century, and, indeed, by the end of the century, it produced such fervent longings that a passionate mobilization of urban residents emerged to

revitalize it. Scientists, housewives, students, and retired people were joined by salary workers on weekends. They removed invasive species, including moso bamboo, and they opened up the woodlands so that pines could once again thrive. Mimicking peasant disturbance practices, they coppiced oaks and even removed the over-rich humus.

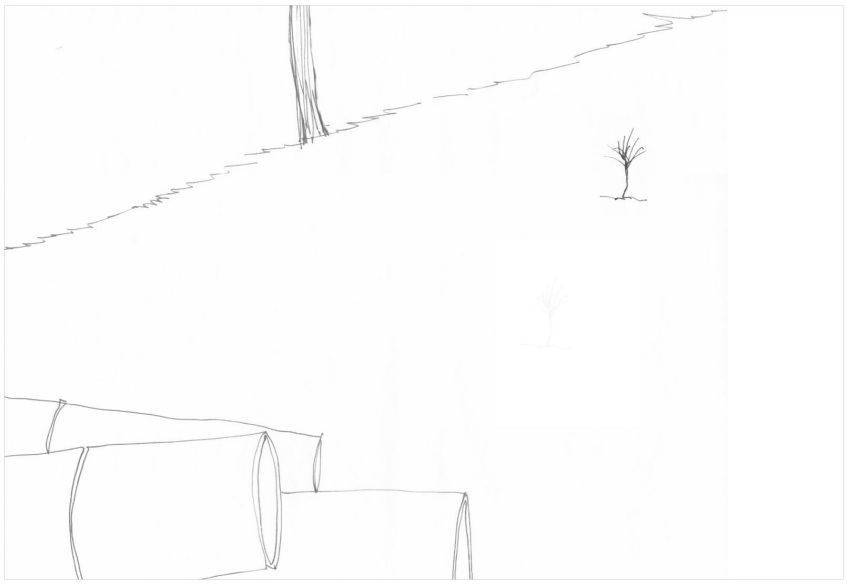

Figure 8. Volunteer groups, such as the Matsutake Crusaders, have mobilized to revitalize satoyama. Drawing by Elaine Gan.

Here is where matsutake makes a new appearance. Satoyama advocates want the landscapes they revitalize to be spaces of work and livelihood—not just passive aesthetics. The high prices of matsutake can pay for satoyama revitalization. Despite millions of yen invested in trying, no one knows how to cultivate matsutake. The best anyone can do is to encourage the kind of forest in which matsutake likes to grow. Volunteers, such as Kyoto's Matsutake Crusaders, do just this. Revitalizing satoyama brings back the fugue of oaks, pines, matsutake, and humans.

Figure 9. Satoyama landscape. Photograph by the author, reworked by Elaine Gan.

Satoyama landscapes include villages, rice fields, gardens, irrigation canals, planted forests, as well as satoyama woodlands, and advocates have argued for the necessity of recreating connections across them, particularly through revitalizing the woodlands. In 2010, Japan announced a Global Satoyama Initiative.[4] Perhaps this allows me to take the concept farther afield.

As I have stressed, satoyama woodland has features of an ideal—a diagram or a musical score. It is known in its decline, and in its revitalization. To see this kind of peasant forest in less choreographed action, let me take you to central Yunnan Province, in China, where humans, oaks, pines, and matsutake have a similar symbiotic landscape—but without the aesthetics of ideal imaginings.

Here, too, I argue, these species work together to create livability. But this is a messier scene of livability. Most foreign experts and conservationists—

who mainly come with US habits and eyes—miss such symbiosis, and they work to save the peasants, oaks, pines, and mushrooms from themselves.

Figure 10. Yunnan village forest. Photograph by the author.

In the mountains of central Yunnan, the landscape is not so different from central Japan. There are oaks, pines, matsutake, and farmers, making a common landscape—but here without satoyama intentionality. As in central Japan, pines disappear in this part of Yunnan without human disturbance. One difference is the kind of oaks: in this part of Yunnan there are only evergreen oaks, but they are also hosts for matsutake mushrooms, making the oak, pine, matsutake, farmer complex even more clear. In the category "oaks," I include tanoaks and chinquapins, which behave similarly to true oaks in coppicing and in being host to matsutake. You see some across the background in Figure 10.

Yunnan has its own history. My research took place after a province-wide logging ban had been put in place, allowing felling of trees only for domestic purposes. After the ban, matsutake mushrooms—and other non-timber forest

products—became much more important as a source of income. Meanwhile, the ban itself was in part a response to the power of Western experts and researchers in Yunnan. Most do not like the messiness. In contrast to Japan, no one sees the landscape as a model of livability. Yet, against this grain—and with the guidance of satoyama, one can see the same principles here. Human disturbance can participate in an oak, pine, matsutake, and farmer symbiosis.

Figure 11. Yunnan mushroom collector in young village forest. Photograph by the author.

Notice the pines in Figure 10. All their branches have been cut off—to collect pollen for the cosmetics industry. Pines with edible seeds are also pollarded, and some are also tapped for turpentine. This is a messy space. As for the oaks, they are cut and cut for firewood—if they aren't eaten by the goats, who even eat pines. Firewood is used not only for human cooking but also cooking for the pigs. And pine needles are raked from the forest floor for bedding for the pigs—and then transferred to the fields coated with manure. This is a young and disorderly woodland. And it is a great place for matsutake, as well as other mushrooms.

Figure 12. Yunnan firewood and pine needles. Photograph by the author.

It was hard for me to learn to appreciate this this ecology. I saw the grazing and the coppicing; I saw the mess. It took me awhile to appreciate the multispecies mutuality in which humans form part of the disturbance regime. One thing that convinced me was the alternative: A small fenced reserve has been created so that visiting researchers can see matsutake growing in the forest. A walkway keeps visitors off the forest floor. For fifteen years, no one has cut trees or removed the duff. No goats are allowed inside. The trees have grown tall and shady. The duff has built up. There are still a few matsutake mushrooms growing there, but it is clearly not the flourishing mushroom forest that one sees outside the reserve.

Figure 13. Yunnan matsutake reserve. Photograph by Michael Hathaway.

It is refreshing and shady in the reserve—but there is not enough human disturbance for the oak, pine, matsutake, farmer symbiosis to sustain itself. In the midst of disturbance: symbiosis, coordination, history, landscape.

Let me return to central Japan. I have been showing you histories that make peasant woodlands, in their symbioses of livability, and also histories that break the coordinations that keep these woodlands in place. So far, I have stuck to historical examples where revitalization seems possible. A different suite of plants, animals, and fungi succeeds when the woodland is fenced or abandoned; yet a volunteer movement is capable of bringing the earlier suite back. This is the ecological resilience upon which we have come to depend. The crisis of livability of our times, however, is something different—and it is that difference that is signaled in the term Anthropocene. Anthropocene does not mark the dawn of human disturbance. As I have been showing, human disturbance can form part of resilient Holocene ecosystems, such as peasant woodlands. Anthropocene marks instead a break in

coordinations that is much harder to heal. We are thrust into new ecologies of proliferating death. My final section gestures to this problem.

Four: Some human ecologies break the coordinations necessary for livability.

Return again to Figure 9: a diagram of the satoyama landscape, including not just woodlands but human habitation and cultivation. It was the beauty and charisma of this kind of landscape that inspired Japan's Global Satoyama Initiative in 2010. This was to be Japan's outreach to the world, a conservation initiative with cultural values at its heart. Its first big event was held on March 10-11, 2011.[5] But by March 11, no one was listening to this story of valued nature. A tsunami had hit the city of Fukushima, and the nuclear reactors there had cracked open and melted down.

Radiation spread throughout the region. Worse yet, Japanese authorities decided to support the region by requiring municipalities across Japan to accept food grown in Fukushima. Landfills across Japan now carry Fukushima radiation.[6] So too do woodlands, although unevenly. Iwate Prefecture, close to Fukushima, has some of the nation's most famous matsutake woodlands. But mushrooms collect radiation. Valuable matsutake from Iwate have suddenly become poison.

Figure 14. Radioactive cesium: an unprecedented rupture of satoyama coordinations. Drawing by Elaine Gan.

Elaine Gan's idea of how to represent this unprecedented change in coordinations was to reverse the photograph you just saw. Now black is white. Coordinations have changed. Matsutake pulse with the rhythms of radiocesium. Not just humans but also other animals eat mushrooms, and they carry the radioactivity around. In Chernobyl, ecologists have made the surprising finding that radiocesium levels are not decreasing in the landscape the way they do in the laboratory.[7] Chernobyl topsoils are almost as radioactive now as they were in 1986, when the power plant ruptured. Meanwhile, wild boar eat mushrooms and carry them across long distances. German gourmets who have enjoyed wild boar find that their meals have been poisonous. In the midst of disturbance: symbiosis, coordinations, history, landscapes. These relationships still hold. But the Anthropocene marks new terrors in unlivability. Not just radioactivity is involved. The global transfer of organisms at industrial scales has done much to create virulent new pathogens for both humans and other species. Chemical contaminations, and

the spread of chemical fertilizers, spoil freshwater ecologies. Climate change disrupts interspecies coordinations, heading many populations toward extinction. To learn about this is urgent work in which anthropologists might want to participate.

The first task in this project is to learn something about other species, including wild species, which do so much invisible work to make it possible for humans to survive. Humans cannot live without other species. This is not just because we eat them. Multispecies landscapes are enactments of livability. We need those coordinations to stay alive. At every scale, from our intestines to our planet, we need landscapes of common livability, achieved through symbiosis and coordinations.

Yet to learn something about nonhumans, new kinds of collaborations will be necessary. I have been suggesting that we might find natural-science allies by paying attention to discussions and debates among different forms of natural science. It is not helpful to imagine science as a monolith. This does not mean that we should be silent about the flaws in scientific expertise and the political consequences of research programs. It also does not mean that we need adopt a scientific positivism and abandon all the things we have learned as anthropologists.

One tactic for an alliance that holds on to anthropological stakes is to take cultural programs for knowing and "doing" livability really seriously. In discussing peasant landscapes, I have been guided by an explicit program for working with multispecies assemblages: the satoyama. How far regionally that takes me is an open question, but this is the kind of question anthropologists can tackle. I have been unwilling to stop with an outsider's

examination of Japanese programs for “doing” forests. Instead, I have chosen to join those programs to see what an anthropologist might learn about forests, and in Yunnan as well as Japan. This is not the only way to “do” forests, and I would not promote it for every landscape. But it clarifies some theoretical questions anthropologists are asking today, including the role of symbiosis—biologically, as collaboration, and, more generously, as landscape formation. The metaphorical symbiosis of collaboration involves more than watching each other do what we do. It requires learning enough to look for productive emergences—perhaps in those arenas of “something extra” that noticing provides across disciplinary expertise.

Exploring livability, I’ve argued, requires appreciation of landscapes as analytic tools. To allow landscape to re-enter the vocabulary of anthropology in better standing, my first move has been to refuse the genealogy of landscape as a distant representation, to instead look for multispecies moots in emergence. I am arguing that humans cannot survive without such multispecies moots. Neither can other species. There is some urgency then in pursuing this trajectory of doing landscape.

But landscape still seems passive, even dead, to most people, including anthropologists. Landscapes are backgrounds for the exciting action. I’m arguing that we need to bring landscapes to life, and to make them protagonists of our stories. We need to develop excitement to learn what happens next. Developing a new genre of storytelling is always risky. Until audiences learn to hear the new genre, it is deadening. It would have been easier to capture your attention by telling you colorful stories of human mushroom foragers and their antics. But I’ve tried instead to show you active

landscapes, landscapes having adventures through the symbioses and coordinations that form and reform them. I've tried to make this activity clear by pointing to varied players in the mix, and especially oak, pine, matsutake mushrooms, and human farmers. To make their roles apparent, Elaine Gan and I introduced them through a diagram, a musical score, a script for an ever-changing play. Together, they tell a story—and a story we need to know. I'm still out on a limb here, and I need your suggestions about how to make the adventures of landscape more convincing. But this is the new animism we need—not limited to single animals, in their parallels with humans, but rather distributed across landscapes of livability. In the midst of disturbance, symbiosis, coordination, history: here landscapes have adventures.

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[1] The program is Aarhus University Research on the Anthropocene. See http://anthropocene.au.dk
[2] Interview for *Women's Own*: http://www.margaretthatcher.org/document/106689
[3] http://blogs.discovermagazine.com/80beats/2009/06/16/a-near-extinct-blue-butterfly-flourishes-again-thanks-to-a-red-ant/#.Var8gotsze5
[4] http://satoyama-initiative.org
[5] http://satoyama-initiative.org/en/the-first-global-conference-of-ipsi-3/
[6] Daisuke Naito, personal communication.
[7] "Chernobyl exclusion zone radioactive longer than expected," *Wired,* http://www.wired.com/2009/12/chernobyl-soil/

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