Building Plant Bodies: People, Trees, and Grafting in the Walnut–Fruit Forests of Kyrgyzstan

By

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Table of Contents

List of Figures

Abstract

Grafting is a horticultural technique that combines parts of different plants in a single body, in which they grow together and function as a single composite organism. Understood as a partnership between human and plant, grafting sheds light on the project of posthumanism, which seeks to decenter the figure of the human and understand agency as distributed in networks of heterogeneous actors. But grafting does more than remind us of our nonhuman neighbors and the partnerships we enter into with them. Southern Kyrgyzstan is the site of the world's largest walnut–fruit forest, in which grow many trees that can, to greater or lesser extent, be grafted. This sets the walnut–fruit forest apart from most other temperate forests: with populations of apple, pear, plum, peach, cherry, almond, walnut, and pistachio, this is a forest that is engaged not only silviculturally but also horticulturally, through techniques like grafting. This potential matters: nearby villagers and state foresters must consider the value of negotiating close horticultural relationships with forest trees, thus transforming their bodies and the fruit they bear. Their choices—to graft or not to graft—ramify outwards, altering the forest that confronts more distant actors as well.

This dissertation uses the tools of posthumanist political ecology to examine this "graftability"—and in particular the possibility of grafting wild walnut–fruit forest trees with domesticated material—and what it means for the resource and conservation politics of southern Kyrgyzstan. Grafted and ungrafted trees act differently. This, in turn, has consequences for state officials changing how land and trees are owned, Soviet foresters embroiled in scientific debates in the 1950s, conservationists worried today about natural areas and their genes, and locals who want better fruit from their backyard forest. Using ethnography, archival research, surveys, and participant observation, this dissertation examines how the graftable and ungraftable trees of the walnut–fruit forest are owned and accessed, in the process shedding light on the workings of power in relationships between humans and non-humans more generally.

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The flaws in this dissertation are my own doing, of course, and none of the people mentioned above should be held responsible for them in the slightest.

Jake Fleming, May 2017, Fargo, ND

List of Foreign Terms and Acronyms

adat: customary law, as opposed to formal law (Kyrgyz)

CEPF: Critical Ecosystem Partnership Fund, a biodiversity hotstpot conservation project

CFM: collaborative forest management

CWR: crop wild relative

FAO: Food and Agriculture Organization

GOSLESAGENSTVO: State Forest Service. See also SFS

GPS: Global Positioning System

KIRFOR: Kyrgyz–Swiss Forestry Support Programme

kolkhoz: collective farm (from *kollektivnoe khozyaystvo*), a Soviet-era institution of agricultural governance (Russian)

LES-IC: KIRFOR's implementation unit

leskhoz: state forest enterprise (from *lesnoy khozyaystvo*), a Soviet-era institution of forest governance (Russian)

lesosad: forest–orchard, a plot where wild-growing trees have been modified using horticultural techniques (Russian)

NCGR: National Clonal Germplasm Repository

NPGS: National Plant Germplasm System

NTFP: non-timber forest product

SFS: State Forest Service. See also GOSLESAGENSTVO

sovkhoz: state farm (from *sovetskoe khozyaystvo*), a Soviet-era institution of agricultural governance (Russian)

tokoi: forest (Kyrgyz)

USDA: United States Department of Agriculture

zapovednik: strict nature reserve (Russian)

Chapter 1 – Introduction

On a hillside, in a fenced backyard in a village in southern Kyrgyzstan in post-Soviet Central Asia, all the trees are made of pieces. They have been built, their bodies assembled from disparate elements brought from down the street or across the country. The effects are striking: a scrubby tree of small yellow cherries features one branch of big red plums. An apple tree, its sutures still visible from an operation years past, offers big juicy fruit above the scar and little spitters below. A wild hawthorn, its bitter haws of strictly medicinal use, turns to cherry at shoulder height, though its growth above the transition is weak and its fruit scarce. Many other operations are in progress here, branches plugged into trunks just beginning to grow together into new patchwork bodies.

These trees are the product of long-running experiments in horticultural practice, years of plant tinkering by a man I'll call Rysbek.[1] Although it is Rysbek, and his similarly-inclined father before him, that has brought together these plant parts and assembled them here, it has not been a straightforward process. Only some trees will consent to such manipulations; if the cherry/hawthorn grows only haltingly, other combinations will not grow at all, insisting on a bodily integrity that these chimeras can manage without. Each graft here is a small success that could have failed had human or plant acted differently, a success dependent on the care that Rysbek has taken, the techniques he has deployed, and the pliable nature of the trees he has engaged. Over decades of careful collaboration and attention to craft in this hillside workshop, Rysbek and his backyard trees have worked out ways of growing that are amenable to them both.

[1] Other than certain public figures, all the names in this dissertation are pseudonyms.

From one perspective, this is remarkable stuff: the body of each built tree here has multiple origins, its various parts bearing different characteristics and histories and genetic signatures and meanings such that it is hard to say, for many of them, precisely what they are. From another perspective, however, this backyard is perfectly commonplace. These trees have all been grafted, and Rysbek's careful negotiations with his trees have been anticipated by thousands of years of horticultural interventions. Classical sources from 1000 BCE debate specifics of grafting practice, and the technique has been "a pivotal technology in the history of temperate fruits" ever since (Mudge et al. 2009, 439). Today, many of the most familiar tree crops rely absolutely on grafting for their commercial propagation, and the trees in any industrial apple or pear orchard are as crafted together as Rysbek's, though efforts of standardization and optimization have made the bodily negotiations that constructed them less visible. Human–plant interactions are fundamentally shaped by this capacity of some plants to live and grow in bodies cobbled together from pieces of other bodies.

This dissertation is about grafting. In this introductory chapter and the chapters that follow, I argue that grafting, a horticultural technique by which plant parts grow together and function as a single composite organism, is of real theoretical and practical significance for geographers and other social scientists. Most immediately, as a partnership between human and tree, grafting sheds light on the project of posthumanism, which seeks to decenter the figure of the human and understand agency as distributed in networks of heterogeneous actors. Rysbek's backyard workshop is not his creation alone but the product of the labors of multiple humans and nonhumans with widely divergent capacities. The plant bodies that populate the hillside are the result of a "dance of agency" (Pickering 1995), in which human and tree have each taken actions that enable their partnership to persist. Indeed, it is misleading to call one partner a "grafter" and describe the other in the horticultural fashion as "grafting material," a terminological decision that emphasizes human activity and tree passivity when a vocabulary of *inter*activity would be more appropriate (if also more cumbersome). The grafted bodies on Rysbek's hillside are horticultural co-constructions with multiple authors, both human and non-. By examining the bodies and places these authors have created together, I work alongside other efforts to bring non-humans more fully into our geographical analyses.

But grafting, at least where Rysbek does it, does more than remind us of our nonhuman neighbors and the partnerships we enter into with them. Southern Kyrgyzstan is the site of the world's largest walnut–fruit forest (See Figure 1), in which grow many trees that can, to greater or lesser extent, be grafted.[2] This sets the walnut–fruit forest apart from most other temperate forests: with populations of apple, pear, plum, peach, cherry, almond, walnut, and pistachio, this is a forest that is readily engaged not only silviculturally but also horticulturally, through techniques like grafting. This potential matters: nearby villagers and state foresters must consider the value of negotiating close horticultural relationships with the trees with which they share the landscape. Their choices—to graft or not to graft—ramify outwards, altering the forest that confronts more distant actors as well.

[2] Typographical care is needed here. This forest is distinguished not by the fruit of the walnut tree (which would be a "walnut-fruit forest," with a hyphen), but rather by the combination of walnut trees and other fruit trees (thus, "walnut–fruit forest," with an en dash).

Figure 1: Present distribution of the walnut–fruit forest. Adapted from Grisa et al. (2008).

Rysbek's backyard is embedded in a broader terrain that bears many trees of multiple origin and habit, thanks to grafting manipulations that date back nearly a century. Though the effects of grafting are especially visible on Rysbek's plot, where he has concentrated his efforts, the widespread graftability of forest trees has consequences for human–forest relationships across this landscape. In places, the forest is as much a product of human–plant collaboration as Rysbek's backyard hillside, and this shapes how the material resources of the forest are owned and accessed.

Grafting involves implanting a *scion*, typically a single bud or short twig taken from one plant, into the body of another plant, which serves as the *stock* or *rootstock* (See Figure 2).

Figure 2: Grafted apple in an orchard in Kyrgyzstan. Author photo.

If a section of a third plant is inserted between them, it constitutes the *interstock*. To a first approximation, the plant parts thus assembled do not mix, and scions retain many of the characteristics they had before their grafting. The fruit of scions, for example, is generally unaffected by the stock to which they are grafted, and the most common purpose of grafting in fruit tree crops is to produce desirable fruit on trunks that could not otherwise do so. In the walnut–fruit forest, wild trees are used as rootstocks to which scions of cultivated varieties are grafted; these scions' fruit quality can be relied on not to change in their move from nursery to forest. The plum branch that Rysbek has grafted to a wild cherry tree would yield fruits as large, as red, and as juicy if it had been grafted to a specially-bred plum rootstock instead. Other parts of grafted bodies are similarly reliable, so that even after wild apple trees have had all their branches replaced with cultivated scions, their roots retain the robustness that they had before. Although the notion of "graft hybridization"—two plants grafted together to give rise to something intermediate and new—has been around since Darwin (1868), no mechanism has been proposed for the alteration of DNA sequences, in either stock or scion. The grafted branches of Rysbek's backyard trees are genetically identical to the trees from which he clipped them, and genetically distinct from the trunks that now support them.

A tree is not only its genes, however, and while grafting makes no difference to the DNA sequences of the plant parts it recombines, the same cannot be said about other facets of tree being. For some features of interest to human interlocutors, scion and stock *do* affect each other. Tree size is one of these: grafting on dwarfing rootstocks yields apple trees that can be harvested without a ladder, even shrubby apples that are grown grape-like on trellises (See Figure 3). In other words, the development of the scion's trunk and

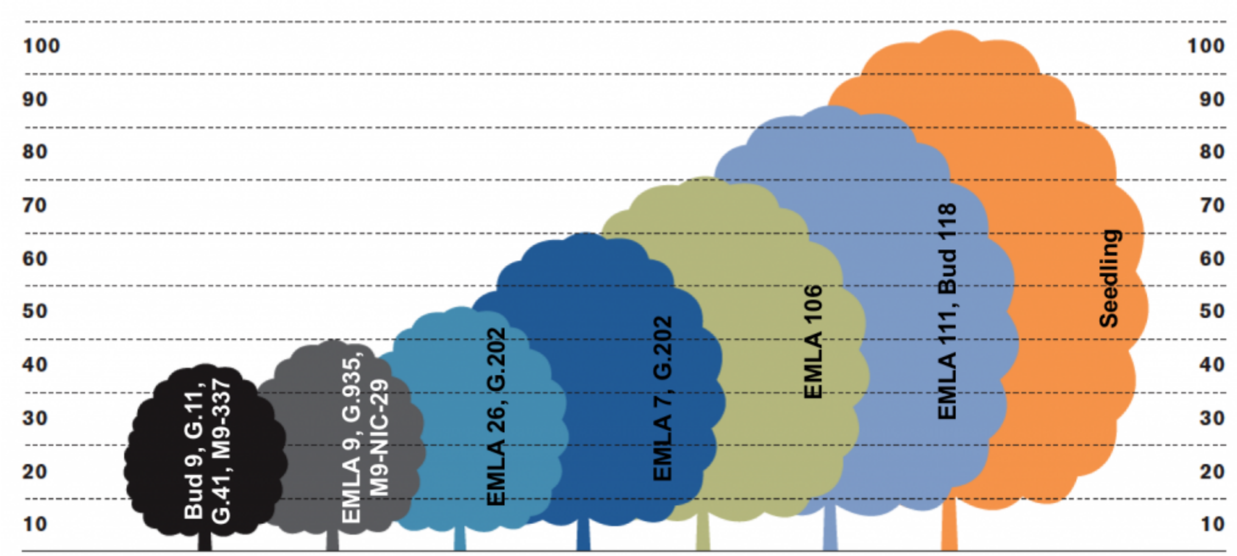

Figure 3: The dwarfing effect of different apple rootstocks, with resulting trees represented as a percent of a wild tree's height at maturity. Wikimedia Commons.

branches—unlike that of the fruit they bear—is made more or less vigorous by the stock to which it is fused. To be pithy about it, grafted parts *do* mix, at least in this sense, and the grafted body is, quite literally, more than the sum of its parts. So long as the tree is not reduced to the set of its genes and fruits, it becomes clear that the various elements of grafted bodies are not simply juxtaposed, but find their capabilities and functionings modified by their coexistence with pieces of other trees brought to inhabit the same body.

The classic focus of grafting research—stock–scion compatibility, or, what can be grafted to what—is further evidence of the same point. Precisely what happens at the *graft union*, where stock and scion meet, has been the topic of much scientific debate (Waugh 1904; Simons 1986; Atkinson 2003; Yin et al. 2012). To a first approximation, like grafts to like, and the closer the genetic relationship between stock and scion, the better for the hopeful grafter. Again, though, this rule of thumb conceals as much as it reveals—"something more than kinship is required for a good union" (Garner 2013, 50). The grafting of stocks and scions in some combinations leads to the activation of complex pathways of wound repair and healthy tissue growth, while in other, genetically very similar, combinations, it leads to different complex pathways of unbalanced hormone production and selective or total cell death. Some scions can grow on stocks of other species or genera—"Fertility" pear scions, for example, are unusually compatible with apple stocks—but others, like plums, show complex patterns of *intra*specific incompatibility, rejecting stocks that are genetically nearly identical to themselves, with dire horticultural consequences (Garner 2013). Tables tracking these combinatorial compatibilities betray no obvious patterns (See Figure 4), and researchers have struggled to disentangle the influence of mechanical, genetic, and cellular

APPENDIX II

PLUM ROOTSTOCKS AND THEIR USES

Some Suggested Combinations of Rootstock and Scion which appear Suitable and Compatible, and some to be Avoided

	Rootstocks							
Scion Varieties	*Myrobalan B*	*Brompton*	*Marianna*	*St. Julien A*	*Common Plum*	*Common Mussel*	*Pershore*	*Pixy*
Belle de Louvain		L	L			L		
Bryanstone Gage	L	L			S			
Bush (Kentish)	L							
Cambridge Gage	L		L	S				S
Cherry Plum	L							
Comte d'Althann's Gage	X	L			S		S	S
Czar	L	L	X		X	S		
Damsons	L		X		X			
Denniston's Superb Gage	L		X		S			
Early Laxton	L	L		S	S	S		S
Giant Prune	L	L	L			S		
Jefferson	L	L			S			
Laxton's Gage	L				S			
Marjorie's Seedling	X	L	X	S	X			
Monarch	L	L			S	S	S	
Ontario	L	L						
Oullins Golden Gage	X	L	X	S	S			S
Pershore (Yellow Egg)	L	L	L		S		S	
Pond's Seedling	L	L				S	S	
President	L	L	X		X	S		
Purple Pershore	L		L		S			
River's Early Prolific	L	L	L		S	S		S
Severn Cross	L	L			S			
Thames Cross	L	L			S			
Victoria	L	L		S	S	S	S	S
Warwickshire Drooper	L	L				S		
Peaches and Nectarines	X	L		S	X	L		
Apricots		L		S		L		

L = Combinations for large to medium trees. S = Combinations for medium to small trees. X = Combinations to avoid.

Figure 4: Stock–scion compatibility in plums (Garner 2013, 302).

factors in combination (Feucht 1988; Pina and Errea 2005). Again we see that grafted parts are not modular, like bricks, but enter into relationships with the other parts of the body they end up sharing. Through careful management of these relationships, horticulturists can not only manipulate fruit quality but also hasten the onset of fruiting, reinvigorate older trees in decline, repair mechanical damage, create single trees bearing multiple varieties or even species of fruit, and combine useful traits like disease resistance and cold tolerance (Garner 2013).

The variegated body that results from these manipulations is the product of a partnership between the human grafter and the two or more trees he or she brings together, and made possible only by the capabilities of all these actors. The character of the grafted body is of horticultural interest, but its exploration opens onto many other fields of inquiry too. As the following chapters demonstrate, graftability, which characterizes some plants but not others, makes a difference in southern Kyrgyzstan in processes of land reform, forest conservation, genetic prospecting, and local resource use. Adequately representing this difference requires reconceptualizing these social processes as incorporating trees not as mere resources but as actors. In other words, a consideration of graftability demonstrates that the society that undertakes land reform, deliberates over conservation, puts genes and bodies to innovative uses, and performs the local economy of southern Kyrgyzstan is a society of humans, trees, and many other things besides.

Political Ecology and the Community of Politics

The issues that interest me, and which I use grafting to explore in this dissertation, are those considered by the field of political ecology. Since its emergence in the 1980s out of "the concerns of ecology and a broadly defined political economy" (Blaikie and Brookfield 1987, 19), political ecology has analyzed the unequal and power-laden manner in which resource users vie for access to an environment that is never fully captured in the process (Bryant 1992; Peet and Watts 2004). In southern Kyrgyzstan, the interaction of walnut–fruit forest trees and agrarian Kyrgyz and Uzbek communities within larger-scale post-Soviet economic reform and global conservation campaigns ticks a number of classic political ecology boxes. For example, forest grafting is a means of humanizing what might otherwise be considered a wild forest; my examination of it resembles how other political ecologists have explored the humanization of other forests (Fairhead and Leach 1996; Gomez-Pompa and Kaus 1992; Willems-Braun 1997). In recent years, the forest's management has been decentralized and access to its resources transformed, processes which resonate with political ecology's focus on property relations (Mansfield 2007) and the neoliberalization of nature (M. Goldman 1998; Heynen et al. 2007; Castree 2008). Grafting itself has received comparatively little attention from political ecologists (an exception is Prudham 2003), but Rysbek's backyard blurs lines between forest and garden, and its inhabitants unite the labors of human and plant, in ways that raise questions of naturalness with which political ecologists have wrestled extensively (Cronon 1996; Demeritt 2002). Most fundamentally, and like other approaches in people–environment geography, ecological anthropology, and rural sociology, political ecology insists on examining the natural and the social together, a position that makes it an appropriate framework for investigating the relationships between people and trees in southern Kyrgyzstan.

Political ecology emerged in examinations of rural communities in the Global South, but the field has since deployed its analytical tools on sites in developed countries as well (McCarthy 2002). Notwithstanding this territorial expansion, the erstwhile Second World, the Soviet Union and its satellites, has been comparatively neglected by political ecologists (exceptions include Fernández-Giménez 2001; Cellarius and Staddon 2002; Schwartz 2005; M. Schmidt 2008). Debates over the proper scope of political ecology unfolded without reference to anything beyond the former First and Third Worlds (Robbins 2002; Wainwright 2005), in dichotomies that exaggerated the coherence of these categories. McCarthy's aside that countries formerly of the Second World had by 2005 "presumably differentiated into one or the other" of the First World/Third World pair (2005, 955) is both untrue and indicative of political ecology's neglect of a large part of the world with an importantly distinct history that continues to matter today (Stenning and Hörschelmann 2008). This is ironic: the field grew out of analyses of societies "in transition" into the global economy (Watts 1983), and its tools are well-suited to the post-Soviet states. Amid the formal flux of post-Soviet transformation, political ecology's insistence on the importance of informal institutions (Agrawal 2001; Robbins 1998; Scoones 1994) is valuable, as is its differentiation of access from formal property rights (Ribot and Peluso 2003). Yet, in recent years, even as many of the world's most ambitious reworkings of the landscapes of power and property have played out in post-Soviet space (Allina-Pisano 2008; Burawoy and Verdery 1999; Stark and Bruszt 1998), political ecologists have had little to say about ongoing post-socialist transitions (O'Rourke 2004).

In Kyrgyzstan, which spent most of the 20th century as the Soviet republic of Kirgizia, these transitions have been jarring. Notwithstanding agricultural land reform (Bloch and Rasmussen 1998) and sweeping transformations of other sectors (Abazov 1999; J. Anderson 1999), the 4% of Kyrgyzstan that is forested remains under the aegis of the State Forest Service, as it was during the Soviet era. In the walnut–fruit forest belt, fourteen state forest enterprises (Rus: *leskhozes*)[3] persist, each including a village and managing a tract of nearby forest. During the Soviet era, these enterprises worked to forest management plans designed in Moscow, and depended heavily on outside resources (Carter et al. 2003). With the collapse of the Soviet Union and the concomitant withdrawal of these resources, they

[3] *Leskhoz* is a syllabic acronym of the phrase *lesnoy khozyaystvo*. In the literature of the Soviet economy, *leskhoz* parallels the more-common *sovkhoz* (usually translated "state farm") and *kolkhoz* ("collective farm"), and refers to a state-sanctioned entity whose focus is forestry.

have seen their capacities shrink (M. Schmidt 2005). Unsurprisingly, these institutions have been targeted for reform, most importantly by the Kyrgyz–Swiss Forestry Support Programme (KIRFOR) between 1995 and 2012 (KIRFOR 2009). In close partnership with the Kyrgyz Ministry of Forestry, KIRFOR worked to overcome what project officers saw as the harmful legacy of Kyrgyz forestry's Soviet past—overcentralization, sclerotic bureaucracy, general financial irrationality, and an inattention to questions of sustainability—by putting "all productive functions in forest management…into private hands" (Samyn 2010, 5). Political ecology is an ideal approach for analyzing what this means for the people on the business end of these changes, but few political ecologists have tested their analyses in post-Soviet waters.

For my purposes, the most important exception to this political ecological blind spot is the work of Matthias Schmidt, which has in fact included political ecological analyses of the walnut–fruit forest.[4] Although his most thorough treatment of the topic, *Mensch und Umwelt in Kirgistan: Eine politisch-ökologische Untersuchung im postkolonialen und postsozialistischen Kontext* (2013), is available only in German, Schmidt has also published in English (2005, 2008, 2012; M. Schmidt and Sagynbekova 2008; M. Schmidt and Doerre 2011), linking the conceptual toolkit that political ecologists have developed elsewhere to many of the Kyrgyzstani issues mentioned in the previous paragraph. Using ethnographic methods and archival sources to track material processes across a variety of scales,

[4] To hopefully forestall one potential confusion: each of the two leading academic experts on human–forest interactions in the walnut–fruit forest is surnamed "Schmidt." Matthias, a German, is a political ecologist who publishes in geography and regional journals. Kaspar, a Swiss development consultant, wrote a dissertation in development studies at the University of Reading on livelihoods and forest management which figures in several of my later chapters (K. Schmidt 2007a). Each focuses on some of the same villages I researched. A third Schmidt, Peter, has published on agricultural research elsewhere in Kyrgyzstan (P. Schmidt 2001); this is his only appearance in this dissertation.

Schmidt's work situates the decision-making processes that characterize local livelihoods both spatially—as responsive to the mountainous terrain in which land managers live—and temporally—as informed by the legacy of Soviet institutions and management decisions. He depicts the walnut–fruit forest as a dynamic space infused with human meanings, and argues that its ongoing environmental degradation is not best attributed to overpopulation or laid at the feet of irresponsible locals but must be related to the economic and political structures that constrain them. In other words, Schmidt has quite effectively brought critical political ecological analysis to the walnut–fruit forest. It is fair to ask, then: What does my focus on grafting add to this existing treatment, given that each employs the theoretical framework of political ecology and the topical preoccupations that come with it?

In short, the chapters that follow differ from Schmidt's work in the place they accord the nonhuman residents of the walnut–fruit forest, most notably the trees that do or do not enter into grafting relationships with people. In the very broadest of strokes, this is what distinguishes Schmidt's excellent political ecology of the walnut–fruit forest from my own effort: Schmidt focuses on contestations between different groups of people over forest resources—a basically humanist environmental politics—whereas I use grafting relationships and the trees that enter into them to construct a posthumanist political ecology. I expand upon this distinction, and argue that grafting is an appropriate means of pursuing it, in Chapter 2. In what remains of this introduction, then, I provide background, information that lays the groundwork for that intellectual effort and the chapters that follow. It comes in four parts. I first introduce the place where I did my fieldwork, southern

Kyrgyzstan, and its distinctive graftable forest that inspired this investigation, including a cast of the characters who figure most prominently. Next, I characterize my fieldwork and relate it to this text. I then provide a short history of forest management in southern Kyrgyzstan, both as complement to Chapter 4's deeper examination of mid-twentieth century Soviet governance and as background for the present-day explorations of Chapters 3, 5, and 6. Finally, I introduce each of these chapters in turn, as a roadmap for the rest of the dissertation.

Southern Kyrgyzstan's Graftable Forest

The walnut–fruit forest belt consists of the walnut–fruit forest itself, the world's largest of its type at roughly 230,000 ha[5], and roughly fifty thousand people who live in villages within it. For most residents of forest villages, the forest features prominently in their livelihoods: villagers harvest the fruit of forest trees, graze their animals on forest pastures, and plant row crops in forest clearings (K. Schmidt 2007a). These forest-based practices are complemented by other practices based elsewhere. Households tend additional fields in the village, where they grow potatoes, maize, sunflowers, onions, and carrots. Some keep more complex home gardens as well (Currey 2009), and livestock spend the winter in the village eating forest-harvested hay (Rehnus, Mamadzhanov, et al. 2013). Endeavors outside the village include more extensive grazing circuits on the open pastures above the forest belt (Borchardt et al. 2011), trading in larger towns in the Fergana Valley, and emigration abroad, an increasing source of income for those who remain (M. Schmidt and Sagynbekova

[5] Areal estimates of the forest, and of the walnut-covered area within it, are notoriously unreliable, due to the uncertainties of categorization and the unreliability of state statistics (Venglovsky 2009). This figure appears in Beer et al. (2008).

2008; Reeves 2012). These pursuits overlap in complex ways characteristic of agroforestry systems worldwide (Messerli 2002; Rehnus, Mamadzhanov, et al. 2013), together making up agrarian lifeways that draw on the heterogeneous resources of a varied mountain landscape.

Every autumn, the walnut–fruit forest's horticultural side becomes increasingly important and village lifeways orient themselves toward forest fruits. The most important of these for village livelihoods is walnut, which dominates the forest canopy in places and produces an annual harvest that, in good years, represents a sizable percentage of village incomes (K. Schmidt 2007a). Walnut income is supplementary, in a sense: late spring flower-killing frosts occur frequently enough—roughly three years out of ten (K. Schmidt 2007a)—that no household can rely on it. In years with a walnut harvest, though, many village families move to tents in the forest for up to a month, living there on whatever can be brought from the village and bringing in the nuts. This involves sending agile young men up into the canopy to shake the branches (See Figure 5), with everybody else picking up the nuts that are shaken loose (See Figure 6). This forest sojourn features prominently in the annual cycle of village life, and extended family members from outside the forest belt often come pitch in with the harvest.

Cast of Characters

As behooves a posthumanist treatment, the figures I introduce here include actors both human and otherwise. Some familiarity with each of these will clarify the encounters between them that this dissertation's chapters consider.

Figure 5: Harvesting walnuts in a forest leasehold above Kyzyl Ünkür. Author photo.

Figure 6: Harvesting walnuts in a forest leasehold above Kyzyl Ünkür. Author photo.

The Fergana Mountains. This range, a product of the ongoing collision between the Indian and Eurasian plates that has uplifted more than 90% of Kyrgyzstan's territory beyond 1000m asl, provides the environment in which the walnut–fruit forest can thrive. In particular, the walnut–fruit forest grows on the middle slopes of the mountains surrounding the Kyrgyzstani end of the Fergana Valley, at elevations between 1100 and 2000 meters asl where the climate is cooler and wetter than it is in the lowlands. The mountains not only enable the growth of the forest, they also complicate the exploitation of its resources, which are distributed over rugged and seismically active terrain. The Soviet Union formally recognized the rigors of mountain life in its social welfare system, setting retirement ages up to ten years earlier in Kyrgzystan and other "mountainous zones" than in the rest of the union (Nove 1969). Even so, the mountains of Kyrgyzstan should not be understood to determine the character of life there, especially not as essentially isolated or peripheral (M. Schmidt 2008). Indeed, the mountainous topography enables connection as well: the trade in mountain walnuts may no longer link Kyzyl Ünkür to Moscow directly, but it still connects forest villages to the bustling market towns of the Fergana Valley, from where nuts make their way to Russia and Europe (K. Schmidt 2007a). As contributors to and shapers of the processes of daily life, the mountains are active players in the relations in which the humans and nonhumans of Kyzyl Ünkür are embroiled.

Trees. While the walnut–fruit forest is similar to fruit and nut forests that grow elsewhere in Central Asia (FAO 2007), it is set apart from them by the particular mix of tree species that make up its canopy. These can include maple, hawthorn, ash, poplar, spruce, juniper, and fir (Grisa et al. 2008), but I will be focusing on the forest's eponymous species, the walnut and rosaceous tree fruits, where the latter category contains members of the family Rosaceae, including apple, pear, plum, and cherry. Of these rosaceous species, the apple tree is the most important for human–forest relations, and with the walnut occupies most of my attention in the remainder of this dissertation.

Walnut. My first impression of the walnut–fruit forest was the smell of walnut trees. Upon first arriving in spring 2011 in Kyzyl Ünkür, the walnut–fruit forest village that hosted most of my fieldwork, I stepped out of my share-taxi into what seemed to be a cloud of juglone, a sharp-smelling herbicide naturally produced by walnuts. As it turned out, this was a fair introduction to the place: walnuts are as ubiquitous on the landscape as they are in the odorscape, and walnut trees define the top layer of the forest canopy on the slopes around the village. The walnut that grows in Kyrgyzstan is *Juglans regia*; elsewhere called the English or Persian walnut, it is a species of global economic importance. Locally, they are especially numerous where soil is well-watered, but make up close to half of the canopy across whole leskhoz territories (K. Schmidt 2007a).

For as much as forest walnuts dominate the landscape around Kyzyl Ünkür today, and for as much as their harvest structures life there, this seems to be a relatively recent development. Pollen analysis suggests that walnuts arrived in the region no more than 2000 years ago, and were most likely introduced then by people (Beer et al. 2008). Genetic comparison of walnut populations across Asia supports the same conclusion, and locates the ancestors of modern Central Asia's trees in Pakistan or the Caucasus (Pollegioni et al. 2014, 2015). These findings have come as a surprise to interested local residents and scientists alike, who had previously considered walnuts to have lived in what is now Kyrgyzstan since before the last ice age, shielded by the mountains in ice-free refugia (Vavilov 1931; Vyhodtsev 1968). In any case, although modern scientific investigations have revealed human manipulation deep in walnut lineages, the trees certainly seem to the untrained eye to have always been where they are now. Individual plants brought in along ancient trade routes have given rise to self-sustaining populations, and today's forest bears no trace of whoever carried the first walnuts to southern Kyrgyzstan. Indeed, scholarly consensus has the Kyrgyz themselves arriving in Central Asia less than 1000 years ago, more recently than the trees they now harvest (Soucek 2000).[6]

The past of Kyzyl Ünkür's walnut population is more human than previously suspected, but it is in the present that forest walnuts are more importantly humanized through extensive and ongoing daily interaction with people. The forest around Kyzyl Ünkür is not pristine or untouched but immersed in cultural processes, from grazing to firewood collection and fruit harvesting to haymaking (K. Schmidt 2007a; Borchardt, Schmidt, and Schickhoff 2010; Rehnus, Mamadzhanov, et al. 2013). In this human–forest landscape, walnut trees occupy a central position thanks to the value of their nut crop. Each fall, walnut markets spring up in the larger towns of the valley, where Turkish middlemen buy up the forest's nuts by the sackload and truck them away to Europe and Russia (See Figure 7). In the past, walnut trees were also cut down for their wood and dissected for their burls (UK: burrs), gall-like

[6] Along with growing nationalism in Kyrgyzstan has come motivated questioning of these historical figures. I spoke with a Kyrgyz scientist preoccupied with poking holes in the palynological data so as to demonstrate walnut's primordial status in Kyrgyzstan (pers. comm., 7/4/2011). I also heard on several occasions that, no, the Kyrgyz have always been precisely where they are now, and, moreover, that any attempt to prove otherwise is an affront to their ethnic dignity (pers. comm., 10/26/2011).

Figure 7: Seasonal walnut market in Bazar Korgon. Author photo.

growths which can be sliced thin and polished for veneers, but these more intrusive modes of interaction were banned in 2007, when the Kyrgyzstani legislature imposed a since-extended five-year moratorium on cutting walnut trees (Venglovsky 2009; Lapeña et al. 2014, 53). A host of other uses for walnut are recorded in folk medicines, from teas made from the coats of unripe nuts to treatments for tuberculosis and rickets made from the leaves (Molnar et al. 2011; Vahdati 2014). These, though, are minor compared to the nut harvest, consideration of which dominates the property negotiations I consider in Chapter 3.

Apple. Less central to local economies but still prominent in forest ecologies are the rosaceous tree species, including cherry, plum, pear, and apple, of which the last is the most prominent. These trees make up a substantial part of the lower canopy and shrub layer in places, and, like forest walnuts, they are close relatives of trees grown in temperate orchards worldwide. Unlike the walnuts, however, rosaceous fruits command little interest in the bazaars. During my stay in the region, wild walnut prices ranged from 60 to 150 som/kilogram, while wild apples hovered around 1 som/kilogram and other wild rosaceous fruits could not be sold reliably enough to make their collection worth it (see K. Schmidt 2007a, 295, for similar data from ten years earlier). This makes sense—wild apples vary widely in quality, but most are mealy or mushy, sour or bitter or astringent, and cannot be transported or stored. But even if merchants will not pay for the forest's apples, they still figure, often informally, in local livelihoods. Wild apples make good animal fodder, they can be processed into fruit leather (Kyr: *chelpek*) or beverages (e.g. *kompot*), and they are full of vitamins and occasionally somewhat tasty, especially when freshly picked. This makes them particularly welcome neighbors during the walnut harvest, when many villagers live in remote patches of forest, away from their kitchens and easy access to markets.

Palynological and genetic investigation have weakened the walnut's claim to being a native of southern Kyrgyzstan, but they have strengthened the apple's. The history of the domesticated apple was long the subject of botanical debate, as even though Vavilov himself had argued for its Central Asian origin (1931), alternative hypotheses were not firmly rejected until the plant's genome was published in 2010 (Velasco et al. 2010; see also Juniper and Mabberley 2006; Richards et al. 2009; Cornille et al. 2012, 2014). Using genomic analysis to peel away the effects of thousands of years of human intervention in apple biology, Velasco et al. determined that *Malus sieversii* is the ancestor of the apple of commerce (2010). Best known from the apple forests of southeastern Kazakhstan (Pollan

2002), *Malus sieversii* is also a common understory tree in the walnut–fruit forest, and its Kyrgyzstani population includes genetic diversity not found elsewhere (Volk et al. 2009).[7] This means that, in addition to their appeal for hungry locals, apples in the walnut–fruit forest also draw the attention of plant breeders worldwide, who look to Kyrgyzstani populations as potential sources of genetic diversity (Forsline et al. 2004), as Chapter 5 examines in greater detail.

Apples and walnuts differ, importantly, in the trait that centers my investigation of posthumanism: graftability. In the social conditions generally prevalent in the walnut–fruit forest, adult walnut trees are effectively ungraftable. While expert grafters can coax successful grafts out of walnut seedlings, almost all grafts of adult walnuts fail (Coggeshall and Beineke 1997). Without any growth across the graft union to incorporate them into the rootstock's circulatory system, grafted scions soon die and fall off, potentially endangering the stock if the failure is extensive. On the other hand, apples, under the same conditions, are much more graftable than walnuts, with success rates of 90% readily achievable. As a result, anybody with a few common tools, a moderately steady hand, and a free afternoon at the right time of year can graft the apple trees in his or her surroundings. Although apples are the most graftable of the common tree species in the walnut–fruit forest, the other rosaceous trees of the forest are also graftable, with accessible resources and a little care. Graftability is, note, a comparative trait: no stock tree can be grafted with just any

[7] Another apple, *Malus niedzwetzkyana*, is also present in the walnut–fruit forest, though much less abundant than *M. sieversii*. The fruit of *M. niedzwetzkyana* has bright red flesh, and some apple breeders hope to introgress the genes responsible into domesticated apple populations. Unless otherwise noted, I use "apple" to refer only to *M. sieversii*.

scion and even apple grafting must be undertaken advisedly, but the barriers to successful rosaceous grafts are much, much lower than those to walnut grafts.

Thanks to this graftability, some trees in the walnut–fruit forest are unusually receptive to horticultural overtures from their human neighbors. Wild apples have little commercial value, but the trees they grow on will happily support any apple scions grafted to them.[8] The fruit these scions produce in the resultant hybrid body is unaffected by the wild nature of the stock; that is, a tree whose own fruit is inedibly astringent can be made to produce Red Delicious, Honeycrisp, Zestar!®, or whatever other domestic variety of which the grafter can acquire a scion. Thanks to graftability, the fruit of every wild apple tree in the forest is easily improved, the tree effectively domesticable one branch at a time. In 2011–2012, wild apples sold in Fergana Valley markets for 1 som/kg—too little to cover the cost of their harvesting—but domestic apples sold for 15–30 times more. This process, of grafting domestic scions to wild stocks for the improvement of their fruit, is called ennoblement (Rus: *oblagorazhivaniye*; Kyr: *asyldandyruu*). Wild cherries can be similarly ennobled to produce much tastier domestic plums, and bitter almonds, which inhabit the drier reaches of the lower foothills, can be reworked to yield sweet almonds and apricots.

Village Grafters. In order for trees to be reshaped by grafting, they need a human partner.[9] For the graftable trees of the walnut–fruit forest, the most likely partners are people I call

[8] In skilled hands, they may also be induced to support pear scions, though less happily—that is, at lower success rates and usually with obvious stunting (Prutensky 1962, 21). They would presumably do about as well with quince, medlar, shipova, and Asian pear, which often do well in apple grafts (Garner 2013), but scions of these fruits are not so easily obtained in rural Kyrgyzstan.

[9] This is, strictly speaking, not true. Natural grafts can occur too, where plants grow together without human involvement. This is widespread beneath the ground, with effects that remain poorly understood (Lev-Yadun

village grafters. These are, in short, simply local residents who graft. That is, there is nothing that sets village grafters apart from their neighbors in terms of livelihood or location. They mostly pursue horticulture as a hobby: in the two villages I know best, there is just one man who considers himself a professional grafter, and several others who used to be professionals, back when the Soviet state employed a grafting brigade. Other than the professional, even village grafters do not spend much time grafting; it is a side project that requires some preparation in winter and an afternoon in spring. Still, as Chapter 6 explores in greater detail, this is enough of an investment of time and energy for village grafters to have reshaped the walnut–fruit forest, in ways that matter ecologically and politically.

Foresters. I noted above that, while most agricultural and residential land in Kyrgyzstan has been privatized in the quarter-century since independence, the walnut–fruit forest belt is still owned by the state and governed by state forest enterprises called *leskhozes*. The local employees of these enterprises include foresters (also called forest guards or forest rangers), who are the most important figures in the trenches of walnut–fruit forest governance. The central responsibility of the foresters is to police the interaction of villagers and forest, which mostly means keeping firewood use to legally sanctioned levels and preventing any illicit walnut logging or burl-taking. During walnut season, foresters also try to adjudicate disputes over harvesting rights, but they are stretched awfully thin. What's more, for purposes of good governance, this workforce should probably be staffed by non-locals, the better to free enforcement of resource conservation from local pressure for resource exploitation. As it is, however, the State Forest Service cannot afford the added

2011). Above ground, it typically involves mechanical stimulation of some sort, as with branches rubbed together by wind, and characterizes only a few species (Mudge et al. 2009).

expenses of so extensive a rural relocation program. As a result, foresters are usually local men and boys, and they are not paid well (K. Schmidt 2007a). Accordingly, the governance they provide is often not what development consultants would call good. Put differently, many foresters are too sympathetic with the villagers whose forest use they police for the forest enforcement bureaucracy to function well, with the disinterest that good bureaucracy requires.

Method

I spent a year in two villages in the walnut–fruit forest belt, spending roughly ten months in Kyzyl Ünkür and two months in Arslanbob. I had a host family in each village, and spent most of my time doing ethnography, or, as Bowers puts it, "hanging around and making something of it" (1996, 120). I did my best to immerse myself in village life, attending village festivals and town meetings, initiating conversations on forest management and property distribution, drinking vodka with foresters on lunch breaks, and pitching in with haymaking and walnut harvesting (though I was invariably deeply terrible at such tasks, and letting me help was often actively harmful to actually getting the job done[10]). I conducted roughly 120 Kyrgyz-language interviews, of varying length but lasting up to 2 hours and usually fairly open-ended. I also hired two field assistants and, with their help, conducted 156 household surveys and mapped two tracts of forest. All of this was directed toward exploring the place of grafting and graftability in human–forest interactions. In the chapters that follow, I engage graftable plants by working through stories of what Brice

[10] I suspect this is a common experience of ethnographers getting to know their rural field sites. Let us be straight with each other: "Ethnography: Inadvertently Sabotaging Villagers' Manual Tasks and Making Something Of It."

(2014a, 946) calls “modes of human–plant cohabitation” in southern Kyrgyzstan. I spend as much time as I can in the company of walnut–fruit forest trees, and in the company of people who engage walnut–fruit forest trees.

The people I spent most time with were inhabitants of the two villages mentioned above, Kyzyl Ünkür and Arslanbob. The first of these is a settlement of close to 5,000 people at the end of a road that begins in the province capital of Bazar Korgon, while the second, with 11,000 residents of its own, sits at the end of its own road, in the next valley to the southeast (See Figure 8). Each of these villages is the center of its own leskhoz. Kyzyl Ünkür Leskhoz covers 57,915 ha, and was a particular center of extensive livestock grazing under the Soviets. Arslanbob Leskhoz, despite its greater population, covers only 32,748 ha, and was a center under the Soviets of horticulture and tourism.

The pairing of these two villages requires a mention of ethnicity, which for all that it is an important facet of local identity this dissertation does not otherwise much refer to. Kyrgyz and Uzbeks make up the large majority of the population of the forest belt, though there are also Tajiks and, still, a few Russians. There is significant segregation at the village scale, and Kyrgyz and Uzbek villages are readily identified as such in local conversation. In particular, Arslanbob is mostly Uzbek, while Kyzyl Ünkür is nearly entirely Kyrgyz. This has implications for forest use, as cultural traditions of forest management differ by ethnic group (Marti 2000; K. Schmidt 2007a). Despite these differences, with the Kyrgyz generally prioritizing animal husbandry and the Uzbeks generally favoring agriculture, the basic ingredients of forest livelihoods are shared. Local dialects of Kyrgyz and Uzbek are

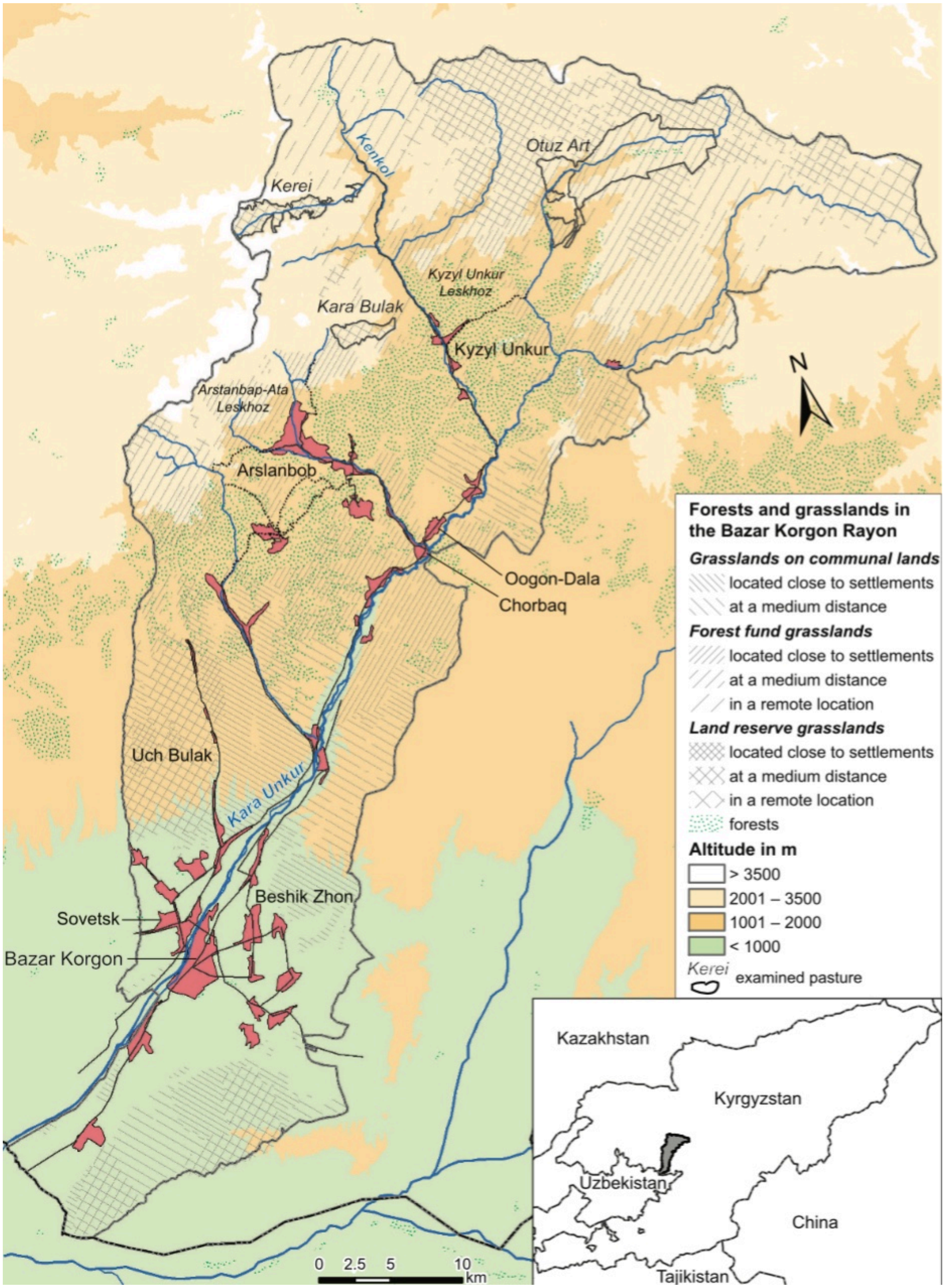

Figure 8: Bazar Korgon rayon, including Kyzyl Ünkür and Arslanbob (Dörre 2012)

mutually intelligible, though Russian remains common in official settings, including forest management. Ethnicity gained new salience in 2010, when interethnic violence erupted in Bazar Korgon and other Fergana Valley towns (Bond and Koch 2010), drawing mountain villagers into its orbit to greater or lesser extent. Even where they did not participate directly, this violence changed ethnicity's significance, as the Kyrgyzstani state used it as an occasion to move firmly in the direction of Kyrgyz ethnocentrism (Megoran 2013). Uzbeks in the forest belt became increasingly isolated as a result, meaning, for example, that the Uzbeks of Arslanbob, who must make do with less forest per capita than the Kyrgyz of Kyzyl Ünkür, will find no relief from a State Forest Service increasingly hostile to their rights. Friendships across ethnicity do occur, however, and most practices I consider proceed without overt reference to ethnic difference. I will have more to say about methodology in the next chapter, on the topic of posthumanism and the doing of multispecies ethnography.

A Brief History of People and Trees in Southern Kyrgyzstan

In Chapter 4, I consider one historical episode, from the mid-twentieth century, in some detail, while the other chapters include only enough historical depth to provide immediate context for the particular arguments they advance. In the interest of fleshing out my account of graftability in the walnut–fruit forest belt, then, I provide some more historical depth, drawn from secondary sources and focusing on past forest governance around my field site.

Pre-Soviet Governance

Forest management in southern Kyrgyzstan was informal until the 19th century, and did not involve states or their local representatives. Like the rest of what is today southern Kyrgyzstan, the walnut–fruit forest belt was governed from the 18th to the mid-19th century by the Khanate of Kokand, but at considerable remove. Local life was structured more prominently by resident "clans" than by the khan, clans which consisted of extended households defined by patrilineal descent and ultimogeniture (Geiss 2003).[11] Resource use decisions were decided at periodic face-to-face meetings of clan elders, with courts resolving any disputes according to the tenets of customary law (*adat*) and all agreements remaining verbal and informal (Martin 2001). As a result, little documentary evidence remains of practices of resource access at the time, but elderly Kyrgyzstanis can still sketch out how this informal system probably worked. As DeYoung et al. find in their oral histories of southern Kyrgyzstan, "a clan could not 'own' a place; instead, other families, clans and tribes 'understood' which families laid claim to which territories" (2013; see also Beyer 2011).

It is hard to understand an oral culture at 150 years' remove, but at least humans speak aloud. What role did less voluble actors like trees play in clan governance in the walnut–fruit forest? Surely the forest was recognized and engaged somehow by all who came in contact with it, and its fruit and nuts likely had a place in supporting local livelihoods. Still, the Kyrgyz emphasis on nomadic pastoralism as central to rural life (DeYoung,

[11] The use of "clan" here isn't ideal. "Clan" was initially a tsarist category meant to make tax collection easier, and the term is further weighted with anthropological baggage (Jacquesson 2010). I use it here to point to the importance of kinship, which structured societies all over Central Asia (Geiss 2003; Jacquesson 2004).

Zholdoshalieva, and Zholdoshalieva 2013) weighs against the odds of any systematic interrelation, at least in Kyrgyz-inhabited areas. Even today, locals of all ethnic groups sometimes describe the Kyrgyz as congenitally unconcerned with forest management as a result of their being, in their inmost essence, a nomadic people (Kyr: *köchmön el*). Uzbek and Tajik villages may have been different, as befits the sedentarism supposedly ingrained in their residents; indeed, in the origin story of the Uzbek village of Arslanbob, walnuts were introduced to the area by the village's founder around 1100AD, a date which fits the palynological data intriguingly well (Beer et al. 2008, 628–29). Along with the palynological data itself, this suggests deep tree–human histories in at least some parts of the walnut–fruit forest, but it is difficult to say more than that.

Did graftability play any part in these histories? It is yet more difficult to say, but if it did it was most likely a limited one. If trees can point us toward their own spatial histories by the pollen they deposit, grafts leave no such lasting legacy. Larger walnut trees still extant today began as saplings under Khokandi stewardship, but the graftable trees of the walnut–fruit forest lead shorter lives, rarely reaching one hundred, and even a few decades of growth can conceal the scars that almost any graft leaves behind. Grafting was certainly known in the broader Islamic world: the Mecelle, an Ottoman civil code of the nineteenth century and the earliest codification of Sharia law by an Islamic state, provides guidance on the grafted tree, advising that "If a person grafts a tree…the branches which spring from the graft are his own…property, so also is their fruit his" (Tyser, Demetriades, and Effendi 1901, 203). But the Mecelle is an outgrowth of Sunni Islam's Hanafi legal tradition, and *adat* was only superficially Islamized (Geiss 2003). It is unlikely, therefore, that this formalized provision was much referenced in the walnut–fruit forest. According to villagers in Kyrgyz areas today, it was only with the arrival of the Russians that grafting and other practices of organized forest horticulture began. This is by no means definitive: a few active grafters might easily escape the collective memory of village elders who encountered them as children. Things may also have been different in Uzbek areas like Arslanbob, where orcharding is more common today and links to agriculture in the valley are better established. In other areas, though, while neither tree bodies nor *adat* provide definitive evidence, grafting was probably absent.

Human–forest relations took a dramatic turn with the arrival of the Russian empire, which introduced formal property relations and other inheritances of imperial modernity to the area. Schmidt and Doerre (2011) demonstrate that, very shortly after the Russian Empire annexed the Khanate of Kokand in 1876, Russian colonial administrators were taking a strikingly different view of the walnut–fruit forest than had earlier authorities. By 1883, scientific publications describe the forest's ecological function and interaction with local populations, who—using language familiar from conservation discourse today—had apparently mismanaged it into dire straits. For this perceived problem, Russian colonial administrators blamed the incompetence of their Kokandi predecessors as well as what they portrayed as uncontrolled cutting and burning by locals. For Lisnevskii, writing in 1884, the underlying problems included religious fatalism and an underdeveloped property regime: "because [the forests] do not belong to a specific individual they can be exploited . . . by anyone living there . . . For Allah will plant new forest to replace what has been cleared" (cited in M. Schmidt and Doerre 2011, 291). In response to this apparent local neglect, the colonial administration quickly claimed the forests for the state and prioritized their protection.

This early ecological justification for state involvement soon gave way to economic exploitation, especially through the extraction of walnut burls for export (M. Schmidt 2005). In fact, this growing intervention in the forest led indirectly to the founding of Kyzyl Ünkür itself. Unlike neighboring Arslanbob, which has been around for nearly a millennium, Kyzyl Ünkür was a twentieth-century creation. According to Kapar, the son of one of its founders and in his early 90s by the time we spoke, a Russian-sponsored burl-collecting mission left Jalalabad in 1905 and passed through what is now Kyzyl Ünkür (Kapar called it "Nikolai's expedition," referring to the tsar at the time). At that time, as Kapar tells it, the valley had no permanent residents, though it was used as a seasonal animal pasture and a stopover on the path north over the mountains toward Toktogul. The site had clear agricultural potential, however, and Kapar's father and two other Kyrgyz expedition participants from Jalalabad returned on horseback seven years later, in 1912, and set up camp. After a successful first year, they made their new location permanent and invited their families to join them. Thus established, Kyzyl Ünkür extended the reach of agricultural and silvicultural intervention in the forest.

Soviet Governance

This intervention reached a new height under the Soviet Union, culminating in forced collectivization between 1929 and 1933. In the walnut–fruit forest, collectivization brought with it a thorough transformation in the use of forest resources. Previously an ad hoc source of timber and burls to be obtained through occasional expeditions like Tsar Nikolai's, the walnut–fruit forest was reconceived by the state as a resource—the "forests of the nut industry zones" (M. Schmidt and Doerre 2011). Forests were "quintessential forms of state property" in the Soviet system (Verdery 2004, 195), and the fruitfulness of southern Kyrgyzstan's walnut–fruit forest made it a particularly appealing target for planners pursuing Soviet economic development with ever greater zeal. Timber use jumped with the October Revolution, but ongoing commodification and infrastructural development throughout the 1930s and 1940s further increased forest exploitation (Jerdev et al. 1967).

While often represented as nothing short of apocalyptic, Stalinist collectivization was not in fact a total negation of everything that had come before. The execution of Moscow's programs in Central Asia inevitably required finessing its planners' boldest ideological positions; Kyrgyz institutions were rebuilt to suit the desires of ambitious administrators, but along preexisting kinship lines and with substantial local input (Yoshida 2005; Beyer 2011; DeYoung, Zholdoshalieva, and Zholdoshalieva 2013). Some environmental focus survived, too, despite Stalin's monomaniacal drive for industrial development. Brain's monograph on mid-century Soviet forestry finds that state policies of the era prioritized economic growth but also embodied their own sort of environmental thinking (2011). In 1947, management of the walnut–fruit forests were reassigned to the Ministry of Forestry and the affected state farms (*sovkhozes*) were converted into state forest enterprises (*leskhozes*) and rededicated to forestry (M. Schmidt 2012). Walnut collection was regularized and formalized in these years, while local nut collection, haphazard and unofficial from the standpoint of state administrators, was taken as evidence of mismanagement and backwardness. In response, neighborhoods were organized into brigades and assigned exclusive forest territories for harvesting. Locals remember this as a thoroughly collective procedure, at least by mid-century, with brigades leaving the village together and sharing the tasks of shaking tree branches, scavenging the hillside for fallen nuts, and husking walnuts of their fleshy green coats to expose the shell and nut inside. The state constructed new infrastructure to support this intensified and centralized walnut harvesting, building nut collection points far out in the forest and improving the roads that connected them to villages.

The Soviet effort to boost the collection of forest resources considered not only walnuts and wood but many other forest products as well (See Figure 9). Unlike today, when walnut

Сортировка фруктов

Figure 9: Sorting forest fruit under collective management (Arakelyan, Abdrakhmanov, and Dyadyuchenko 1956)

harvesting dominates state attention, the leskhoz's deployment of its forest brigades reflected administrators' conviction that the forest's diversity could support Soviet society along multiple fronts (Pulko 1965). Wild apples, cherries, and mushrooms were each line items in the leskhoz's annual economic plan, and villagers in the beekeeping brigade chased honey production targets by tending hives in dozens of far-flung forest clearings. Industrial processing facilities were built to support these collection efforts, dehydrating, juicing, or distilling forest fruits that no longer find any buyers, industrial or otherwise. Drawing on the rich history of foraging in Russian culture (Turkin 1954; Lyudkovskii 1973) and responding to the inclusion of wild-growing forest products in the official production quotas that structured Central Asian forestry (State Forestry Committee of the USSR Council of Ministers 1971), the Soviet-era state incorporated a broad range of things from the walnut–fruit forest into its formal property regime.

With so many elements of the walnut–fruit forest being reframed as resources and subsumed under state ownership, top-down forest conservation was also extended to protect them. In April 1945, a Fruit-Tree Forest Reserve was created with the goal of "reconstruction and development of the walnut–fruit forest and the rational and comprehensive utilization of its resources" (Pulko 1965, 4), and decadal forest inventories were used to set acceptable benchmarks for local resource use (M. Schmidt 2005). Village residents remember how strong (Kyr: *katuu*) the enforcement of forest protection laws was in the 1960s and 1970s, especially in contrast to how nonexistent it became after the end of Soviet subsidies. Tight state control depended on truly aggressive policy. In addition to muscular bans on walnut felling and overzealous firewood collection, the Soviet-era state also limited personal livestock ownership to one cow, one calf, and five sheep per household and reliably kept livestock out of the forest.[12] Human residency in the forest zone was also policed: according to one ex-forester, the Soviet-era provincial government required all foresters' children to move away upon reaching adulthood if they could not find local forestry work themselves (pers. comm., 6/21/11), a drastic measure indeed for an agrarian society that prioritized kinship relations. Whether or not it was effective—and in the walnut–fruit forest, as elsewhere in the Soviet world, it had its successes and its failures—top-down conservation, like the centralization and formalization of the walnut harvest, marked an extension of state control into the forest.

The state intervened not only in the consumption and conservation of living things in the walnut–fruit forest, but also in their production as well. Insofar as Soviet administrators understood forest trees as natural resources, they were resources which could be improved through concerted state effort. As one scientist and veteran of forest-improvement efforts wrote, "to change for the better the fundamental character of the harvest of fruit-bearing species, in terms of both quality and quantity, is within our power" (Prutensky 1962, 9). Over decades of research, tree breeding, and other state programs, Soviet-era foresters sought to intervene in the lives of walnut–fruit forest trees to improve their contributions to the ongoing socialist project, especially by raising their fruit and nut yields. I leave further discussion of this project for Chapter 4, but suffice to say that, at the

[12] As noted in Chapter 5, grafted tree bodies serve as evidence for this claim. Forest trees grafted during this period were grafted low to the ground. This is convenient for human grafters but puts new grafts in grazing danger wherever farm animals roam free, as in today's forest.

height of its ambition, Soviet forest governance was defined by an abiding faith that the state could remake forest trees into strong socialist allies through horticultural ingenuity. The forested landscape that villagers inhabit today was produced in part by actions informed by that faith, as well as by the other interventions of forest governance noted above.

The Shape of Chapters to Come

In the rest of this dissertation, I explore the significance of grafting from several directions, and in conversation with several different human groups. In Chapter 2, I do this abstractly, arguing that the plant-specific phenomenon of graftability can be used to articulate a newly posthumanized political ecology. *Posthumanist political ecology* is a term that has been used before (Sundberg 2011), but I argue that in order for posthumanism to offer political ecology something *new*, a different facet of it must be emphasized. I identify this facet as *bounded empathy for the nonhuman*, and argue that consideration of the graftable tree allows for this bounded empathy, as well as revealing planty possibilities that have been generally neglected in geography. The graftable tree is thus the quintessential figure of a posthumanist political ecology that has been suitably enriched by bounded empathy for the nonhuman.

Chapter 3 returns to Kyrgyzstan, examining present-day contestations of use of and access to forest resources. Building on the political ecology framework already introduced, I argue that property regimes are best understood as performances undertaken by diverse communities of actors, including both humans and nonhumans. I define a performative property that draws our attention away from capital cities and policy think tanks—typically the focus of property work—to places like rural Kyrgyzstan, where the performances of all kinds of human and nonhuman actors determine the fate of property reforms currently underway. I describe recent efforts to decentralize the forest walnut harvest, as spearheaded by beginning with KIRFOR, a Swiss–Kyrgyz joint program, and continuing with a subsequent campaign in one village to redress inequalities that KIRFOR formalized.

In Chapter 4, I step backwards in time to Soviet forest management while turning from property to science. I focus on the mid-20th century, when the Soviet state systematically modified hundreds of thousands of forest trees in large part because of how grafting was understood by Soviet biological theorists following Trofim Lysenko. Using archival material and the published proceedings of several Soviet conferences on walnut–fruit forest management, I track the rise to prominence of the *lesosad*—a land use meant to combine the strengths of forests and orchards through the systematic deployment of grafting and other horticultural techniques on forest trees—the general failure of trees to cooperate with foresters' designs on them, and the resulting end of state-led forest grafting. This historical episode demonstrates particularly clearly how grafting has mattered in the walnut–fruit forest: not only was the *lesosad* program a dominant feature of forest management for several years, but its material legacy in the forest has persisted to this day.

Chapters 5 and 6 return to the present, and take two different cuts at the entanglement of graftable trees in human communities today. In particular, I present two different positions regarding the wisdom of grafting in the forest as the *lesosad* program did. In Chapter 5, I explore the argument against forest grafting as it is voiced by conservationists. For some conservationists, grafting has the potential to corrupt what they take to be the most important feature of the walnut–fruit forest, the distinctive genes within its trees. This position distinguishes between good and bad grafting based on where it is done—the same techniques opponents of forest grafting would like to ban in the forest receive their endorsement when conducted on trees of the same species in gardens and orchards. This is, in other words, an argument for dichotomizing the landscape and confining the spatial and bodily transformations that grafting effects to only part of it. Using discussions with conservationists and horticulturists and published material from organizations they run, I examine the gene-thinking that characterizes conservation today and use grafting and its effects to argue for an alternative, which I call phene-thinking.

Chapter 6 turns to the converse of Chapter 5's topic: the argument in favor of forest grafting and the people who make it. In southern Kyrgyzstan, grafting, banished from the realm of acceptable state forest policy after the failure of the *lesosad* program, lives on as a means by which village grafters move biological material across the landscape and blur the lines that gene-thinking sharpens. Using a household survey on grafting prevalence and preference, and material gathered during time spent with contracting grafters, do-it-yourselfers, and hobbyists working to improve their own forest allotments, I describe how the technique is used by villagers operating in legal and property-regime gray areas. I argue that this is an example of what might be called a "vegetal political ecology", which combines the plant focus of vegetal politics with the tractable, practical politics that posthumanist political ecologists prioritize. In particular, I contend that the graftability of some trees—their capacity to enter into horticultural partnerships with interested villagers—imparts an anti-hierarchical tendency to the political processes with which they engage. This also has spatial consequences: whereas the previous chapter's anti-grafting partisans strive to keep forest and village separate, grafters' work constructs a landscape in which forests and gardens are blended through horticultural ingenuity, a—if you will—socioecotone. Building on the argument of the previous chapter, I suggest that the botanic particulars of grafting lend themselves to the decentralized, informal networks that structure its performance today.

Chapter 2 – Graftability and the Posthumanization of Political Ecology

Since its early days, political ecology has endeavored to take the nonhuman world seriously. Blaikie and Brookfield's definition of the field flags "the concerns of ecology," the recognition of which they hold to distinguish political ecology from earlier versions of Marxist political economy insufficiently attentive to the material environment. Incorporating ecology's concerns is not straightforward, however, and debates over the proper role of ecology, the knowledge it produces, and the things it examines have characterized political ecology ever since (Forsyth 2003; Walker 2005; Turner 2015). Is it enough for the field to address "politics somehow related to the environment" (Vayda and Walters 1999, 168), or must political ecologists align themselves more closely with ecological inquiry and the entities that make up that environment? And what form might that alignment take? How can ecology be rendered sufficiently political to do justice to the processes that characterize environmental situations of interest without thereby losing its claim to scientific validity? Conversely, how can political economy make use of and contribute to the knowledge produced by natural science without giving up its distinctive critical stance? Much of political ecology's deepest and most field-defining work has come from wrestling with these questions, as scholars have debated the merits of triangulating between different sorts of knowledge (Rocheleau 1995; Robbins 2001a; Forsyth 2008, 759–60; P. Jackson and Neely 2015), critically engaging with multiple knowledge claims (Agrawal 1995; Fairhead and Leach 1996), and examining not only the application but also the production and circulation of environmental knowledge (M. J. Goldman 2009; M. J. Goldman and Turner 2011).

In this chapter, I argue that most attempts by political ecologists to reckon with the concerns of ecology have lacked what I will call a *bounded empathy* for the nonhuman, the incorporation of which creates a *posthumanist political ecology* fully worthy of the name. In the pages that follow, I first contextualize this posthumanist political ecology with regards to other political ecological treatments of the nonhuman, including those that also go by *posthumanist political ecology*. I then argue that the quintessential figure of this posthumanist political ecology is the graftable tree, first by examining the place of plants in posthumanist geography and then by exploring the theoretical promise of graftability itself. Finally, I work through a methodological question, namely what role does science have in constructing the bounded empathy for the nonhuman that a truly posthumanist political ecology requires.

The Posthumanizations of Political Ecology

Political ecology has been posthumanized before.[13] Sundberg (2011) is the most prominent example—not least because she calls her approach *posthumanist political ecology*—but others have also contrasted their analyses to humanist precursors, while not necessarily flagging the result as primarily *posthumanist*. Posthumanism starts from the premise that our actions play out in a world where "all the actors are not human, not self-identical, not 'us'" (Haraway 1997, 142). The human that populates earlier humanist accounts is only a relatively recent invention, the product of modernist notions of rationality and autonomy, sovereignty and progress (Latour 1993; Gareau 2005). Posthumanist geographers—and others writing under related headings like more-than-human geography (Braun 2005;

[13] I imagine it will be posthumanized again.

Greenhough 2012b; Ginn 2014) and geographies of the nonhuman (Lulka 2004; J. Lorimer 2007; Pile 2014) or inhuman (Yusoff 2015)—refuse to tie their analyses to such a figure. Instead, they argue that our work must more deeply acknowledge the presence of once-excluded actors, reflecting that we operate in a world already full, amid pre-existing assortments and collectivities (Bingham 2006). The multifarious things that surround us have capacities and tendencies of their own, the particulars of which shape socioenvironmental outcomes in important ways (Nadasdy 2007). This shaping is an active process, going beyond the stubborn resistance to human designs that earlier accounts found and into realms of creativity and surprise (Braun 2008). For posthumanists, these nonhuman-driven outcomes cannot be adequately addressed as long as nonhumans themselves are relegated to passive objecthood.

As stated, this is not news to political ecologists, who well know that the world is not a human playground. Even the initial incorporation of "the concerns of ecology" was not so far removed from this more recent recognition that nonhumans are active participants in social relations. In short, the move to accord nonhumans greater analytical weight reoccurs in different guises, and with different methodological corollaries, throughout political ecology's history. These include turns to relations (Swyngedouw 1999; Castree 2002), hybridity (Swyngedouw 1996; Zimmerer 2000; Schneider 2011), actor–network theory (Perkins 2007), networks (Mathews 2011; Birkenholtz 2012), and assemblages (Ogden et al. 2013). What, then, does posthumanism offer the political ecologist who already addresses the nonhuman, be it through ecological methods (Zimmerer 1991; Turner 1993) or actor–network theory (Robbins 2001b; Perkins 2007)? Most importantly, the posthumanism I am proposing emphasizes an affective commitment to inter-species recognition, expressed in an empathy that seeks to identify with the very different sorts of actors with which we share political terrain. This is not to deny our differences, note—our empathy is necessarily bounded by the impossibility of total identification. Still, we humans engage nonhuman others not distantly, across a fundamental divide imposed by our essential natures, but intimately, in the mutual dependences and bodily encounters that build up daily practices in our shared multispecies communities (Whatmore 2002; Haraway 2008). The others we engage are not mere examples of their species but individuals and collectivities making their own ways in the world, and perceiving and depicting them as such is an ethical imperative. This gives political ecology's incorporation of posthumanism a very different feel from analogous turns to actor–network theory, with its hyper-local topologies (Rudy and Gareau 2005; Holifield 2009), or assemblage thinking, with its dynamic compositions and decompositions (Ranganathan 2015; Horowitz 2016). Posthumanist political ecology instead deploys what the environmental philosopher Thom van Dooren calls our "capacity to care for others both of and beyond our own species, to recognize their interests and act in ways that make room for our combined flourishing" (2014, 40). This empathetic engagement is what posthumanism adds to political ecology's efforts to take the nonhuman world seriously, and it requires a close attention to ways of nonhuman being that shares the non-dualism of networks and assemblages but engages all of our faculties of recognition and consideration in a way that those approaches tend not to.[14]

[14] A recent article by van Dooren and others calls for "passionate immersion" in multispecies worlds (van Dooren, Kirksey, and Münster 2016). This is similar to my proposal, but I think it important to maintain empathy as a goal, although (or perhaps because) it can never be attained.

Empathetic engagement with the nonhuman other seems a natural fit for political ecology, "a field that is fundamentally normative and places social ethics at the core of its agenda" (Walker 2007, 365). Political ecology's ethics have mostly been grounded in other ways, however. In the field's early days, when so-called dualist ontologies still held sway (Castree 2003; Bakker and Bridge 2006), political ecology's commitment to "the rights and concerns…of the poor over those of powerful political and economic elites" (Bryant and Jarosz 2004, 808) was premised on these groups being human. By contrast, nonhumans were treated with analytical distance. More recently, actor–network theory's influence has directed more attention toward nonhumans, but most often as effectual actants capable of shaping outcomes, rather than as subjects meriting care or recognition. Feminism could have authorized empathetic engagements, but early feminist political ecologies focused on the role of human gender in environmental politics (e.g. Rocheleau, Thomas-Slayter, and Wangari 1996). Only more recently, and through the intermediary of feminist science studies, have political ecologists awakened to the empathetic possibilities of other feminist concepts like embodiment (Atchison and Head 2013) and care (S. Jackson and Palmer 2015). Now, though, the way lies open to a posthumanist political ecology that constructs boundedly empathetic treatments of nonhuman ways of being, building a multispecies ethic of care upon the intimate interdependencies to which we are all committed. If political ecologists explore "our obligations and responsibilities to 'distant strangers' near and far" (Jarosz 2004, 918), posthumanist political ecology admits nonhumans to that community of distant strangers to whom we are responsible.

This is a slightly different reading of posthumanism's promise than appears in Sundberg (2011), the definitive treatment of posthumanist political ecology to date (see also Barua 2014a). For Sundberg, the chief benefit of posthumanist theory is that it offers political ecology sustained thinking on "who counts as a political actor and how agency is enacted" (2011, 321), and indeed her portrayal of boundary enforcement along the U.S.–Mexico border is the fruit of such sustained thinking. While much of the environmental politics involved is easily told in humanist terms—from the history of public land management in the American Southwest to the narratives mobilizing Border Patrol agents or migrants—Sundberg insists that cats, mesquite, rivers, and the desert landscape itself play active roles in producing current practices of boundary enforcement. Border agents on patrol must take nonhuman features like the borderlands' temperature regime and mountainous topography into account, for example, while the Endangered Species Act ensures that the habitat preferences of local ocelot and jaguarundi populations also carry political weight. Seeking to hinder the movement of undocumented migrants, the Border Patrol plans to mow scrub thickets and install stadium lighting in border canyons, but finds itself opposed by Fish and Wildlife Service agents pointing out that the local wild felines depend on dense vegetation and dark desert nights for their survival. Sundberg distinguishes the political programs of these two groups of actors—she calls them the boundary enforcement collective and the south Texas Thornscrub collective, respectively—and demonstrates that substantive contributions to the latter, a particularly "nature-inclusive" collective, come not only from humans but from cats and other entities as well. To define these entities out of politics, as humanist political ecology implicitly does, is to miss part of what is happening along the border. By thinking posthumanistically, on the other hand, political ecologists can fill in these blind spots. Sundberg asserts that "addressing nonhumans as actors allows me to tell different and more complex stories about the politics of boundary enforcement" (2011, 332).

This, however, ignores the many ways that political ecologists already had to address nonhumans as actors, while underselling what is indeed distinctive about the posthumanism Sundberg uses. It is not clear, for example, that posthumanism lets Sundberg tell "more complex stories" than political ecologists were already telling, even about her specific topic of accommodating nonhuman agency across human-defined boundaries (e.g. Bakker 2003; Mansfield 2004b; Sneddon 2007). But Sundberg's story actually *is* different than these examples, and her posthumanism *does* offer something new, namely the empathetic affect that marks her analysis. Sundberg's account relies, crucially, on a respectful account of feline intentionality. Using ethnography, thick description of nonhuman practices, and citations from the natural sciences, Sundberg constructs a portrait of border politics that turns on the decisions taken by jaguars. This is a cautious and bounded empathizing: Sundberg does not ask her readers to imagine themselves as cats, but her methods even so present the felines fully enough for us to identify, partially, with their predicament. The result is a treatment that is particularly effective in dramatizing the active participation of nonhuman others in environmental politics.

In subsequent work, Sundberg further emphasizes this empathetic engagement, though she does not identify the result as political ecology. In a call for the decolonization of posthumanist geography, Sundberg advocates renewed attention to Indigenous epistemes, which “take the material world very seriously in constituting political ontologies” (2014, 37) yet have been ignored by Euro-American posthumanists. Sundberg finds particular value in several empathetic registers that are especially prominent in Indigenous theorizing. She highlights the Zapatista notion of “walking with,” and glosses posthumanist politics as the quest for “a world in which the multiplicity of living beings and objects are addressed as peers in constituting knowledges and worlds” (Sundberg 2014, 42). These concepts constitute a bounded empathy—the things of the world are not equals but they are peers and we must recognize and engage them as such—which, Sundberg argues, Euro-American posthumanisms have resisted. Taken to heart, concepts like these can inspire a relational political ecology better able to achieve its own ethical and political goals while taking the concerns of ecology seriously.

This assertion raises some immediate questions. If Sundberg has mostly succeeded in addressing border-dwelling jaguars as peers, what of the many other nonhumans that do not act so manifestly with intention? How are we to empathize with actors that contribute to our shared worlds in ways yet less similar to our own, actors who are even more insurmountably other in their performances? What does it mean to address a tree, for example, as a peer, and what kinds of politics come along with such addressing?

I contend that not only is addressing a tree as a peer possible, it is exemplified by certain kinds of grafting. All grafting entails intimate relating between human and plant, but this alone does not constitute bounded empathy; the professional grafter who modifies hundreds of seedlings a day has not thereby identified with or recognized each of them in turn. Where grafters work with adult trees, however, the relationship between them is, although never equal, still recognizably one-to-one (or one-to-one-to-one, grafter and scion and stock). The tree thus engaged does not feel like a resource to those doing the engaging, nor is it treated like one. Trees in other circumstances can also achieve recognition, becoming companions and neighbors and familiars (Jones and Cloke 2002), but grafters find such affects intensified by their active and considered role in shaping botanical/horticultural lives. In horticultural texts and garden conversations, grafters around the world enthuse about their plant interlocutors, not only for practical reasons like the fruit they provide but also for their consenting to respond to the grafter's careful manipulation. Graftable trees seem to be amenable to some degree of working together, in other words, provided that the proper efforts of engaging them are undertaken. They are comparatively agreeable. The successful grafter, for her part, must develop an exquisite sensitivity to the bodies and needs of plants, a sensitivity that is cultivated over time and through long familiarization and exchange. Together, across their vast differences, grafter and graftable plant enter into a collaborative engagement that draws on what they find themselves to have in common. This is a bounded empathy that can inspire posthumanist political ecology, and stands as a model for more-than-human environmental politics more broadly.

Posthumanism, Plant Life, and Vegetal Politics

The posthumanist program I have introduced here is a tremendously ambitious one. Where before the social sciences centered on the "human"—a figure which was defined and defended (K. Anderson 2014) but also thereby kept relatively narrow—posthumanists look instead to the apparently-unbounded "more-than-human" and aim to distribute analytical significance as widely as possible. In contrast with animal rights campaigners, who have worked to make subjects out of only a few of the most human-like creatures—most notably great apes and dolphins (Yusoff 2012; Ogden, Hall, and Tanita 2013)—posthumanists have found agential possibilities in all manner of things, be they ever so humble. Bennett, for example, attends to the capacities of gutter refuse and includes the "small agencies" of earthworms in the political publics she describes (2010). This is not because annelids and garbage are actually sovereign subjects pursuing their own plans, but rather that nothing, not even people, ever had that kind of autonomy in the first place, whatever our brains and modernist theory may tell us. And if "we have never been human" (Gareau 2005; Gane 2006), that puts people on the same plane as not only the cleverer animals but everything else too, in an ontology flattened for all (Latour 2005; Marston, Jones, and Woodward 2005). But though this version of posthumanist theory would seem to demand that our analytical scope be widened to include all kinds of non-humans, geographers using it have tended to emphasize the presence and agency of some non-human actors over others.

Whatmore's important 2002 *Hybrid Geographies* is illustrative of posthumanism as it has been developed in geography: although the book devotes a chapter to the governance of plant genetic resources, posthumanist geographers have made more of its extended treatment of leopards and elephants (Whatmore 2002). In part, posthumanist geography's zoological emphasis is inherited from humanism, which constructed the form of the Human by distinguishing humans from animals (Agamben 2004; K. Anderson 2014). Where animals were thus banished to the periphery by earlier analysts, they present more appealing opportunities for posthumanist revisionism than do other non-humans who never figured in humanist arguments in the first place. It is not surprising, then, that a rejuvenated animal geography has been instrumental in the infiltration of posthumanist ideas into geography (Wolch and Emel 1998; Fox 2006; Hobson 2007; Buller 2014). Just as he did over a decade earlier (2003), Castree recently drew attention to this facet of animal-oriented work, writing, "It explicitly questions the self-sufficiency of the 'human' in human geography" (2014, 455). For Braun (2004), this is posthumanism as *deconstructive responsibility*, and it centers animals precisely as a response to humanism's marginalization of them.

Braun (2004) identifies two other threads of posthumanism, however, and in these domains geographers' emphasis on animals is less justified. In Braun's typology, these are posthumanism as *anti-essentialist ontology* and posthumanism as *non-anthropocentrism*. For these projects—prioritizing becoming and the multiplicity of bodies, in the former case, and recognizing the extent to which the world is not of human making, in the latter—there is no good reason for posthumanism to emphasize animals and animal ways of being, yet that is what posthumanist geographers have done. Cases tilt toward the zoological (e.g. H. Lorimer 2006; Buller 2008; Dempsey 2010; J. Lorimer 2010; Collard 2012), while theoretical innovations attend to capacities specific to animals. Lulka, for example, argues that mobility is central to nonhuman existence (2004), while others have deployed von Uexküll's notion of *Umwelt* (lifeworld) (J. Lorimer 2007; Dixon, Hawkins, and Straughan 2013; Whitney 2014). Von Uexküll himself focused on animals, which possess *Umwelten* on account of their sensory engagement with the world; Deleuze and Guattari note his resulting emphasis on "active, perceptive, and energetic characteristics" (1987, 51; see also Woodward, Jones, and Marston 2012). Philo (2005) bases his justification for posthumanism on interiority instead, a capacity less outwardly dynamic but just as limited to animals. If these are to be our metrics for what makes a worthy actor, then we are likely to replace our rejected anthropocentrism with, at best, anthropozoocentrism.

This focus on animals—and capacities that only they possess—also characterizes those political ecologists that have begun to incorporate posthumanism into their accounts. Barua's compelling treatment of human–elephant relations in South Asia emphasizes that elephants have intelligible goals, but the goals he identifies—drinking alcohol, coping with the stresses of postcolonial living, dwelling in the landscape like good Heideggerian subjects—are intelligible only to the extent that they reflect animal capacities that humans share (2014a, 2014b). In other words, Barua interprets elephantine desires on the basis of his own interiority, an effective gambit but one that confines the utility of posthumanism to those political ecologies that include prominent animal actors. This is empathy, to be sure, but of a sort that, because of its strength, is quite limited in scope. Sundberg's "nature-inclusive collectives" are more broadly conceived to include mountains and rivers too, but her treatment of distributed agency concentrates on ocelots and jaguarundis, which in desiring certain types of habitat act more like agents than do the heat, aridity, and mesquite that also inhabit her account (2011). In a flag-planting manifesto coauthored with two of her former students, Sundberg identifies "recognizing animal autonomy" as central to making political ecology work in new conservation landscapes (Collard, Dempsey, and Sundberg 2015). As effective as these animal-oriented geographies have been, their themes "have dominated, and arguably come to stand for, more-than-human geographies" (Head et al. 2014, 863).

There was for some years, then, a mismatch in scope between the theoretical justifications for posthumanism—which insisted on flat ontologies, dynamic assemblages, and openness to the engagements between all the kinds of things that populate the world—and the tools that posthumanist geographers developed, which were suited to sentient animals and other easier cases. I am not the first to make this observation, as illustrated by the discipline's reception of Haraway's companion-species work (2003, 2008). Haraway pitches her arguments expansively, and there are no scope constraints inherent to many of her crucial concepts (e.g., staying with the trouble, natureculture), but even so she returns again and again to animals and people interacting face-to-face, typified by the agility events in which she and her dogs compete. Early geographical incorporations of this work read the companionship of species in the same way, as an intimate relationship among beings that are fairly similar to each other, at least in the context of the full diversity of living things (e.g. Birke, Bryld, and Lykke 2004; Fox 2006). More recently, however, geographers have begun to argue against these taxonomic and thematic tendencies, insisting that posthumanism must move beyond lovable animals intimately cobecoming (Greenhough 2012b; J. Lorimer 2012; Beisel, Kelly, and Tousignant 2013; Collard 2014; Ginn 2014). The animals that inhabit geographical accounts increasingly include the notably difficult-to-love—mosquitoes (Beisel, Kelly, and Tousignant 2013), slugs (Ginn 2014), coral (Hayward 2010), and bees (Kosek 2010)—while yet more ambitious theoretical transformations have spotlighted bacteria (Helmreich 2009; Hird 2009), fungi (Brice 2014b; Jasarevic 2015), and viruses (C. Lowe 2010; Greenhough 2012b).

Plants, on the other hand, are conspicuously absent from this list, even compared to groups that play much less visible roles in our daily lives. The sociologist Myra Hird argues that bacteria have been inappropriately neglected on account of not being "big like us" (2009), but the size of plants presents no such challenge. Plants are obvious enough that they made up one of the two kingdoms of living things identified by Aristotle and Linnaeus, and folk taxonomies feature the same dichotomy: plants and animals, flora and fauna, the two broad camps into which living things apparently divide (Berlin, Breedlove, and Raven 1973; Berlin 1992). Even so, and even as animals have become the topic of so much research in posthumanism and geography, plants have remained effectively invisible in the posthumanist project (but see Robbins 2007a, 2007b). In Greenhough and Roe's fine literature review on cross-species ethics (2011, 62), the authors cite many of the works mentioned in the previous paragraph but reach all the way back to Evelyn Fox Keller's *A Feeling for the Organism*, published in 1984, for an example that concerns plants. If posthumanism is to work not only as deconstructive responsibility but also as anti-essentialist ontology and non-anthropocentrism, as Braun suggests, this lapse is a problem. Plants are intimate partners in our lives, and their ways of being and becoming foreground different currents of materiality than the dynamic animal subjects that dominate geography's treatments of posthumanism. In incorporating plants into posthumanist analyses, geographers can help reconcile the mismatch between the expansive theoretical ambitions of posthumanism and their zoocentric implementation of it.

Posthumanists are not the only academics to focus less on plants than they should. The botanist–educators Wandersee and Schussler call this phenomenon "plant-blindness," a multifaceted affliction that includes "(a) the inability to see or notice the plants in one's environment; (b) the inability to recognize the importance of plants in the biosphere and in human affairs; (c) the inability to appreciate the aesthetic and unique biological features of the life forms that belong to the Plant Kingdom; and (d) the misguided anthropocentric ranking of plants as inferior to animals and thus, as unworthy of consideration" (Wandersee and Schussler 1999, 84). Jones and Cloke's *Tree Cultures* (2002) diagnoses plant blindness among cultural geographers, while Nabhan (1985) sees something similar in cultural ecologists. Still, it may be particularly difficult for posthumanists, many of whom have relied on Deleuzoguattarian notions of mobility and becoming, to attend to plants, which seem so slow and still. But just as research in ethology has made possible the revolutions of the new animal geography (H. Lorimer 2006), recent work by botanists and plant ecologists allows for a parallel reconsideration of plants, notwithstanding their inescapable alterity. Botanists are increasingly imputing cognition (Calvo and Keijzer 2009), complex communication and neurobiology (Brenner et al. 2006; Barlow 2008), and even intelligence (Trewavas 2003; but see Firn 2004) to plants. Even without signing on to the more controversial claims for plant dynamism, posthumanist geography sets its sights too low when it defines its task as the reimagination of landscapes—perhaps the prototypical plant co-construction—as the "dwelt achievement of people and animals" (Barua 2014a, 916). If we are to overcome our own plant-blindness, we must interrogate our own assumptions that consign plants to the backdrop of our work.

In his 2011 *Plants as Persons*, the philosopher Michael Hall argues that the consequences of plant-blindness are not merely analytical but ethical and practical as well. Following Val Plumwood and other environmental philosophers, Hall argues that the environmental destructiveness of the industrialized world grows out of hierarchies embedded within Western thought. Geographers writing on the Anthropocene outline similar connections between posthumanist theory and environmental ethics (Gibson-Graham 2011; Clark and Yusoff 2014; Ginn 2015), but Hall emphasizes that it is plants, in particular, that occupy the bottom rung of our civilizational hierarchy, and are most abjectly excluded from our ethics of care and conscientiousness. Surveying the history of mainstream Western thought, Hall delivers a diagnosis of "zoocentrism…a deliberate philosophical strategy for marginalizing and excluding plants. Zoocentrism is a *method* for achieving the exclusion of plants from relationships of moral consideration. For want of a better term, it is a *political* tool in an exclusionary process" (Hall 2011, 6, italics in original). As a corrective, Hall recovers a minor history of plant inclusion in other traditions, including Jainism, Buddhism, and paganism, and suggests that these less-hierarchical realms of plant thought may help Western societies address their environmental problems.

Hall's argument finds allies in the recent geographical literature on "vegetal politics," which has begun to redress the plant blindness that has so far afflicted posthumanist geography. Writing in the introduction to a themed special issue of *Social & Cultural Geography*, Head et al. argue that hybrid and posthuman geographies have ignored "the specific capacities of plants," which are "profoundly backgrounded in most of Western thought and life" (2014, 864). Certainly some geographers have given plants serious attention, drawing attention to plant cultures (Jones and Cloke 2002; Cloke and Jones 2004), plant encounters (Hitchings and Jones 2004), plant agency (Robbins 2007a; Doody et al. 2014), plant efficaciousness (Robbins 2007b; Weisser 2015), plant materiality (Head, Atchison, and Gates 2012), and plant vitality (Richardson-Ngwenya 2012). Similar themes have been pitched to popular audiences as well (Chamovitz 2012; Holdrege 2013; Pollan 2013; Sacks 2014). Still, Head et al. (2014) presents the clearest call yet to integrate an existing recognition of the importance of human–plant relations with theoretical advances in the social sciences, most obviously in the posthumanist direction.

Interestingly, Head et al. include no discussion of their use of *vegetal*, which appears only in the paper's title and once, scare-quoted, in its abstract. The most prominent exponent of *vegetal* as usefully denoting the things that plants can do is philosopher Michael Marder, whose 2013 *Plant-Thinking: A Philosophy of Vegetal Life* makes the boldest claims of all for the benefits of overcoming plant-blindness. In Marder's treatment, plants lead uniquely decentered, exterior, surficial, and non-teleological lives, and thus provide a model for a "vegetal anti-metaphysics" that escapes Kantian subject–object dualisms and can license new philosophies and ways of being (Marder 2013). Marder advances this argument from within Western philosophy, and his creative reading of Aristotle, Hegel, Heidegger, Levinas, Bergson, Plotinus, and others complements Hall's mining of non-Western thought. Unfortunately, Marder doesn't know very much about plants, and seems disinclined to learn (Ginn 2017). In grounding the value of the plant encounter in plant alterity, Marder points toward the necessity of analytically engaging specific plant capacities, but he insists that this task cannot include objective description, which he feels would necessarily reduce plant otherness. Untethered therefore from plant science and basically hostile to the empirical methods of most geographers, Marder's approach offers little guidance in answering the questions that interest political ecologists.

In fact, as I demonstrate in the chapters that follow, an empirical consideration of plant capacities is a possible—indeed, a necessary—component of any plant-informed posthumanism that political ecologists might want to draw upon. The active performances of plants matter in many of the environmental conjunctures that political ecology explores, but Aristotle and his successors' ruminations on plant being can offer us little guidance as to how. For the specifics, the mattering of specific plants in specific cases, political ecology needs a plant-centered empirics instead. For methodological reasons I explore below, a plant-centered analysis—what I call, in Chapter 6, a vegetal political ecology—does not exclude humans; conservation and forest management, in particular, are fundamentally-human realms, which include both people and trees as participants, all with certain degrees of agency and embroiled in relationships of various kinds. By deploying the geographer's methods to investigate these relationships, augmented with the bounded empathy I introduced above, I explore the intersection of plant and human worlds that Marder acknowledges but cannot, with his philosophical methods, engage.

The Vegetal Politics of Grafting

So, from among the set of plant capacities and tendencies, why have I chosen grafting as an entrée to vegetal politics? Why have I described the graftable tree as the quintessential figure of posthumanist political ecology? Subsequent chapters will address this question concretely, in the material relations of conservation, governance, and resource politics in southern Kyrgyzstan. Here, I address the question abstractly, without recourse to place. As noted in Chapter 1, grafting involves implanting a *scion*, typically a single bud or short twig taken from one plant, into the body of another plant, which serves as the *stock* or *rootstock*. Even in the most easily-grafted plants, a graft is no sure thing; the grafter's manipulations can only succeed if the plant takes its own actions in support of them, including callus growth and the development of new cambial and vascular connections (Hartmann et al. 2002). While the plant's reasons for doing so in some cases but not others remain obscure, it seems that these are not passive responses to wounding but involve active processes of cellular recognition across the graft union (Pina and Errea 2005). Grafted bodies are horticultural co-constructions, the production of which requires coequal and direct participation by people and plants. They are thus, quite literally, posthumanist productions.

As such, graftability is an expression of the plant alterity that Marder explores, a fine illustration of what he calls "vegetal modes of dwelling on and in the earth" (2013, 8). The fact that tree parts can so flourish in piecemeal bodies, and that they grow in these bodies so directed by worldly histories yet pursuing their own indeterminate ends, precisely demonstrates plant decenteredness and non-teleology. In fact, Marder himself sees grafting's metaphorical appeal, and his newest book is called *Grafts: Writings on Plants*. "Grafting: do we ever do anything other than that?" he writes, and hails "the practice's quiet rebellion against the strictures of identity" (Marder 2016, 15). But as with vegetal being in his earlier book, graftability serves here only as a foundation for Marder's impressive theoretical edifice—his vegetal anti-metaphysics. But graftability has concrete and empirical effects as well; perhaps we are all always metaphorically grafting as we traffic across difference, but some people and some plants, at some times, are also literally grafting.[15] This grafting, the productive juxtaposition of plant parts that vegetal growth enables, has consequences that are not only philosophical but concrete and empirical as well. "To graft is to create unlikely encounters, hybrid mixes, and novel surfaces," as a blurb for Marder's *Grafts* states (Univocal Publishing 2016), but it is also to create unlikely bodies, hybrid ecosystems, and novel market relations—just the sorts of things that political ecologists are committed to exploring.

Grafting has two additional attractions, the first metaphorical or figural and the second more material. First, the grafted tree can be an anti-foundationalist mascot. Anti-essentialist theory has cycled through various amodern figures of anti-foundationalism. Actants, cyborgs, rhizomes, and monsters each draw attention to the messiness of material construction and the lack of autonomy in entities we might otherwise take to be sovereign actors. These figures are not all the same, and theorists have opted for one or the other according to the focus of their work, but each is counterposed to the actor of classical social theory and its illusion of total creative control. Like these, the grafted body, which lacks a unified origin and bears the marks of its assembly in its being, dramatizes the interpenetrations of human and non-human agencies and the complex natures of the actors to which these interpenetrations give rise. As Marder recognizes, grafting depends on the ability of different entities to accommodate each other across their difference; this

[15] Put differently, when Marder asks "Grafting: do we ever do anything other than that?," the correct answer is "Sure, sometimes we do other stuff."

characterizes the relationships forged not only by stock and scion within the grafted body, but also by grafting human and grafted tree in the extended horticultural encounter. As a result, and like other figures of anti-foundationalism, the grafted body can stand in for hybridity, bricolage, and construction.

The grafted body performs anti-foundationalism by being, in effect, an anti-organism. In biology, an organism is defined by the presence of mutually interdependent parts, and grafted trees certainly seem at first glance to function organismically. They inhabit delimitable bodies, they fruit and produce seed, and their branches and roots exchange nutrients and water in a perfect picture of mutual interdependence. On the other hand, the grafted tree's body is evidence that plant parts can be separated from each other and reconstituted in new configurations. The branches of a graftable tree do not, it turns out, depend on the roots of that tree, but can work as well with other roots; their interdependence is not organismic but functional. The grafted body encompasses processes of interdependence and interconnectedness, but these processes combine elements not initially held within the same body, and emerge not through adaptation in deep evolutionary time but from specific actions in specific places at specific moments. In the terminology of Robbins and Moore (2013), the grafted tree is a post-Edenic actor: where the trees in the Garden of Eden are divinely sourced, transcendent, and whole, grafted trees are collaborative, worldly, and piecemeal.

As noted above, other post-Edenic figures are already well-established in critical analysis; actants reject transcendence as well as any grafted body, and cyborgs are themselves anti-organismic. The grafted tree does anti-foundationalism differently, however, which is why it may be worth adding to the anti-essentialist roster. Haraway's cyborg is the grafted tree's closest match, another entity that lacks a unified origin and combines disparate parts in a single chimeric body (Haraway 1991a). Haraway notes that "the cyborg would not recognize the Garden of Eden" (1991a, 151). But the cyborg derives its boundary-fuzzing punch from interconnections between the organic and the machinic; it conjures wonder by queering technoscience. Grafting is no less productive of wonder than is the cyborg—there is a fascination that typifies discussions of what grafters and plants can do together (Shavelson 2012; NPR Staff 2014; Woodruff 2015)—but it is organic and low technology, not digital but analog. Compared to cyborgification, grafting is cheap and accessible, an interweaving of human and nonhuman actions much less tightly tethered to capitalocentric exclusivity. As a result, in the grafted tree, efforts at more-than-human negotiation and cohabitation are made visible and embodied, and in a very different register than the cyborg. It is hard to think the cyborg away from the showiness of the technological frontier; grafting, on the other hand, takes place not in clean rooms in world cities but on rural plots in the world's villages, and enrolls not corporate-funded technologists and exotic rare earths but peasants and farmers and trees.

The graft has metaphorical promise, then, but graftable bodies are also interesting from a more material standpoint. Posthumanism has sometimes come under fire for theorizing an undifferentiated nonhumanity with which an often-equally-homogeneous humanity hybridizes across the Great Divide between them (Lulka 2009; Abrahamsson et al. 2015). For Lulka, this is an unacceptably "thin" hybridity, setting up humans and nonhumans in neat analytical pairs that obscure the fullness of nonhuman lives. By digging into the capacities of specific nonhumans enough to distinguish one sort from another, he continues, we can construct a "thicker" hybridity that addresses "the world at large" (Lulka 2009, 384). For vegetal politics, this means engaging specific modes of plant practice and plant action, not merely an undifferentiated plantness. There are real differences in capacity and ways of living between eucalyptus and bluegrass, oak trees and pine trees, mosses and mums, the exploration of which is necessary for constructing a posthumanism equal to the diversity of plant lives. Marder is again a useful contrast here: he posits a "plant-being" or "plant-soul" that explicitly erases all differences among plants and their capacities (2013). Head et al.'s *Ingrained* (2012), while far more attentive to plants' particulars, offers the notion of *plantiness*, which is intended to specify features of all members of the biological kingdom Plantae but approximates Marder's plant-soul in the way they actually use it. In contrast to these treatments, which look to capture all plants but lose their thickness in the process, focusing on grafting is one way of specifying plant capacity and keeping the richness and diversity of plant life in the analysis of vegetal politics.

Grafting has several other material features that recommend it as a specifying project for posthumanist analysis, from among the various other things that plants can do and ways that plants can be. First, not all plants enter readily into grafting partnerships, for reasons related to fine details of bodily structure and composition.[16] Adult walnuts, for example, are more difficult to graft than adult apples because of differences in how sap runs within their

[16] In keeping with his hostility to empirical data, Marder bases his articulation of plants as collective entities on what seems to be a mistaken assumption that all plants can be grafted (2013, 195n24).

respective bodies (Coggeshall and Beineke 1997). The distinction arises not from the souls of these plants, but from their cellular, physical, woody, emplaced, tangible bodies. Grafting, in other words, is mundane and material, and defies any potential appeal to an inheld plant-soul. Second, grafting is a sort of lateral transfer, in which propagation is not by descent but by relocation. Lateral transfer is commonplace among microbes, the recognition of which is rendering treelike depictions of evolutionary history increasingly problematic (Bapteste et al. 2004; Helmreich 2011). In the case of graftable plants, lateral transfer disrupts patterns of descent as a result of human–plant partnerships that only obliquely rely on essential characteristics of each. Instead, graftable plants possess histories, which they display in their variegated bodies. What's more, this is the processual history that Ingold describes as classically limited to (human) persons, a history that is actively made by the actions of subjects (as opposed to the eventful history of populations, which is not made but simply happens as occurrences concatenate) (Ingold 2016, 61–62). Third, grafting draws our attention to human–plant relating, the mutually conditioning actions that people and trees take alongside and with regard to one another. Abrahamsson et al. critique Bennett's version of materialist politics for indulging in "liberal notions of isolated individual actors" (2015, 1). While mutual interdependence suffuses all of our worldly encounters, grafting, a close worldly encounter between fleshy humans and woody plants, makes it glaringly obvious.

Indeed, there is something hard-headed, perhaps even obtuse, about connecting the horticultural practice of grafting and the plant bodies it assembles with poststructural posthumanist theory. The stitched-together botanical beings that inhabit the apple orchard and the Kyrgyzstani forest perform anti-essentialism *obviously*, on their very surfaces. Theoretical arguments built on their piecemeal bodies court a naïve realism that critical geographers have attempted to leave behind (Wilson 2009 makes a similar point regarding geographers' use of the cyborg). Hybridity has become perhaps the central trope of anti-essentialist geography, but it is also completely divorced from its origin in botany, no longer "the concern of plant scientists alone" (Demeritt 2005, 819). This is surely to be lauded: bricolage, as deployed in post-structural theory, builds up all manner of bodies, not just the obviously constructed ones. On the other hand, there is value in exploring the worldly lives of our terms' referents. Whatmore (2002) scolds Deleuze and Guattari for invoking rhizomes without regard for actual fungi, and poststructural geographers can learn from what plant scientists have to say about hybridity. As I hope to demonstrate in the chapters that follow, southern Kyrgyzstan is a place where the anti-foundationalist, anti-organismic characteristics of grafted trees matter not only for the metaphysics of critical theory but also for more mundane questions of resource access and local environmental politics.

The Methodological Question: On Writing the Grafted Tree

There is a clear methodological challenge in the notion of bounded empathy for nonhuman others, not least vegetal ones. How can the plant be written, whatever its graftability? Posthumanism has developed techniques suitable for engaging animals, which require creativity and innovation on the part of scholars reaching out to vastly different entities. But the task of similarly engaging plants requires crossing yet vaster differences, and surmounting yet more profound challenges. If von Uexküll used *Umwelt* to ground his theorization of animal interiority, he accords plants only the much sparer *Wohnhülle* (dwelling–integument), which even the boldest plant semioticians find difficult to deploy (Kull 2000; Cox 2002). It is hard to imagine a plant posthumanism resorting to prosopopoeia—that is, writing in the voice of an entity which cannot itself write—as Whatmore (2002) does with a leopard, or Latour (1996) does with an automated train system. In short, to try to inhabit the interiority of a tree is to badly misread vegetal being, and any posthumanism that requires interiority of its actors will inevitably exclude plants.

Faced with this methodological scenario, vegetal politics has begun to develop methods of its own, better suited than animal posthumanism's methods to the slow and quiet processes of planty creatures. Richardson-Ngwenya (2014) considers the methodological challenge in introducing her vital materialist treatment of sugar cane breeding in Barbados, but she admits that most of the methods she settles on—videotaping, diaries, a brief stint of participant observation—end up yielding her no transformative insights. She therefore singles out the "cultivation of a *vitalist geographical imagination*, or 'attitude'" (2014, 297). However, Richardson-Ngwenya doesn't explain what this imagination means in and for specific places, leaving fieldwork and, ironically, plants themselves seemingly unnecessary to her work. More promisingly, Pitt (2015) holds to field methodologies, writing compellingly on the merits of moving, working, and watching, which all seem better fitted to the sorts of things plants are. She puts these techniques toward a variety of ethnography that prioritizes sustained engagement with plant-interested people in the presence of the plants they are interested in. Whereas animal geographers explore the benefits of following animals (H. Lorimer 2006), plant geographers use garden and forest walks with other plant enthusiasts in order to put themselves in planty spaces. There, they open themselves to being shown what it is to be a plant, by experts both human and nonhuman. Only through such ethnographic approaches can scholars of vegetal politics gain the time and space to become as aware as possible of how plants are being and doing. Even so, the problem remains inescapably difficult, and Pitt is appropriately modest about plant ethnography's potential achievements. "The goal of human–plant ethnography is not to represent nonhumans by speaking for them," she writes, "but to tell stories of them to enable others to discover plantiness directly" (Pitt 2015, 50).

Scholars of vegetal politics must be clear that they are not inventing their storytelling toolkit from scratch but developing it in conversation with the plant-oriented natural sciences. This is ground better covered by political ecologists, who, in moving to incorporate nonhumans, have always had to position themselves carefully with respect to ecology.[17] Ecology has, after all, been defined by the examination of nonhuman capacities and tendencies, and geographers discovering the same topics run the risk of becoming ecology dilettantes with hipper jargon. In assessing the place of nonhumans in emergent political collectives, Sundberg seems comfortable summing up feline desires with a couple citations of ecological research (2011, 329), rendering them a surprisingly static feature in an otherwise dynamic performative framework. Other geographers have been more reluctant to assess nonhumans so plainly (Pitt 2015), unsure of their own qualifications or worried that such representation can only reobjectify the nonhuman other. What can

[17] This applies not strictly to ecology but to natural sciences in general. Where posthumanist geographers examine nonliving entities, they also interact with geology (Yusoff 2015), cosmology (Clark 2010), and other disciplines. Ecology figures most prominently, however, in the posthumanism of political ecologists.

posthumanist geographers add to debates about how cats act, which might seem to be the natural domain of ecologists and ethologists, or, for that matter, about what graftable trees do, a topic more obviously botanical or horticultural than geographical?

Posthumanist geographers have advanced three overlapping responses to this "science question," each implying a particular disposition toward the ecological sciences and carving out a particular niche for their own interventions. First, some insist that posthumanism's representational task is different than the one natural scientists undertake. Precisely because they seek to put humans and nonhumans on equal analytical footing, posthumanist geographers choose some kinds of "data" over others, investigating for example the various "traces" that creaturely performances produce (Hinchliffe et al. 2005; Sundberg 2011) or focusing on animals as individuals rather than members of populations (Lulka 2004; Bear 2011; Nadasdy 2011). Ecologists have tended to reject this material as useless for testing hypotheses or building up quantitative datasets, but it nicely fits the project of illustrating nonhumans' active shaping of socioenvironmental outcomes or addressing them with bounded empathy. By developing their own cuts at the nonhuman things they analyze, posthumanists seek to capture them not as objects that Society finds in Nature but as quasi-objects that destabilize the boundary between those two Modern categories (Latour 1993; Robbins 2007b). Seen this way, the posthumanist project appears less a bastardized ecology than a reinvigorated natural history, but it may lean on the knowledge that ecologists have produced for their own purposes, as Sundberg and her citations do.

Second, one might embrace the charge of ecology dilettantism as properly indicative of political ecology's mission. It has always been true that, in combining ecology and political economy, political ecologists give up some depth in each. In most cases, our ethnographies are based on less field time than anthropologists', our soil analyses and forest transects are pared-down versions of ecological research, and our stays in the archives will never match what historians undertake. Yet though each of these fields could accuse political ecology of corrupting their methods in fitting them to its own needs, political ecologists have found value in these "disciplinary transgressions" (Bryant 1999, 148), working shallower but more broadly and combining approaches from better-disciplined disciplines. One field's dilettantism is, perhaps, another field's mixed methods. From this angle, posthumanism is making new and different disciplinary traditions into natural allies of political ecology, which for all its wide ranging has not much drawn on profound investigations into the material world undertaken by ecologists, ethologists, botanists, and horticulturists. In this approach, posthumanist political ecologists cannot attend to nonhuman capacities as thoroughly as natural scientists do, but we should not take this as a reason to abandon the effort (Stallins 2012).

For posthumanist geographers who respond to the science question in each of these two ways, mainstream ecological inquiry is basically an ally. By the first logic, ecologists use different techniques but study the same things as posthumanist geographers, and often in broadly complementary ways. By the second, ecologists are the experts in their subject area, and we posthumanist geographers should emulate them to the extent possible, given our other analytical commitments. The third response, however, relates differently to the discipline of ecology, seeing it not as a complement but as an object of inquiry. By this third logic, the fact that other disciplines have preceded us in studying nonhumans means that these disciplines themselves should be included in the scope of our own investigations. An inquiry into human–forest relations is incomplete if it does not include botanical and silvicultural research among the relations it examines, for these are central to the way humans and forests relate. In making this move, posthumanist political ecologists align themselves with scholars of science studies, just as other political ecologists have done (M. J. Goldman, Nadasdy, and Turner 2011; Lave 2012).

In this third category, two recent examples stand out, neither by a self-proclaimed political ecologist but together illustrative of how posthumanist political ecology might incorporate natural scientists into their analyses. The first is the work of the anthropologist Matei Candea, who has developed Isabelle Stengers's notion of the *redescription* of science as a means of both "highlighting the value of science as a particular kind of adventure [while] simultaneously depriv[ing] it of the power to rule out of court other adventures" (Candea 2013, 107). Stengers has hovered toward the back of literature reviews for more than a decade, but Candea's articulation of redescription, or *counter-effectuation*, nicely tailors Stengers's thought to the projects of political ecologists. For Candea, it is Stengers's formulation of science as "material engagement with the world" that offers most promise: even as scientists describe themselves as seeking epistemic detachment, their means of doing so include deep immersion into carefully chosen material processes. In the case of field ecologists working on the Kalahari Meerkat Project, Candea's informants switch readily between, on one hand, disaggregating meerkats into collections of behaviors which can be examined in precise experimental setups and, on the other, seeing meerkats as whole beings that affect socionatural assemblages in accordance with their own desires and tendencies (Candea 2013). There is no contradiction between these modes of interaction, but the second is written out of the publications by which the project formally disseminates its findings. But just because the ecologists categorize only some of what they do in the field as properly scientific does not mean that geographers researching those ecologists should use the same categorization. Rather, we can follow scientists as we do other actors, attending to all of the ways their actions shape the places they operate, both within experimental setups and beyond them; insofar as the redescribed science acquires new meanings in the process, it has been, in Stengers's term, counter-effectuated. For Candea, it is the task of anthropologists to keep two sorts of actions in view at once: first, those undertaken in pursuit of the epistemic detachment that scientists understand themselves to be targeting, and, second, those constitutive of the material immersion that philosophers of science have demonstrated that scientists are also engaged in (see also Nading 2015).

For political ecologists following Candea's lead, the job is to describe how science as material engagement with the world contributes to the political contestations we study. Where humanist political ecology has dealt with scientists and scientific practice, it has dealt with science as if it were only a failed project of epistemic detachment, "ideological arguments posturing as matters of fact" (Latour 2004, 227). Once critically deconstructed, science appears in political ecologies as a tool of governance, most notable for justifying various state impositions upon the land managers and field sites that dominate our research itineraries and sympathies. But, as Stengers and Candea demonstrate, scientists are also deep engagers with the materiality of the world, epistemically detached but ontologically embroiled. In recognizing the value of their investigations while asserting our right to apply our own understandings of them, we replace deconstruction with redescription. A posthumanist political ecology analogous to Candea's anthropology incorporates natural scientists into its accounts of environmental politics by addressing all the adventures in which they are engaged.

The second example of how posthumanist political ecology might engage natural science concerns the work of Jane Bennett, like Stengers a mainstay of posthumanist literature reviews, and one critical response to it. Bennett, a political scientist, has argued that a certain vibrancy is intrinsic to materiality, allowing matter of all kinds to attain agency in heterogeneous political assemblages (2010). Bennett's project draws inspiration from the philosophies of Spinoza, Bergson, and Deleuze, but it also mobilizes knowledge produced by natural scientists. For example, Bennett makes much of the nutrition science finding that people with diets high in omega–3 fatty acids may show decreased aggression and depression and enhanced mental acuity. For Bennett, this is indicative of nonhuman agency: fatty acids are actors because they effect chemical changes inside human brains, and the autonomous selves that we think we are emerge instead from the molecules of the food we ingest. And this, critically, is true because natural scientists have told us it is so.

The politics of Bennett's vibrant materiality is elusive. In her preface, Bennett casts her book as an intervention into mainstream environmental politics, arguing that, as anthropocentric thinking has contributed to environmental problems, undoing that thinking can help solve them (2010, viii). Importantly, she leaves many intermediate steps unspecified; how, exactly, does recognizing the vibrancy of rocks and worms bring about the changes in energy policy or patterns of consumption that Bennett hopes to see? Not to worry, however: Bennett gives herself another route to political relevance by redefining the term. Politics, she explains, is located wherever force animates matter to do things, and simply acknowledging "more nonhumans in more ways" has an incremental democratizing effect (2010, 109). As useful as this reframing is for Bennett, a politics distributed across all forceful matter seems to offer little aid in posthumanizing political ecology, which has tended to insist on a more practical politics linked to the field's roots in Marxian political economy (Walker 2006). In their own turn to the power of nonhuman things, geographers Shaw and Meehan argue that "the political has always been…the metaphysical strife between objects" (2013, 217), a very Bennettesque formulation but one not easily married to political ecology's existing model of politics.

Happily, Abrahamsson et al. (2015)'s critique of Bennett's vital materialism corrects its attenuated politics and points toward a posthumanist political ecology that, like Candea's anthropology, centers on the material engagements of natural scientists. Focusing on the omega–3 example noted above, Abrahamsson et al. diagnose two flaws in Bennett's work. First, they argue that Bennett gets her nutrition science wrong, overgeneralizing from a study of violent prisoners to all people and failing to distinguish between the effects of different vitamins. Worse for Bennett, though, Abrahamsson et al. argue that the prisoner study shows that omega–3 acts causally and predictably—precisely *not* as an agent with room for maneuver on its own terms because of its intrinsic vibrancy. Indeed, by controlling variables and isolating study populations, the study explicitly aims to reveal causation and rule out the possibility of agency. Rather than focusing on an object, omega–3 fatty acids, and asking after its agency, Abrahamsson et al. call for the investigation of what that object is doing in the relations in which it is enmeshed. In the case of omega–3, some of the fatty acids in supplement pills come from fish caught off of impoverished Western Sahara, linking the dietary whimsies of the Global North to the overfishing and malnutrition that beset the Global South. They thus reveal a tractable politics in the very material Bennett leaves so politically underspecified.

Bennett may be no nutritionist, but Abrahamsson et al. argue that she also exemplifies how posthumanist social sciences should *not* engage the natural sciences. Bennett runs aground, they argue, in treating scientific conclusions as removable from the context in which they were derived. She shows no interest in the experimental practices of nutrition science or the epistemological questions that surround them, fixating instead on a scientifically-validated fact to which her own argument can be appended. For Abrahamsson et al., on the other hand, "learning from the natural sciences…requires that their methods and concerns be carefully attended to" (2015, 4). To use scientific studies as sources from which to cherry-pick facts is to throw out the situatedness and effort of scientific practice, to delude oneself that epistemology can be disregarded, and to accede to the overly narrow and falsely-apolitical framing of much scientific writing.

I have outlined three ways in which posthumanist political ecology might relate to the natural sciences.[18] As it happens, my posthumanist political ecology draws on each these. Like the first approach, subsequent chapters rely on what horticulture and botany have to say about trees and their graftability, but in pursuit of my own program of demonstrating their analytical parity with humans and other more-talkative entities. Namely, whereas horticulture, in particular, illuminates graftable bodies so as to manipulate them through ever finer mechanisms of human control, I take graftability as evidence that plant bodies have their own realms of control in sociopolitical encounters. Like the second approach, I'm happy to admit that my treatment of grafting biology would strike a botanist as superficial, but it should still be deep enough to contribute something new and important to my analysis, and to the field of political ecology. And like works that display the third approach, my version of walnut–fruit forest political ecology gives scientists a comparatively prominent role, as humans whose practices help us illuminate the lives of nonhumans. This is not primarily because of the bits of knowledge they produce, but thanks instead to the nature of worldly engagement that scientists as material and ontological actors display.

In conclusion, the remaining chapters of this dissertation use the graftability of many trees in southern Kyrgyzstan's walnut–fruit forest to construct a posthumanist political ecology of human–forest interactions there. My ethnographic fieldwork was conducted before Pitt (2015)'s methodological considerations were published, but her use of moving, working, and watching with plant-enthusiasts in the company of plants resembles the techniques

[18] There is a fourth possibility: the blunt refusal exemplified by the plant philosopher Marder, who understands objective description to be intrinsically and unacceptably reductive. Political ecology, with its embrace of critical realism (Forsyth 2001, 2003) and long history of engaging other fields, seems unlikely to follow Marder's lead.

that featured in my own time in the field. The goal, as articulated here, is to enable in the reader a bounded empathy for a variety of actors in southern Kyrgyzstan's forested landscape, emphatically including its graftable trees. More ambitiously,[19] I intend this empathy across vast difference to suggest the kind of difficult, creative, intersubjective, scientifically-informed engagement that must come to characterize more-than-human environmental politics as a whole.

[19] (!)

Chapter 3 – The Graftable Landscape: Horticulture and Ownership in Kyrgyzstan's Walnut–Fruit Forest

In the autumn of 2011, state foresters in the Kyrgyzstani village of Kyzyl Ünkür were confronted with a daunting task. Along with monitoring the surrounding walnut–fruit forest for timber theft, which made up the bulk of their workaday responsibilities, these sixteen men had been tasked by their superiors in the State Forest Service with checking the extent of each of more than 400 tracts of land in the 58,000 hectares surrounding the village. The tracts in question had been leased out to village households, who manage them year-round and spend several weeks living on them each fall and harvesting the walnuts their trees produce, but all leasehold boundaries now needed formal confirmation to keep Kyzyl Ünkür in compliance with a new national regulation. This was no mere office job, but meant a ground-truthing visit to each tract in turn, establishment or reestablishment of its boundaries, and a determination of how much area these boundaries enclosed. Such tract visits were not trivial—the walnut–fruit forest grows on mountainous terrain, which foresters traversed on horseback, on foot, or by hitching rides in the few vehicles travelling the unpaved roads. What's more, tract delineation had to be finished quickly and all ambiguities resolved before the forest walnuts ripened and leaseholders arrived to collect them. And all this needed to be accomplished in a season during which most foresters were preoccupied with bringing in their own harvests from backyard gardens that would supplement their small government salaries and feed their families through the winter.

This task of forest measurement was initiated fairly recently, but it could be seen as a belated echo of the fall of the Soviet Union. Now more than a quarter-century past, the end of the Soviet system is still reverberating through people–environment relations across Eurasia, and means of distributing resources remain unsettled even as post-Soviet societies become ever-less definable by that moment of transition (Stark and Bruszt 1998; Burawoy and Verdery 1999).[20] Of particular importance in Kyzyl Ünkür, for local livelihoods and forest politics, are transformations in the harvest of forest walnuts (K. Schmidt 2007a). Since Kyrgyzstan's independence, the walnut harvest has been decentralized: whereas villagers once collected forest walnuts under the direction of the Soviet state's local representatives, many a village household now holds a long-term lease on a walnut-bearing tract and, there, participates in forest management directly. Lessees pay a fee to the state, but keep for themselves any nuts they collect and whatever profit they gain from their sale on the open market. This has not been full privatization—indeed, private ownership of land under forest is illegal, as it was before, and many restrictions constrain what leaseholders may do with their parcels (K. Schmidt 2007a)—but it *is* quasi-privatization. To be precise, it is exquisitely targeted privatization: the land remains in state hands, as do the trees that grow on it, but the nuts borne by the trees have passed to the leasing residents of Kyzyl Ünkür. The boundary-delineation upon which foresters embarked in autumn 2011 was intended to clarify, then, precisely which trees had been leased by whom, and thus who had ownership of what nuts upon their branches.

In Kyzyl Ünkür, in this way, forest property is being remade. Relations that have been left comparatively informal until now are being subjected in new ways to the intervention of

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[20] Debates over the legacy of "transition" are ubiquitous in studies of the region. Even now, researchers continue to situate rural Central Asians as living, first and foremost, "in transition" (e.g. Shigaeva et al. 2007; Toleubayev, Jansen, and van Huis 2007; Thieme 2008; Wolfgramm et al. 2010; Dörre and Borchardt 2012).

state actors, who in delineating forest parcels give the legal system new purchase on the rights and responsibilities associated with them. This remaking requires effort, as the foresters' autumn agenda demonstrates. Every day when he was not needed in town, each forester would head out to his assigned territory and spend the day walking the bounds of leased plots with portable GPS unit in hand, collecting data for the calculation of household allotment areas and attached fees, as well as for the production of new cadastral maps. This boundary-walking requires strong legs and strong lungs. Walnuts grow happily on quite rugged slopes, and the property lines drawn around them are often intentionally pushed to the slopes' most rugged parts, brush-filled gullies and exposed ridgelines that nobody much wants to own. Where hillsides are too steep, foresters crawl on hands and knees, improvising switchbacks as close to the bounds as possible. Typically, foresters walk each parcel's bounds with a member of the household that harvests walnuts there, as bringing a local along is the best way to get the boundaries right. It is also the only way to get villagers to believe the numbers that the GPS unit produces, a forester tells me (pers. comm., 9/30/11), but trust is an issue throughout. Several times, a forester mentions that his local guide has cut corners, literally, on the walk just completed, in order to minimize the family's registered area and, therefore, the associated land fees. Just as often, locals insist that the forester has steered them too wide, out of a personal vendetta or for his own convenience. Given the arduousness of this walking in circles, only some locals can participate. This can introduce inaccuracies into the process, as the young and able-bodied who can handle strenuous hiking are often less familiar with the boundaries than their frailer parents are. When foresters tire at the end of a day of boundary-walking, they send residents off with the GPS to do the circuit alone, data quality be damned. Remaking property is hard work.

Explaining why this should be so—why the project of transforming property relations in southern Kyrgyzstan should depend on strenuous mountain walks—is the purpose of this chapter. This requires the construction of a performative theory of property that is equal to the complexity of property's remaking and also, as it happens, differs from the property theories that post-Soviet scholarship has so far advanced. Especially where property relations are comparatively settled and liberal norms of private property hold sway (Blomley 2005), it is easy to think that property issues smoothly from administrative centers, a product of the legislator's pen that straightforwardly delineates—with, perhaps, some lawyers' assistance—how people own things. Where property is in flux, however, the sprawling effort of its production is made visible, and the list of parties enrolled in its making lengthens. In southern Kyrgyzstan, the remaking of property connects lawyers, development industry consultants, and politicians, who define its rules in Bishkek boardrooms and legislative chambers, with foresters and villagers sweating up and down the slopes above Kyzyl Ünkür. Contributions also come from non-humans of all sorts, in this case including mountains, GPS devices, and trees, and they can make or break a property reform with their own diverse performances. The analysis I present here admits all these actors into the story of property's making and applies insights from political ecology and human geography to a post-Soviet property debate that has until now defined property too narrowly, and too humanly.

The structure of the chapter is as follows: In the first section, I summarize property theory and introduce the concept of performative property, drawn from the recent work of Nicholas Blomley. I also introduce the literature on post-Soviet property reform, which has used a notion of property that is notably unperformative, and as a result has captured only certain aspects of emerging property regimes. I then use this performative lens to describe the ongoing efforts to remake Kyzyl Ünkür's property system, of which boundary-walking foresters are part. By recasting foresters' and others' efforts in performative terms, I admit new actors to, and extend the geographical scope of, the story of how property is made.

Property, Performative and Otherwise

Although human geographers have at times forgotten the importance of property (Blomley 2005), it is one of the main ways that people relate to the more-than-human world around them (Mansfield 2007). The most familiar way of understanding property is as a state-sanctioned system of ownership, a means of controlling nature and distributing its fruits among different humans. Within this idiom, the dominant approach to property, at least in Europe and the United States, is what property theorist Joseph Singer calls the *ownership model* (Blomley 2013). The ownership model is "premised on consolidated, permanent rights vested in a single identifiable owner, identified by formal title, exercising absolute control, distinguished from others by boundaries that protect the owner from non-owners by granting the owner the power to exclude" (Blomley 2013, 26). By this way of thinking, private property is the ideal, and other kinds of property, particularly those supported by state intervention, are generally not to be trusted and often excluded from consideration entirely. The owner is further assumed to be motivated by self-interest and the possibility, in market-driven systems, of economic gain. This ownership model so dominates liberal property discourses as to make other kinds of property thinking difficult, at least in western milieus (Blomley 2005).

The ownership model has many detractors, who take its emphasis on private property to be either unjust or simply unreflective of the many ways worldly things are owned and accessed. Exemplary of this critical approach is environmental historian Ted Steinberg's *Slide Mountain, or, The Folly of Owning Nature*. For Steinberg, as his subtitle implies, property denotes the legal system's attempt to formalize the inherently unformalizable, which in its commitment to mastery fails to account for the complexity, dynamism, and ambiguity of the nonhuman world (Steinberg 1995). These difficulties do not spell the end of state-directed property regimes, of course. Instead, systems of resource ownership and access are creatively reworked in order to enable the accumulation of capital in the face of nature's ambiguities, a topic critical geographers have explored with aplomb (M. Goldman 2004; Mansfield 2007; Prudham 2007; Robertson 2004). But here, too, state actors are the protagonists of property stories. Whether it is as distant steward of an ownership model-inspired system of private property, as the guarantor of transactions concerning a bundle of rights (Alchian and Demsetz 1973), or as presider over a unitary fund in which all manner of things are subsumed (Verdery 1997), states define property regimes in ways that matter greatly for the lives of all those subject to them.

A strong current of thought in institutional analysis and political ecology argues that this state-centered analysis of formal property is far too narrow, and that many more human–

environment relations should be included under the heading of *property* (Turner 2016). Against the notion that property systems are defined solely by states, for example, analyses of common property resources find property systems wherever communities manage resources, and see in them many functions beyond profit-making (Ostrom 1990; Agrawal 2001; Mansfield 2004a; Blomley 2008a). In this literature, property ventures far from the ownership model, and is often governed by informal institutions in strikingly non-modern settings. Ribot and Peluso argue that even this broader reading of property gives too much weight to arrangements that are "sanctioned in some way by some social institutions" (2003, 157). They suggest replacing *property* with *access*, which they define as "the *ability* to derive benefits from things" rather than "the *right* to benefit from things" (2003, 153; see also Nadasdy 2002). This broader category is shaped not only by institutional characteristics, as in common property analyses, but also by history, leadership, politics, power, and other processes better suited to political ecology's in-depth ethnographic methods (Turner 2006). For all of these scholars, property is worth rescuing from its dominant association with Enlightenment thinking, state-centrism, and the ownership model, but some reorientation of the concept is required to fit it to liberatory political projects (Turner 2016).

Geographer Nicholas Blomley has advanced a different critique of mainstream property work, diagnosing it—and many of the critical approaches noted above—as inappropriately representational. For both supporters and "progressive" critics of the ownership model, according to Blomley, property is understood as a legalistic schematic which corresponds, to greater or lesser extent, with an underlying reality that it seeks to manage (Blomley

2013). Even where property is interpreted more expansively, as in the common property literature and some instances of resource access work, the job of property research is to evaluate the fit between the property institution and the real object to which it refers. Property institutions can suffer from scalar mismatch with the resources they concern, for example (Cumming, Cumming, and Redman 2006), and "uncooperative" (Bakker 2003) or "fugitive" (Giordano 2003) resources may pose intrinsic difficulties to their would-be representers. For Blomley, by contrast, property is best understood not as a set of relations between actors that gets applied to a material world, but as a set of practices, themselves material, which are undertaken by various actors in that same world. In his most recent work, this argument has been framed in the language of performance: property is something that is *done*, and not only by judges and bureaucrats but also by all the other actors whose participation is required if the assemblage that we call property is to be realized (Blomley 2013; see also Lindner 2013). Durable changes to property systems come about not because laws have been better fitted to that which they govern, but instead because actors have managed to collaborate so that certain of their performances can be repeated, allowing their effects to sediment with that repetition over time. Property is something which multiple actors must work hard to stabilize lest it fail to cohere; in this performative idiom, the formal property that occupies Steinberg is not the essence it appears to be but an *effect*, the becoming of which is the proper object of property analysis.

The shift from representational to performative property is a consequential one, and puts Kyzyl Ünkür's circumambulating foresters in quite a different light. In a representational idiom, the trick of properly allocating forest resources to villagers is accomplished by getting the right laws written and navigating, somehow, the difficulties of implementation, a broad category to which all of Kyzyl Ünkür's sweating foresters and villagers would be consigned. In other words, this representational property separates the making of the property system from the underlying reality—forest walnuts, say—that it is designed to govern. Furthermore, those walnuts have no say in this property's execution. Nonhumans can only be represented, passively, and property-making in this approach is an exclusively-human affair, perhaps quintessentially so. In performative property, by contrast, the separation between representer and represented is removed; property happens on site, as it were, and what happens in the mountainous hinterlands of Kyzyl Ünkür is not mere application of ideas that were conceived elsewhere, but is itself a crucial part of property's material production. Patterns of resource distribution emerge through the many sorts of actions that myriad actors undertake together.

As this phrasing suggests, Blomley's reformulation of property as material and performative opens the way to its posthumanization as well. That is, just as Sundberg (2011)'s performative treatment of borders makes nonhumans into actors who matter for border geopolitics (see Chapter 2), Blomley's performative property similarly implies a society of property-makers that can include nonhumans. The notion of posthuman property has a certain oxymoronic tang to it—the whole point of owning something, typically, is to ensure that it serve as the object to the owner's subject, and looking for a thing's agency in its ownedness seems perverse. Tang notwithstanding, however, while representative property is defined by legal pronouncements and those who can produce it include only certain trained humans, the performative reformulation of property makes clear that would-be property-reformers must ally themselves with many other parties in order to find success. Nonhumans can be perfectly effective *doers*, after all, and although Blomley's actors are mostly human, he has also written about nonhumans performing property. A 2007 article, for example, examines the work that hedges did in Britain's first enclosures, finding them to have contributed by their impenetrability and durability to new practices of dispossession and exclusion (Blomley 2007). Similarly, a 2008 piece considers the legal complexities involved in making good, stable property out of unstable riverbanks, and here again the capacity of the river to define the property made around it is given considerable analytical scope (2008b). As a 2013 passage has it, property "is not just made through words…but also through the enrolment and arrangement of locks, 'space,' river mud, paper and so on….A fence performs property when it is hooked up to other entities. Put more generally, property is performed when such entities stabilize and work together" (Blomley 2013, 39).

Understood in this performative way, remaking forest property—as Kyzyl Ünkür's foresters are trying to do—means entering into a material collaboration with trees, fences, mountainsides, handheld GPS devices, villagers, and land registrars. By the end of this coperformance, state foresters hope to have assigned every walnut tree in Kyzyl Ünkür's forested surroundings to precisely one village household, thus clarifying the annual walnut harvest and formalizing the leasehold system that forest decentralization has produced. But this program, which would align governance in Kyzyl Ünkür with State Forest Service efforts elsewhere in the walnut–fruit forest belt, cannot be brought to a successful conclusion by foresters' intentions alone, but is subject to the active participation of many other actors too. Even where trees are incorporated into human economic processes as apparently-passive resources, the nature of these incorporations depends on what tree bodies consent to. In the case of foresters hoping to measure and formalize the boundaries of walnut leaseholds in the hillsides surrounding Kyzyl Ünkür, visible human efforts must fit themselves to the less visible—but by no means less active—performances of trees and other nonhumans, without which no property system can come into being. In this performative idiom, property must be done, and it must be done together.

Post-Soviet Property: Fuzzy Freaky

This understanding of property is an innovation within geography, which had been dominated by representational treatments, but also within post-Soviet scholarship. Contestations over property have been a prominent feature of the post-Soviet transition, and so property has been a prominent category for post-Soviet social science. Anthropologists, especially, have found much to say about the effects of new property institutions in areas recently de-Sovietized (Lampland 2002; Hann and The "Property Relations" Group 2003; Verdery 2003; Verdery and Humphrey 2004; Sartori 2010). Of particular influence in anthropology has been Verdery (1997)'s argument, developed over years of research in post-socialist Romania, that post-Soviet property is notably "fuzzy" (Sturgeon and Sikor 2004; Pedersen and Højer 2008). By this, Verdery means that the property relations that have arisen since the Soviet collapse have been "indistinct, ambiguous, and partial" (1997, 105), especially by comparison with the clarity of the measures that neoliberal property reformers tried to implement. Why didn't post-Soviet reality conform to its reformers' intentions? Verdery highlights the clash of their individualistic property thinking, typically hewing closely to the ownership model, with labor and governance structures that were still strongly collective (Verdery 1997; Trevisani 2007). In recognition of this representational mismatch, Verdery argues that any analysis of post-Soviet property regimes must begin not from individuals but from "the total system of social, cultural, and political relations" and take collective property seriously (Verdery 1997, 103, see also 2003). In Kyrgyzstan, anthropologists have followed Verdery in situating property in just this broad-based way (Spector 2008; Steimann 2011).

But while Verdery's diagnosis of fuzziness has had considerable staying power in property analysis, it leans very heavily on the representationalism that Blomley finds so problematic. There is nothing inherently fuzzy or indistinct about the property relationships into which Verdery's Romanian villagers enter; rather, they *look* fuzzy to outside property analysts bearing particular preconceptions about how things ought to be owned. Thelen has criticized Verdery's property focus for deferring inappropriately to the categories of economics (Thelen 2011), which is silly; property may be used by economists, but property relations really do structure human–environment interaction in the post-Soviet world, as everywhere else. But if it is no problem that property is an etic category, to use the anthropological terminology, still Thelen is right that Verdery's representational property does orient her analysis away from the people she is studying. Verdery is correct to consider "the total system of social, cultural, and political relations" in examining how property is done in the post-Soviet world. But one must note *that* it is done and get as close to that doing as possible, at the same time acknowledging that some of its doing may arise from entities not typically included in the social, cultural, and political. Property is of pressing importance in southern Kyrgyzstan, and its renegotiation in the walnut–fruit forest has consumed a great deal of energy on site, in the forest itself, over the last decade. It is in the actions undertaken there that the fate of Kyrgyzstan's property reforms can best be understood.

Doing Property in Kyzyl Ünkür

Chapter 1 introduced the foresters with whom this chapter began, but their role in property's performances requires further contextualization. While at the national scale foresters belong to the State Forest Service, Kyzyl Ünkür's foresters are also among the few remaining employees of the Kyzyl Ünkür Leskhoz. Despite the silvicultural focus implied by its name[21], the leskhoz was once responsible for far more than forestry alone. Like state farms (*sovkhozes*), collective farms (*kolkhozes*), and the other corporate entities of the Soviet socioeconomic system, the leskhoz was an institution that provided not only jobs but also houses, roads, the hospital and clinic, the social club, the kindergarten and school, and other social and cultural infrastructure for its residents (Humphrey 1998). These things were all owned by the state, but rights to their use were delegated downward, with the leskhoz director determining their distribution within the village of Kyzyl Ünkür (Verdery 2004). This arrangement gave the leskhoz tremendous power within the village, but the end of the Soviet Union transformed this institutional structure (Humphrey 2002; Shigaeva et al. 2007). Working closely with property reformers from abroad, the Kyrgyzstani state has ceded ownership of agricultural fields (Bloch and Rasmussen 1998; Bichsel et al. 2010), reworked its system of pastoral management (Undeland 2005; Kerven et al. 2011), and

[21] As noted in Chapter 1, *leskhoz* means "state forest enterprise," approximately.

privatized residential buildings and land (Deshpande 2006). The 4% of Kyrgyzstan's territory that is forested remains under the aegis of the State Forest Service, however, and in the walnut–fruit forest belt, fourteen leskhozes persist, each including at least one village and managing a tract of nearby forest. A parallel system of local government was erected to complement the leskhozes in 1996 (Giovarelli 1998), so that a mayor now presides over many aspects of village life that once looked to the leskhoz director, but Kyzyl Ünkür's leskhoz director still manages the approximately 50% of leskhoz territory under forest (GOSLESAGENSTVO and LES-IC 1997). With the end of cross-regional subsidies that once funded much state activity in the walnut–fruit forest belt (Carter et al. 2003), however, management of even that slimmed-down portfolio has been challenging (M. Schmidt 2005). As recently as 1997, Kyzyl Ünkür Leskhoz still had one hundred people on its payroll and the foresters were classified as low-level managers (GOSLESAGENSTVO and LES-IC 1997). Now, though, the once-comprehensive institution is reduced to a handful of administrators, a retiree who tends the trees outside the leskhoz office, and sixteen underpaid foresters walking property lines.

The lack of state capacity in Kyzyl Ünkür—which superficially resembles state incapacity across the developing world—is specifically post-Soviet in nature (Stenning and Hörschelmann 2008; Collier 2011). Standards of living, life expectancies, and other measures of well-being are low in rural Central Asia, but they were higher in living memory, a fact that sets the region apart from other areas of similar poverty. According to World Bank data, Kyrgyzstan's GDP per capita, adjusted for purchasing power parity, fell more than 50% in the first years of independence, and fairly steady growth since 1995 had still not brought the 2015 figure back to 1990 levels (World Bank 2016).[22] This trajectory figures prominently in people's understanding of themselves and their place in the world (Humphrey 2002; Hörschelmann and Stenning 2008; Reeves 2012). In Kyrgyzstan, the results have been characterized as "de-development" (Farrington 2005), with special psychological and affective ills blamed on it. In Kyzyl Ünkür, the comedown of de-development is visible in the architectural resources of local government. The mayor, whose position was created post-independence and bears no Soviet legacy, works in a small office in a whitewashed mud-brick building indistinguishable from the others that make up the village center. By illustrative contrast, the Kyzyl Ünkür Leskhoz is housed in a much larger building on the hill above, a decaying facility that suited the subsidized era but is far too big for the current staff, and costs more to maintain than the leskhoz can now afford.

KIRFOR and the Project of Property Reform

It should be clear that walnut–fruit forest leskhozes are in no position to initiate property reform. Rather, the party responsible for that was the Kyrgyz–Swiss Forestry Support Programme (KIRFOR), a joint project of Kyrgyzstan's State Forest Service (SFS) and the Swiss Development Corporation that operated in southern Kyrgyzstan from 1995 until 2012. KIRFOR sponsored walnut–fruit forest research on agroforestry (Messerli 2002), poverty reduction (Fisher et al. 2004), and non-timber forest products (K. Schmidt 2007b), but its primary focus was the practical refashioning of forest policy, of which transforming

[22] The same is true of Tajikistan, but the other countries of post-Soviet Central Asia have seen substantially more economic growth in recent years, albeit concentrated in urban areas.

property relations was a key part.[23] In particular, KIRFOR has focused on overcoming what project officers describe as the harmful legacy of Kyrgyz forestry's Soviet past—overcentralization, sclerotic bureaucracy, general financial irrationality, and an inattention to questions of sustainability (Samyn 2010, 3–4)—and reorienting forest management towards international best practices in sustainable rural development. This program assumed different forms over the years of KIRFOR's involvement, but the project's general intentions regarding property reform were a constant.

In performative property, however, intentions are strictly nondeterminative. KIRFOR consultants played an active part in designing a series of SFS directives to advance their project of reform, but, even situated so close to power, KIRFOR officers quickly discovered that the performances of many other actors would bear directly on the fate of the directives they wrote. According to project documents and interviews, KIRFOR consultants had some manner of collaborative forest management (CFM) in mind, but quickly found that "strong reservations about group or community based work" required an initial commitment to individualization instead (Carter et al. 2003; Fisher et al. 2004). This was, consultants argued, an ironic two-fold legacy of Soviet rule, with, on one hand, villagers resistant to the echo of Soviet governance that collaboration implied and, on the other, state forestry officials unwilling to dismantle the power hierarchy that Soviet governance actually entailed (Kouplevatskaya-Buttoud 2009). If CFM was off the table, full privatization seemed to consultants to be the next-best option. This would incentivize responsible land

[23] Much of KIRFOR's research resembles similar efforts undertaken by German projects funded by GIZ or Volkswagen. According to several KIRFOR employees, it was the focus on "practical" institutional changes like property reform that set their own project apart (pers. comm., 9/16/2011).

management, officers hoped, but here, too, KIRFOR met resistance, this time from national politicians convinced that state security depended on the continued central ownership of as much territory as possible. Stymied again, KIRFOR settled on a leasehold system meant to capture some of privatization's gains without raising nationalist hackles. The resulting compromise became State Forestry Directive #226, which decentralized walnut collection by legalizing the personal leasing of forest tracts. This, then, was a fallback option for KIRFOR's property reformers, but they still described #226 as a slashing blow at the old property regime, claiming it would induce the leskhoz to "change its function from an enterprise to that of a consultancy firm" (Carter 1997, 20). This was supplemented by other initiatives, pursued even after #226 was passed, by which KIRFOR continued to try to get back to the CFM-oriented system that project officers favored. Most notably, KIRFOR advanced Collaborative Forestry Management leaseholds (Rus: *Obshchinnoye vedeniye lesnogo khozyaystva*, *ОВЛХ*)[24] in 2001 and Joint Forest Management (Rus: *Sovmestnyi upravlenie lesami*, *СУЛ*)[25] in the early 2010s, but these failed to draw and keep villager interest. As a result, individual leaseholds very quickly—and, for KIRFOR officials, "premature[ly]" (Fisher et al. 2004, 18)—became the default endpoint of KIRFOR's decentralization program.

While Directive #226 first defined walnut–fruit forest leases, their operation was elaborated in a second directive, #482, which was finalized in October 2007 with

[24] These were defined in 2001 in SFS Directive #377 and issued provisionally in 2002 to a handful of households, each of which would tend nurseries, collect seeds, and pursue other leskhoz-favored projects in return for exclusive access to forest parcels (K. Schmidt 2007a).
[25] At the time of my fieldwork, this term was appearing in SFS documents but village administrators were unable to describe what it would mean in terms of village property.

substantial input from KIRFOR. Households were now authorized to lease up to 5 hectares of walnut–fruit forest for terms of up to 50 years. In exchange, lessees paid an annual fee to the leskhoz and agreed to take good care of the plot, although all this meant in practice was managing to avoid cutting down any living trees. In the process of drawing up the leasehold contract, the leskhoz was responsible for mapping the plot and surveying its trees so that this good stewardship could be policed. Whereas #226 had set aside a quarter of all forested land for continued leskhoz administration—"director's land," as it was called—#482 instructed leskhozes to allocate all forested land to those who wanted it. In August 2011, in fact, the Bazar Korgon county government head visited Kyzyl Ünkür Leskhoz to berate the leskhoz administration—in a public meeting, and with the vocal help of disgruntled would-be lessees—about their slow pace of work, both in formalizing existing leasehold boundaries and in creating new ones out of as-yet-unallocated land. And so, in fall 2011, foresters were hastening to circumambulate all the walnut tracts in the leskhoz, GPSs in hand, so that leaseholds might be suitably mapped and formalized under Directive #482.

Directive #482 seems to approximate the ownership model of property as defined earlier. For all that the state retains formal ownership of forested land, the forest code now gives walnut tract lessees more freedom to govern the nut harvest on their parcels as they wish. Again, though, the fate of #482 diverges from the text of the forest code in several important ways. First, although the text of Directive #482 assigns each parcel to just one lessee, the directive's implementation in the walnut–fruit forest has disaggregated NTFPs from each other and made forest tracts leasable, in effect, by fraction. In Kyzyl Ünkür and

Arslanbob, many forest leaseholds confer use rights for only some NTFPs, allowing multiple leaseholds to be layered atop each other. As a result, many forest tracts have their walnuts harvested by one household and their grass cut for hay by another, with apples in some cases going to a third. Rather than being exclusive owners with unfettered freedom to act, many forest leaseholders are constrained by the need to stay on good terms with others who lease the same parcel.[26]

Second, the text of Directive #482 defines an auction procedure for land allocation, in which land is to be leased to the highest bidder. This is meant to encourage market rationality in forest governance, with land aggregating in the hands of whomever is most likely to maximize the value of the walnuts harvested from it. In discussions and interviews, however, state foresters acknowledged that such auctions are rarely held, precisely because their incentivizing of rational self-interest is socially destructive. One leskhoz's head forester described the rioting (Kyr: *topolong*) that would result from such auctions, were they ever actually held. "It was difficult enough to convince people to pay 1000 som/hectare [for their annual leasehold fees]…But then somebody else could bid 1200s, then another 1500s, and we'd have to give it to the high bid. Chaos!" (pers. comm., 11/30/2011). Instead, order is preserved by minimizing the disruptive power of open competitive auctions. Leasehold competitions favor those already established in a place, with extra points awarded to local residents and outsiders informally discouraged from participation. When provisional leasehold terms expire, they are quietly renewed almost without exception.

[26] Kaspar Schmidt confirms this collocation of leaseholds in Arslanbob (2007a, 207), while Venglovsky et al (2010) assert that walnut–fruit forest management suffers because of it.

The biggest departure from the ownership model of property, however, and the strongest evidence that KIRFOR's intentions and the text of the law are only minor players in Kyzyl Ünkür's emerging property regime, is found in the operation of a special village committee to redress inequities in Kyzyl Ünkür's forest leaseholds. Formed in 2011 as a result of villagers' dissatisfaction with the formal system being put in place, this committee includes four leskhoz foresters and five other community members, and pursues fairness in resource access. For the committee members I spoke to, their job involves finding the best fit between two complex objects: village society and the heterogeneous forest. Difficulties arise from both directions. Households differ, most notably in the number of people they contain, and change in size and capacity over time. People arrive in the village from elsewhere, or get married and start new households, or move from one neighborhood to another, and in each case their dependence on the forest also changes. Forest tracts themselves differ too, and in ways that affect their value to lessees; they vary in temperature, elevation, exposure, topography, fertility, size, accessibility, and tree cover, while resident tree populations feature disparate species and age distributions, health, productivity, and history of grafting and other uses. For the committee members I spoke with, these features made their task of bringing fairness to the walnut–fruit forest property regime more complicated, but did not make it impossible.

If it seems unavoidable that some leaseholds be more valuable than others, committee members felt that such differences should be minimized, and *could* be minimized far better than existing leaseholds had done. The current system was, in their description, riven with inequality, and the list of village households without any forest access was their favored benchmark for its failure. Notably, KIRFOR's work of the previous decade had had different priorities; arguably, its reliance on quasi-market mechanisms to get forest tracts in the hands of those best able to use them pushed allocation directly *away* from the equality that the committee preferred.[27] Other sources of inequality were more obviously nefarious: the first round of formal allocation in Kyzyl Ünkür had been beset by allegations of cronyism and corruption (Kyr: *taanysh–bilish*), and the SFS had to dissolve a previous land committee—and dismiss a previous leskhoz director—when too many foresters seemed to be ending up with prime allotments. Observing the property landscape of Kyzyl Ünkür, committee members hoped to redraw property boundaries in the leskhoz against this cronyism and the broader inequality it reflected.

Having set themselves this sizable task, the committee chose to define their equalizing of leaseholds using a comparatively simple metric: the areal extent of walnut-bearing forest. In selecting this focus, the committee opted to treat all walnut trees as equivalent and to ignore other trees entirely. In early conversations among committee members, walnut-bearing forest was to be equalized in terms of area per capita, first at 1 ha, and then, when it became clear that the forest would otherwise run out, at 0.8 ha. Even this proved too complex, however, and the committee shifted to a household measure.[28] By late 2011, its goal was to ensure that each household in the village, of whatever size, had a walnut-

[27] A late KIRFOR document notes the exclusion of the poorest people from the property regime that KIRFOR had helped install, with apparent surprise (Carter et al. 2010). This surprise is unwarranted.
[28] The Kyrgyz household (Kyr: *tütün*, literally *chimney*) as invoked here typically consists of a married couple and whoever else typically dines with them (a synonym is *bir kazan*, or *one cookpot*). This can include their children, the elderly parents of the husband, and other relatives, all of whom usually share several residential buildings around a shared courtyard, but there is substantial flexibility in living arrangements. This can make official household surveys problematic (Kandiyoti 1999).

bearing leasehold up to, but not exceeding, 5 ha. For those on the landless list—a number that fluctuated as new petitioners appeared and old ones acquired leases, but which sat around 150 households when the committee began its work—land would have to be found. Two sources within the leskhoz boundaries were forthcoming: first, the "director's land" that Directive #226 had set aside for leskhoz administration, and second, any forest that could be wrested away from villagers who were in violation of Directive #482, either because they had not paid their leasehold fees or because their walnut pastures encompassed more than 5 ha.

These two sources of spare land imply two different procedures, and the committee pursued both of them. First, as in this chapter's opening vignette, they sent out foresters to circumnavigate all existing parcels. This not only allowed the leskhoz to include maps on the contracts being formalized for all leaseholders, it also revealed leaseholds large enough to be split up and reapportioned to those currently without. In our boundary walks together, foresters reminded villagers about the #482 provision that a household can lease *up to* 5 ha; those below that mark would keep their current leaseholds, while those above it would have some appendage of their walnut pasture stripped away for reassignment. Second, foresters also conducted excursions into the director's land and other unallocated areas, escorting leaseless petitioners to potential pastures for their approval. I went along on one of these outings, and with a dozen locals from the top of the committee's leaseless list spent two days climbing up and down the mountains, on foot and horseback, in a remote spot called Ydyk. By the end of the outing, thirteen households had been allocated walnut leaseholds, and another few dozen hectares of walnut trees had been assigned exclusive harvesters. At the conclusion of my fieldwork, the committee was continuing to work its way through the landless list, helping ensure that Kyzyl Ünkür's eventual compliance with Directive #482 leaves villagers with as even access to resources as possible.

Nonhuman Contributions to Property-Making

There are lots of reasons that political reforms can fail, many of which have been put on vivid display in the course of post-Soviet transitions. As such, it is not inherently interesting that the lived property regime of the walnut–fruit forest diverges from both the initial intentions of KIRFOR's officers and from the text of Directive #482. Development is hard, forest governance is hard, and Kyzyl Ünkür is far away from Bishkek, so why shouldn't property reformers struggle or fail? But to understand the complicated fates of KIRFOR's reforms as simply failures of implementation is to misconstrue what happens in property's making, and to miss, in particular, the contributions of many of the actors who played important parts in it.

To repeat a passage quoted above, property "is not just made through words, such as Lockean pronouncements, but also through the enrolment and arrangement of locks, 'space,' river mud, paper and so on" (Blomley 2013, 39). The construction of Kyzyl Ünkür's property regime takes place not in Bishkek, where #226 and #482 were ratified, nor wherever KIRFOR's officers were posted when they chose leaseholds over the alternatives, nor yet in a placeless clash of ideas where privatization goes up against socialism, but in Kyzyl Ünkür and the surrounding forest, on land inhabited not by lawyers and legislators but by Kyrgyz and Uzbek villagers and graftable and ungraftable trees. The succession of legal doctrines and directives that makes up most property histories needs to be supplemented, in other words, with circumambulating foresters and tree behavior. Property in Kyzyl Ünkür is enacted in Kyzyl Ünkür, by the many actors that make up what, in this context, might be called not a walnut–fruit forest but a walnut–fruit–farmer–sheep–horse–forester–grass–bee–mountain–… forest. From among that many-headed collective, I focus on the property-making activities of two additional actors: walnut trees and handheld GPS devices. These each play vital parts in the hashing out of Kyzyl Ünkür's property reforms, and stand in here for the sorts of contributions, in unexpected places and from unexpected sources, that performative property can bring into sharper focus.

Walnut Trees

Walnuts are the explicit focus of most of the attention that Kyzyl Ünkür's human residents put towards their property institutions, but linking trees with owners is not easy to do fairly, thanks in part to particulars of walnut behavior. For instance, given that walnut trees differ in their productivity (mostly by age, with older trees producing more, but health and other factors can also make a difference), simply allotting each household the same number of trees seems unlikely to equalize the harvest. Walnuts also grow unevenly on the landscape, favoring certain types of soil, exposure, altitude, and drainage, so assigning each household the same area of walnut forest may fare no better. Still, given the difficulty of taking further complexities into account, leskhozes across the walnut–fruit forest belt have chosen one or the other of these methods, despite their shortcomings. So in Kaba Leskhoz, immediately downhill from Arslanbob, each person was issued 25 individual walnut trees, according to one village resident I spoke with (pers. comm., 8/4/2011), while in the higher-up leskhozes of Arslanbob and Kyzyl Ünkür, households were assigned leases by area. Even where leases have been assigned by area, though, lessees are acutely aware of the individual trees that they harvest. Land disputes between neighboring leases can come down to whether a tree of interest is located on one side of the property line or the other. I saw one woman tell the presiding forester that she and her family had been harvesting four particular disputed trees since first receiving the leasehold in 2004, an appeal dependent on her history with the trees in question.

Handheld GPS Devices

It used to be that areal extent was computed in the walnut–fruit forest using a compass-like device called a *sarjyn* in Kyrgyz, which was pivoted repeatedly along the edges of a plot to measure their length. Now, however, foresters carry handheld GPS devices that calculate area automatically. This is not, perhaps, the most precise calculation. Some ambiguities come from the impossibility of walking the exact boundary line, but to this the machine adds its own uncertainty. At their best, with a good satellite link, the foresters' GPS units have a listed precision of ±5m, with potential errors compounded in the unit's opaque area calculations. But once the GPS produces a single number the stacked imprecisions vanish. 2.2ha, 3.68ha, 4.99ha: people who can't tell a handheld GPS unit from a walkie-talkie take the output as the truth, and, as the forester writes it immediately into their new registration documents, it assumes very truthlike status. I note, at one point, that one of the GPS units has no Russian-language option, and worry that it might therefore be difficult for foresters and villagers to understand, but one forester tells me "It could be in Chinese for all we care, just so long as it gives us the exact number of hectares!" (pers. comm., 10/3/2011). After a few days each walk is uploaded to the virus-ridden computer in the *leskhoz* office, where one forester who knows a modicum of GIS will convert the waypoints of his colleague's walk into a polygon that will stand in for the walnut leasehold's extent going forward and allow the *leskhoz* to claim that they've moved another step closer to compliance with the Directive #482.

Conclusion

From a representational standpoint, it would not be a mistake to call KIRFOR's experience with property reform in Kyzyl Ünkür an example of fuzziness. Even though they seemed on board with the collective institutions that Verdery scolds other property reformers for ignoring, KIRFOR's experience seems to consist of a series of setbacks. From their initial hopes for a new collaborative property regime, KIRFOR officials moved to a privatization scheme before compromising on a system of household leases. As directives like #226 and #482 have been implemented, however, and as foresters and villagers and trees have reworked their interrelationships in light of their provisions, the property practices shaping human–environment relations have been tugged ever further away from that framework as well. Recent renegotiations, while maintaining much of what #482 prescribes, abide by a moral economy that resembles neither the ownership model nor the CFM initially envisioned by KIRFOR.

As long as our account of property-making recognizes the full constellation of participants, the fact that trees stand still need not render them passive or peripheral. In his history of

Mexican forestry, Mathews observes that “Pine forests…are socionatural actors with particular kinds of livelinesses and resistances; they come into history in ways that affect what kinds of natures and cultures they are woven into” (2011, 90). The same is true of Kyrgyzstani walnut–fruit forests, which are active contributors to determining what property systems are ultimately woven around them. In their fruiting behaviors, their distributions, and their habits over time, the trees of the walnut–fruit forest hook up in their various ways with other entities, in turn affecting the form and function of forest-associated assemblages that can be maintained.

In June 2011, I sat in on one of the Monday staff meetings at which the foresters of Kyzyl Ünkür Leskhoz discuss the work of the previous week and the tasks of the week ahead. At the time, property renegotiations were concentrated on herding leaseholds on the high pastures above the forest, where foresters were busy implementing new herding fees and regulations. Unsurprisingly, not every herding family was aware of the changes, or interested in conforming to them, and the foresters were finding it difficult to enforce them on people who, in many cases, were their own relatives. In an attempt to inspire his reluctant foresters, the leskhoz director noted, (and I’m paraphrasing here, not having been permitted a recording device), “The facts of the pasture law are being established now, in the early days of the program.” In other words, foresters should enforce the letter of the new pasture code not only because its innovations represented sensible change, or because that enforcement was part of their jobs as foresters, but also because doing so would in fact help make the law real. It is in concrete encounters between forester and herder, but also between foot and slope, forester and tree, harvester and handheld GPS unit, that property is performed into being.

Chapter 4 – Political Ecology and the Geography of Science: *Lesosady*, Lysenkoism, and Soviet Science in Kyrgyzstan's Walnut-Fruit Forest

The walnut–fruit forest of southern Kyrgyzstan, at more than 200,000 hectares the world's largest of its type, features wild-growing populations of walnut, apple, pear, plum, apricot, pistachio, and almond. In this chapter, I explore the geographic implications of field-based scientific knowledge production by examining the construction in this forest of *lesosady* (sg. *lesosad*), or forest–orchards.[29] A *lesosad* is a plot where forest trees have been modified where they stand, using horticultural techniques to raise their yield, improve fruit quality, and otherwise make them resemble orchard trees. To many biologists and foresters in mid-twentieth-century Soviet Kirgizia, lesosady represented a productive compromise between anthropogenic orchards and wild forests, an intermediate land use that might combine the best features of both. As one group of scientists wrote, "Lesosady must fulfill the inherent functions of forests: protecting topsoil from erosion . . . regulating the regime of mountain rivers, moderating the climate, and so forth. At the same time, for obtaining high-quality fruit production and high and sustainable harvests, it is necessary to implement a system of intensive horticultural methods for the care of fruit trees" (Jerdev et al. 1967, 19). By modifying forests rather than leaving them inviolate or replacing them entirely, the promoters of lesosady would optimize the walnut–fruit forests of southern Kirgizia.

The state program of lesosad construction resembles other modernist projects that used science to rationalize forested landscapes (Langston 1995; Scott 1998; Rajan 2006; Vandergeest and Peluso 2006; Mathews 2011), but this was a specifically Soviet scientific

[29] The Russian word *lesosad* is a concatenation of the words for forest (*les*) and garden or orchard (*sad*).

state forestry. Foresters were drawn to lesosady in part by the work of Soviet horticulturist Trofim Lysenko (1898–1976), whose non-genetic theory of heredity sparked fierce controversy beginning in the 1930s (DeJong-Lambert 2012). Lysenkoist foresters took the walnut–fruit forest to be an ideal terrain for establishing the validity of Lysenkoist theory, particularly through the construction of lesosady (see Figure 10). They modified thousands of trees in hopes of advancing heredity science, with consequences for how people and forests interact in post-Soviet Central Asia today. Using the lesosad program and the distinctive geography of the science that justified it, I argue that concepts from the subfield of the geography of science are useful for political ecologists "building bridges" toward science studies (Lave 2012).

Figure 10: Modifying an adult tree by grafting, a technique central to lesosad construction. Photo by S. Momot (reproduced in Prutensky 1962).

My central claim is that scientists doing science transform the sites in which they work, that political ecologists have neglected field-based examples of this process, and that the geography of science can help remedy this neglect. Some sciences, particularly those produced in the field, modify landscapes in pursuit of scientific ends, simultaneously refashioning the relationships of resource access, environmental identity, and people–environment encounter that political ecologists study. But political ecologists tend to describe a science that is produced in labs, offices, workshops, anywhere but the field sites they know best. There are exceptions within political ecology's famous diversity, but work on the walnut–fruit forest exemplifies the literature in general: it depicts how scientific frameworks like equilibrium ecology and systems biology have been *applied* in the forest (M. Schmidt 2008; M. Schmidt and Doerre 2011). As I show, however, human–environment relations here reflect the forest's past as a place of science's *production* too. Political ecologists have adopted various analytical frameworks to encompass the production and circulation of environmental knowledge, including Latourian hybridity (Zimmerer 2000; Robbins 2001a), Luhmannian forums of articulation (Robertson 2006), boundary objects (M. J. Goldman 2009), and Bourdieuian field theory (Lave 2012). Using conceptual resources developed in science studies, political ecologists have labored to theorize the work of science while accounting for the power and politics that saturate it (Castree 2002; Forsyth 2003; Perkins 2007; Birkenholtz 2008; Holifield 2009; M. J. Goldman, Nadasdy, and Turner 2011).[30]

[30] This largely-American conversation should be distinguished from the largely-British one around posthumanism within the new relational geography, which has also theorized science but less for political ecology than for biogeography (J. Lorimer 2008), conservation (Hinchliffe 2008), or cultural geography (Whatmore 2006). That community has occasionally engaged the geography of science (e.g. Greenhough 2012a), though its Deleuzian commitments contrast with the narrative approach that geographers of science favor.

I offer another approach to the political ecology of scientific knowledge production, one inflected through a literature calling itself the geography of science. Inspired more by Shapin and Gieryn than Latour, and in close conversation with historians of science, geographers of science describe how place and scientific practice inform each other (Livingstone 2003; Naylor 2005; Powell 2007a). The geography of science demonstrates that stories about where concrete, particular, specific scientific practices happen can illuminate the sources of science's authority (Thrift, Driver, and Livingstone 1995; Driver 2000; Powell 2007b; Naylor 2010). The field sites of political ecologists are places where field sciences—ecology, geology, forestry, hydrology, geography—get done, but the messy practices of these forms of knowledge production rarely appear in political ecologists' accounts. By examining the field as a place of scientific practice, I enrich our understanding of how science transforms the world in which it works, and contribute to work at the intersection of science studies and political ecology.

The transformative nature of science is made particularly visible by the case I present: a field-based heredity science, built on Lysenko's articulation of a "proletarian science" not isolated in laboratories but immersed in the people's affairs.[31] Ultimately, Lysenko's vision was not realized. Lesosad construction proved difficult and failed to support Lysenkoist models of heredity, and no proletarian science along Lysenkoist lines emerged. Lysenko himself is remembered as a creature of politicized science or pseudoscience, a "militant

[31] It is beyond the scope of this chapter to explore how this proletarian science foreshadows later calls for participation in science, or how the Soviet philosophy of science out of which it emerged (e.g. Bukharin 1931) informed later movements toward radical science and political ecology. Both topics merit further research.

ignoramus" whose brief prominence reflected his opportunism and the scientific meddling of Soviet bosses desperate to boost crop yields (Joravsky 1986, 200; see also Medvedev 1969; Graham 1972; Soyfer 1994).[32] But the forest's deployment in scientific debates has had lasting material consequences. Horticultural techniques applied in lesosad construction have entered popular use, and forest trees bear the marks of their Lysenkoist past, with effects on local livelihoods that depend on their fruit. The period of lesosad construction cannot be dismissed as pseudoscientific misadventure; rather, its distinctiveness shows the benefits of examining the material work of field scientists pursuing particular scientific ends.

After reviewing what the geography of science offers political ecology, I turn to the lesosad. Using Russian-language documents published in Moscow and Frunze (now Bishkek), I recount the initial insertion of the lesosad into Kirgizian forest policy by Lysenkoist researchers after World War II. I explore Lysenkoism itself, both its scientific claims that attracted adherents in Soviet Kirgizia and its specific effects in the walnut–fruit forest. I then describe the fall of the lesosad in the 1950s and its peripheral role in later forest management, before returning to the significance of the field-based geography of Lysenkoist heredity science.

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[32] Marxist interpreters have taken Lysenkoism more seriously, though this initially meant rehabilitating its Stalinist heritage rather than reevaluating its scientific claims (Lewontin and Levins 1976; Lecourt 1977). It is only with Roll-Hansen's work on Lysenkoism and Soviet science policy that Lysenkoism has reemerged as a science, politicized but not thereby reduced to pseudoscience or non-science (Roll-Hansen 2005; see also Brain 2011; DeJong-Lambert 2012).

The Political Ecology of Scientific Knowledge Production

"A generation ago scientific ideas floated free in the air, as historians gazed up at them in wonder and admiration." So begins the introduction to a 1991 themed issue of *Science in Context* on the place of knowledge (Ophir and Shapin 1991, 3). In Ophir and Shapin's estimation, science studies changed all that, establishing that knowledge, scientific or otherwise, "possesses its shape, meaning, reference, and domain of application by virtue of the physical, social, and cultural circumstances in which it is made, and in which it is used" (1991, 4). Science studies rejected the distinction between universal knowledge, which transcends its place and time of discovery in becoming "truth," and mere "custom," which betrays its local origin. Much work has followed in which science is anything but free-floating—disunited, local, multiple, patchwork, and embedded in contexts (Pickering 1992; Shapin 1995; Galison and Stump 1996).

Geographers of science elaborate the geographical implications of contextualizing science. To call science local is not merely to assign it a location, they note, but to open it to all the geographical approaches to place, making visible the conjunctural dynamics that comprise "the routines behind the science" (H. Lorimer and Spedding 2005, 33). Livingstone's *Putting Science in its Place: Geographies of Scientific Knowledge* (2003) demonstrates this program's utility through an exploration of science's sites, regions, and circulation (Naylor 2005 and Finnegan 2008 offer similar typologies). By assembling accounts of scientific work that dramatize, respectively, the arenas in which it is done, its broader setting in space and time, and its life as products and processes that travel the world, Livingstone depicts a science marked by the signatures of its place. In geographies of science, practicing scientists are actors in geographical contexts, necessitating attention to the places they do science and the ways they do it.

Science studies has focused on science in laboratories (Sismondo 2010), but geographers of science engage more with scholars who study science elsewhere. Of particular utility have been Gieryn's work on "truth-spots," places that lend credibility to scientific claims (2002), and Kohler's cataloguing of traffic across the "lab-field border" (2002a). Using such resources, geographers of science have argued that the field should not be reduced to what the "cartographic eye" makes of the world (Driver 2000), nor understood as a recreation of the laboratory, as Latour has done (1983, 1999, 24–79). Instead, field and fieldwork are constructed through embodied practices (Driver 2000; H. Lorimer 2003; H. Lorimer and Spedding 2005; Powell 2007b; Naylor 2010), which can have far-reaching political ecological effects. Given the similar emphasis on the field in political ecology (Robbins 2004), it is geographies of field science, like the case I describe, that can best augment political ecology's toolkit.

Political ecologists have worked to theorize science, but links to the geography of science remain underdeveloped. An important edited volume—Goldman, Nadasdy, and Turner's *Knowing Nature: Conversations at the Intersection of Political Ecology and Science Studies* (2011)—describes two "impulses" shaping political ecology's recent treatment of science: critical engagement with multiple knowledge claims, and increased interest in not only the application but also the production and circulation of environmental knowledge (M. J. Goldman and Turner 2011, 10). The volume's further recommendations, however, underwrite a science that is insufficiently emplaced to live up to the promise of these impulses. Multiple knowledges can be interrogated by juxtaposing "local people, resource managers, and government officials" (M. J. Goldman and Turner 2011, 16) with a science that often remains resolutely singular and nonlocal (see also the environmental narratives literature, e.g. Bassett and Zuéli 2000). Furthermore, with rare exceptions (e.g. Duvall 2011), attending to the production and circulation of knowledge claims seems to mean leaving the field for where, it is implied, real science is made. In a review of the volume, Robbins articulates this implication: "Here is an opportunity to work through and demonstrate the material politics of actual sites of knowledge production—labs, workshops, or offices" (2012, 885). The field is also a site of knowledge production, and the production of the field sciences shapes its material politics. Geographers of science are not mentioned in *Knowing Nature*, but their attention to the places of scientific production and circulation can help the volume's authors bring political ecology and science studies together.

The problem is a general one: political ecologists too often depict a science that is brought to the field finished and ready for application, rather than constructed there for use in live scientific debates. This science appears distinct from the world it engages, frequently as part of a modernizing project that includes state territorialization, legibilization, and purification (Latour 1993; Scott 1998; Whatmore 2002). These portrayals are not inherently problematic. Science *is* often important in its application, scientific debates are *not* always in progress everywhere, and scientists' self-image as exponents of a unified tradition isn't always mistaken. Political ecologists have built well on the foundation of such accounts of science, be it Forsyth on the misapplication of the Universal Soil Loss Equation (1996), Agrawal on global science as it confronts indigenous knowledge (1995), or Robbins on that same global science hybridizing with other ways of knowing (2003a). In colonial and post-colonial settings especially, the imposition of scientific knowledge claims onto landscapes and people has been well treated by political ecologists (Fairhead and Leach 1996; Cline-Cole 1998). But describing only a singular science imported from outside the study's bounds—free-floating with respect to the analysis—diminishes our conception of the field sciences, shrouds their production in obscurity, and undersells the role of their geography in political ecology.

In short, despite two decades of calls to situate science (Haraway 1991b; Forsyth 2011), we still have few accounts in political ecology of how science done in a place both reflects its materiality and transforms it.[33] Notwithstanding the consensus that political ecologists can learn from science studies, traffic with that literature has flowed largely through Latourian channels. But Latour's lab-centeredness has left political ecologists ill-equipped to see science's production where it affects the rural places and marginal land managers they have classically portrayed. Political ecology's use of actor-network theory has been much debated (Castree 2002; Gareau 2005; Bakker and Bridge 2006; Perkins 2007; Holifield 2009), but less attention has gone to the narrative techniques of the geography of science, which better capture the complexities and consequences of science done outside the lab. Even as political ecology has embraced that complexity, it has depicted science with "generalized discussions of knowledge systems" rather than "detailed contextualization of

[33] I thank Bruce Braun and three anonymous reviewers for helping me clarify this point.

specific knowledge claims from different actors" (M. J. Goldman 2007, 308). As this case demonstrates, the geography of science reveals science as multiple, concrete, and happening in place, with consequences for the place, the science, and the political ecologist who represents them both.

The Southern Kirgizia Expedition and the Horticultural Forest

Russian scientists began researching the walnut–fruit forest by the late nineteenth century (Ashimov 2004), but it was not until the 1944–1946 Southern Kirgizia Expedition that discussions of systematic forest modification gained prominence. Even as the Soviet Union sent the men of Kirgizia off to war, it sponsored an expedition to the walnut–fruit forest, "in order to answer questions of its future preservation and restoration . . . [and of] raising its productivity and rationally using its resources" (Sukachev and Lupinovich 1949, 4). For three years, thirty-nine scientists and sixty-two other workers investigated questions in fruit tree biology, entomology, climatology, soil chemistry, and forest resource use.

In Southern Kirgizia Expedition publications, scientists describe a forest that yields far less fruit than it might, and recommend policies to remedy this shortfall. Of most concern were forest walnuts. Kyrgyzstan's walnut, *Juglans regia*, is the walnut of commerce, and expedition scientists noted that forest trees gave yields of only a few percent of their orchard counterparts (Lupinovich 1949). Expedition vice-director Sokolov lists thirteen factors hurting forest walnut yields, including insect pests, fungal heartrots, overmaturity of trees, and killing spring frosts (1949, 180–182). Forest apples, plums, pears, almonds, and pistachios, each closely related to a commercial crop, also interested expedition scientists. Seeking to raise production of all these fruits, they offered a set of "forest-improvement, agrotechnical, and organizational-productive methods" in support of "a scientifically-grounded, rational organization of the territory of fruit-forest production" (Sukachev and Lupinovich 1949, 4). Through state-led forest restoration (*vosstanovlenie*) and, in particular, the transformation of forest tracts into lesosady, thousands of hectares of forested land would become a key driver of Soviet Central Asian progress.

Chief among the recommended methods for improving forest fruit yields were forms of vegetative propagation, that is, propagation using plant parts other than seeds. Unlike grains and pulses, most useful fruit tree species, including those of the walnut–fruit forest, are highly heterozygous and do not breed true if allowed to reproduce sexually. The apples of a tree grown from the seed of a Red Delicious, for example, will differ dramatically from that parent fruit, generally in ways that make them commercially worthless. Only through cloning—replacing the plant's sexual reproduction with asexual propagation—can horticulturists maintain fruit quality in these species. Horticulturists have developed an assortment of vegetative techniques to enable clonal propagation, including coppicing, suckering, working with cuttings and offshoots, layering, and grafting (Garner 2013). These are tools by which plant bodies are manipulated; their full application yielded the lesosad, a thoroughly reworked forest–orchard uniting twentieth-century technocratic modernism and much older horticultural imperatives. The lesosad is distinctive, then, not for its reliance on techniques of vegetative propagation, which are ubiquitous in fruit tree horticulture, but for the systematic use of these techniques on forest trees.

It was not only the promise of heightened production through horticulture that drew Soviet scientists and foresters to vegetative propagation in the forest. Before I expand on the expedition's recommendations and their implementation, it is necessary to detour through the ideological landscape of contemporaneous Soviet biology. Several expedition scientists understood the forest as ideally suited for demonstrating the truth of what they called Lysenko–Michurinist theory, a scientific project that drove their interventions in the forested landscape.

Lysenko–Michurinism and Better Living Through Vegetative Hybridization

Lysenko was an agronomist whose claims about agriculture and heredity were heralded by Stalin as the basis of a new Soviet biology. With an eye for gaps in mainstream genetic theory and an eagerness to integrate science and socialist politics, Lysenko shot from a lowly post at an Azerbaijani agricultural experimental station to directorship of Moscow's Institute of Genetics. Hailed as a national hero within the Soviet Union and rejected elsewhere, Lysenko and the surrounding controversy remain staples of the history and philosophy of science literatures (Roll-Hansen 2005; DeJong-Lambert 2012).

Over the 1930s and 1940s, building on his early work on transforming winter grains into spring ones ("vernalization"), Lysenko developed a theory of heredity that rejected the existence of genes. After the 1900 rediscovery of Mendel's laws of inheritance, mainstream heredity science increasingly credited biological variation to stable genetic factors located on chromosomes. Bodies were recast as effects of the genes within them, which reshuffled and occasionally mutated but otherwise did not change (Jablonka and Lamb 2005). For

Lysenko, on the other hand, heredity did not inhere only in the chromosome but was distributed, present in "any granule, any droplet of the living body" (1953, 63).[34] Lysenko found Mendelian genetic factors ill-defined, their materiality as yet unproven by Watson and Crick, and genes' apparent isolation inside chromosomes seemed incompatible with the dynamism of dialectical materialism (Lysenko 1953). Instead of issuing from its chromosomes, an organism's hereditary essence arises, he argued, from its interaction with the environment, and changes when subjected to an environment to which it is ill-suited. Heritable characteristics are especially flexible at certain stages of the organism's development, when the breeder can more easily "coerce" it into choosing to grow as it would otherwise not (Lysenko 1953, 71–2). By modifying the target organism's environment and activating the organism's "elective capacity" to become something new, human intervention can have great lasting effect.

For Lysenko, one of the best ways to induce directed change in organisms, and thus one of the strongest lines of evidence for his theory and against genetics, was asexual propagation of plants. In this he followed Russian fruit breeder Ivan Michurin, even calling his theory of heredity "Michurinism." Lysenko hailed Michurin as "the great transformer of nature" (Lysenko 1949, 27), whose feats of plant breeding proved the plasticity of living organisms in the hands of the ideologically informed Soviet citizen. Michurin advanced a "theory of mentors," which held that grafting is not merely the mechanical affixing of pieces of two

[34] Lysenko's position parallels recent findings in epigenetics that body–environment interactions can have hereditary effects (Guthman and Mansfield 2013). In fact, the strict geneticism that Lysenko opposed, and which reached its height in mid-twentieth century molecular biology's "central dogma," little resembles today's molecular biology, with its armies of interacting genetic and non-genetic factors. But though epigenetics has complicated the modern synthesis and allowed Lamarck's reappraisal (Jablonka and Lamb 1995; Koonin and Wolf 2009), Lysenko's claims for the inheritance of acquired characteristics go far beyond Lamarck's, and find no support in the carefully delimited claims of epigenetics.

plants, but can transfer traits from one (the "mentor") to the other and create intermediate forms (Lysenko 1953). Lysenko believed Michurin's work on mentors, which he called "vegetative hybridization," to be inexplicable by mainstream genetics, and argued that "vegetative hybrids provide cogent proof of the correctness of our conception of heredity" (1953, 65). Indeed, well after the mainstream of heredity science had rejected most of Lysenkoism, the biology of vegetative propagation remained an open question (Hudson and Richens 1946). Lysenko set several of his closest associates to work on the topic (e.g. Glushchenko 1948), in hopes of definitively disproving Mendelian genetics.

Lysenko read great political and philosophical importance into his theory of heredity and what it said about vegetative propagation. If the world is to be changeable through human agency, he argued, if we are not to be automata at the mercy of our genes, then the heredity of organisms *must* be modifiable through techniques like vegetative hybridization. Better still, the common man can engage in meaningful heredity work. Whereas advances in Mendelianism required ever more capital in the form of laboratories and long-running cross-breeding experiments with isolated lines (Kloppenburg 2004), any gardener can follow Michurin's lead. Rather than confining an organism's essence to its chromosomes—invisible particles accessible only to the powerful—Lysenko argued that distributed heredity could be explored using relatively commonplace techniques. While his position became increasingly muddled as the materiality of genes emerged, Lysenko and his supporters saw genetics as inherently hitched to the imperial designs of the capitalist west. Their own project, by contrast, would raise yields with a science by and for the proletariat.

The result was towering enthusiasm for the creative efforts of plant breeders and hybridizers. Lysenko outlined how skilled plant breeders can bring useful new varieties into existence, and in a Soviet Union wracked by famine, road maps for progress through backyard ingenuity had clear appeal (Lewontin and Levins 1976). Just as the Soviet state called for "socialist construction" in refashioning society, so calls went out for the "'socialist reconstruction' of plant physiology" (Roll-Hansen 2005, 133). Just as Stakhanovites forged ahead through feats of industrial willpower, so Lysenko's horticulturists were dubbed "agricultural Stakhanovites" (Young 1978). The "rejection of biologistic fatalism" (Young 1978; see also Weiner 1988) so important to Stalinist societal transformation must be achieved by agronomists, Lysenko proclaimed, in part by wresting the power of reproduction from the seed and unleashing it too in the cutting, the sucker, and the branch.

Kirgizian Lysenkoism: Zarubin and the Three-Canopy Ideal

In Kirgizia, Lysenkoists, led by A. F. Zarubin, found a forest on which to deploy these ideas. Zarubin was a Southern Kirgizia Expedition forestry specialist and director of the Kirgizia Scientific Research Station of the Forestry Institute of the National Academy of Sciences. Inspired by Michurin's horticultural use of wild fruit species (Vasil'chenko 1955), Zarubin and other expedition scientists argued that modifying forest trees would both increase fruit production and provide support for Lysenko's theory of heredity. It was primarily Zarubin who wrote the recipe for the lesosad, combining several horticultural techniques of asexual propagation into a package he called "coppicing regeneration" (*poroslevoe vozobnovlenie*), a program of forest improvement to be enacted by state forest enterprises and the residents of forest villages.

At its simplest, Zarubin's lesosad featured a three-layered canopy consisting of high-bearing walnut trees on top, wild apples grafted with cultivated varieties in the middle, and elite sorts of the Sogdian plum beneath (Zarubin 1948; Sokolov 1949). This was an ideal, only possible where fruit cultivation worked best; on slopes steeper than 20° timber production was recommended instead, while higher reaches with southern exposure were unsuitable for walnuts. Even so, the expedition predicted that building lesosady would bring large improvements in fruit production in the forest belt: from 2400 tons of walnuts in a good year to 5000 in an average one, from 800 tons of wild apples suitable only for drying to 7000 tons of marketable domestic varieties, and from 100 to 3000 tons of plums (Lupinovich 1949).

Even the ideal lesosad produced less fruit than an orchard built from scratch, but lesosad-construction had other advantages over full-scale forest replacement. Keeping existing trees on the land would preserve forest topsoil and provide air and water protection (Klimenko 1968). Lesosady thus addressed the concerns of Stalinist environmentalism, which prioritized not conservation or preservation but hydrological integrity (Brain 2011). The lesosad, built on mature root systems, would also reach fruit-bearing age faster than an orchard planted at the same time (Zarubin 1950). To reap these benefits even as the forest's yield was increased, Zarubin advocated selective logging and targeted planting to optimize the mix of species and ensure that all individual trees were productive. The core of coppicing regeneration, however, was three techniques of asexual propagation: grafting, coppicing, and layering (Zarubin 1948, 1950, 1954). These anchored the expedition's prescription for the walnut–fruit forest, reflecting Lysenko–Michurinism's position that plant essences are best manipulated with vegetative methods.

Grafting involves implanting a scion of the desired fruit variety into rootstock of a different variety, using the roots and trunk of the rootstock for nutrient uptake and physical support for the scion's fruit. Apples, pears, and plums are all easily grafted, and amateur orchardists often achieve success rates topping 90%. Many cultivated varieties can succeed when grafted to wild rootstocks, and their fruits far outstrip their wild counterparts in taste, size, storability, and transportability (Fedorov and Fedorov 1949; Prutensky 1962). Grafting walnuts is much more difficult, thanks to their slow callus formation and plentiful sap (Zarubin 1954; Lewis and Alexander 2010), but the potential payoff in the forest was enormous, as walnuts fetched higher prices and mattered more in local livelihoods than other fruit. Whereas wild apples and plums would be grafted with cultivated varieties brought from afar, foresters grafting walnuts would also select for useful traits from within the local population (Zarubin 1948). Of most appeal were late-blooming individuals, the flowers of which more often avoid spring frost damage. While acknowledging the botanical difficulties involved, Zarubin had high hopes for new methods of grafting walnuts, and anticipated the creation of novel sorts as mentor theory suggests: "We are engaged in the raising of young hybrids using Michurin's methods, and coming years will show the suitability of new varieties for our economy" (1948, 92).

Grafting allowed the ennoblement (*oblagorazhivanie*) of a variety of walnut–fruit forest trees, but Zarubin's coppicing regeneration also called for coppicing and layering, vegetative techniques to be used primarily on walnuts. Coppicing is the regrowth of young shoots from the stumps of felled trees, while layering brings an aboveground stem into contact with the ground and induces it to put down roots. Walnuts coppice well, with even tired old trees sending up vigorous crops of shoots once they are chopped down. The expedition's vice-director argued, "The main method that should be adopted for improvement of walnuts is coppicing. Studies have shown that the regrowth of walnut coppice always occurs successfully, fungal heartrot from old stumps does not enter young shoots, and they grow faster and begin to bear fruit before walnuts grown from seed" (Sokolov 1949, 192). The efficacy of walnut layering was less clear, but, emboldened by Lysenko's position that a tree's essence inheres in its every layered branch and resprouted shoot, the expedition designated coppicing regeneration as the standard approach for walnut–fruit forest improvement (Lupinovich 1949, 26).

Where walnut trees were overmature or diseased, which was nearly everywhere in the forest, they were chopped off low to the ground during winter, and their timber put to good use. The following spring, foresters removed all but three of the coppicing shoots on each stem, and grafted the remaining trio with a late-flowering or heavy-fruiting elite sort. When these had attained sufficient length, they were bent down to the soil and allowed to take root. After three to five years, the layered shoot, now with its own root system, was carefully separated from its mother tree (Zarubin 1950). With the 1951 forest code, these techniques became official policy for state forest enterprises of the walnut–fruit forest belt (Zarubin 1954, 16).

This vision of lesosad construction connected Lysenkoism with the walnut–fruit forest. Foresters and researchers were confident in their manipulations of trees because of Lysenko's interpretation of dialectical materialism and plant biology. Walnut–fruit forests are unproductive now, expedition scientists argued, but as Lysenkoism suggests that we can fix them, we would be irresponsible *not* to intervene in forest processes. This conclusion had strong political appeal for good Soviet patriots. In Zarubin's words, relying on walnut regeneration from seed constituted "a policy of laissez-faire that is foreign to the socialist economy, i.e., to knowingly act against Michurinist biological science" (1954, 4). By contrast, "the achievements of Michurinist biology have proved that man can and must do better than nature if he discovers and uses laws of nature in his proper interests" (Zarubin 1954, 7). As a result, the program of lesosad construction was executed broadly in the walnut–fruit forest, its implementers acting out a familiar political ecology tale: imported science, indiscriminately applied.

But that story is too simple, for the relationship between Lysenkoist heredity science and Kirgizian trees was not one-way but reciprocal. Just as the science supported the forest's modification, so successful outcomes—demonstrated transformations of plant essences through vegetative propagation—would be concrete proof of Lysenko–Michurinist biology. Each tree graft was both the material application of Lysenkoist policy and an opportunity to demonstrate the irrelevance of genes, an instance of Lysenkoist theory in the making. And were the trees of the walnut-fruit forest to collaborate in their "lesosadization," the broader apparatus of Lysenkoism—heredity without genes, proletarian science, geographical contentions described below—would benefit. Forest tracts were transformed to serve these goals, becoming sites for both the application of tenets of Lysenkoist heredity science and the production of that science.

If political ecologists have tended to treat their field sites as places where science is more often applied than produced, then what the lesosad program demonstrates is the running together of the production and application of Lysenkoist science. Many field sciences are characterized by just this running together as scientists work to make evidence of the world. The material effects of such efforts need not be so extensive as in this case—few field sciences share Lysenkoism's political and theoretical commitments—but ramify according to the methods of the field scientist and the place of their deployment (Kohler 2002a). Geographies of field science reveal these particulars and their impacts, but political ecologists, little engaged with that literature and liable to locate the sites of scientific knowledge production away from the field, are likely to miss them. I now turn to the specifics of such material effects in Soviet Kirgizia, as the lesosad program acted upon the forested landscape in pursuit of its scientific ends.

A Funny Thing Happened on the Way to the Forest–Orchard

Lysenkoism's power peaked in 1948, when the teaching of genetics was banned in the Soviet Union. In Kirgizia, Zarubin was regional head of forestry research, and the expedition's calls for lesosady were making their way into print. But like Lysenko's interventions in Soviet agriculture, Zarubin's prescription for forest rejuvenation—felling, coppicing, grafting, layering, seeding, with emphasis on the three methods of vegetative propagation—soon lost its official imprimatur. In 1955, researchers estimated that

123,000 walnuts had already been felled and coppiced, 216,000 trees grafted with elite sorts, and 734 hectares transformed through comprehensive coppicing regeneration—shy of the ambitious targets in the 1951–1955 state plan, but nonetheless impressive (Chebotarev 1955, 13–16; Pasechnik 1955). Foresters, however, were struggling to make areas under coppicing regeneration perform as predicted. As their difficulties multiplied, domestic scientific opinion shifted against Zarubin's program until, by 1955, he was almost completely alone in endorsing continued lesosad construction through coppicing regeneration. As one researcher wrote then, "Workers . . . doubt the possibility and necessity of implementing these measures on the territory of fruit and nut forests. The recommendation of coppicing regeneration as central in the recovery of walnut forests of Kirgizia seems ill-founded" (Prutensky 1955, 40).

Coppicing, layering, and grafting each contributed to coppicing regeneration's struggles. Zarubin and his supporters had argued that fungal heartrots were not transmitted from a stump to its coppicing shoots, so lesosady would both increase yields and improve forest health. This proved untrue, and coppiced shoots were soon showing fungal infection rates near 100% (Prutensky 1955). Layering of walnuts, which might have helped isolate coppiced shoots from infected parent trees, enjoyed almost no success, and those few layered branches that put down roots nearly all died when foresters cut them from their clonal mothers (Chebotarev 1955). Finally, researchers discovered no new methods for grafting walnuts, and success rates remained low. Only 4.4% of walnuts grafted in 1952 survived, and only 1.2% in 1953 (Chebotarev 1955). While some of this was surely due to poor implementation, as Zarubin insisted, even trees that Zarubin himself had coppiced, grafted, and layered failed completely (Ozolin 1955). As lesosady depended on modifying adult forest trees, the failure to develop reliable means of grafting adult walnuts was a devastating blow for the three-canopy model. The bodies and heredities of plants were less tractable, it seemed, than Lysenkoists had supposed.

There were other setbacks too. The first step in coppicing regeneration is the removal of all woody plants not slated for retention in the finished lesosad. As the Southern Kirgizia Expedition had found, however, wild apples in the walnut–fruit forest propagate by suckering, and a large tree is often connected by underground runners to trees up to twenty meters away (Fedorov and Fedorov 1949). When lesosad builders removed unwanted apple trees, associated suckers would send up shoots all along their length, overshadowing new grafts and young layered walnuts unless extraordinary labors of "sanitary cutting" (*sanitarnaya rubka*) were engaged (Chebotarev 1968). This was another process of asexual propagation, but one undertaken by the trees themselves and not easily turned to serve foresters' ends. In addition, the very things that made the lesosad appealing as a compromise between orchard and forest hampered its operation. A lesosad, supporters had argued, outproduces the natural forest without conceding too much of its air, water, and soil protection. Striking this balance proved difficult. If the forest–orchard was to protect the soil, then fertilization and irrigation were off-limits, as was the thorough stumping that might combat the suckering apples. Worse, any forest-based horticulture would require vehicular access, and building roads through mountain forests was ecologically detrimental. Without roads, the superior fruit of the lesosad would rot before reaching market (Chebotarev 1968). As the pitfalls of implementation became clear, the lesosad came to seem less like a productive compromise than a foolish one, combining not the positive but the negative traits of forest and orchard. Lesosad yields remained low, and hectares of walnut stumps bearing only diseased coppicing shoots did not suggest successful ecological functioning. The forest might resemble an orchard, but that did not mean it could be made to work like one.

At a 1955 conference in Frunze, participants attempted to assign responsibility for the debacle of coppicing regeneration. Several blamed Zarubin personally, as a fool or a fraudster. "Zarubin's incompetent grafting has destroyed half a million wild fruit trees," Vasil'chenko argued (1955, 249), while Akhunbaev counted two million walnuts felled on broken promises of their regrowth (1955, 252). Others extended their critique beyond Zarubin, blaming the state for problems of implementation, or walnut trees for growing too slowly to be improved on the state's five-year plans (Sokolov 1955). Zarubin defended his method, but his every plea for more time and further research was countered by higher-ups demanding data which he could not provide. As one administrator noted, coppicing regeneration had come to be described by some local specialists as "the method for destroying walnuts" (Pasechnik 1955, 33).

Lysenkoist distributed heredity had already suffered a similar collapse, which was only confirmed by the failure of vegetative hybridization to provide evidentiary support. With the continuing inability of Lysenkoists to defend their scientific claims, the ban on teaching genetics in the USSR lasted only until 1951, and the 1953 death of Lysenko's champion Stalin hastened his marginalization in the Soviet scientific community (Joravsky 1986).

Successful lesosady could have helped resuscitate the theory, but instead the failures of Lysenkoism and its Kirgizian applications reinforced each other. Nobody mentioned Lysenko at the 1955 conference, or his revolutionary hopes for vegetative propagation.

Stripped of its Lysenkoist justification, the lesosad program lowered its sights. Coppicing and layering had failed, and with them the technological package of coppicing regeneration. Grafting remained valuable, if unusable on adult walnuts, and many apple, pear, and plum forest–orchards postdate Zarubin's disgrace (Pulko 1965; Chebotarev 1968). But having found the intermediacy of the forest–orchard elusive in practice, Soviet ecologists increasingly failed to see horticultural potential in the forest at all. By the late 1970s, even walnutless lesosad construction was effectively finished. In 1968, Gan argued that the forest should not "all be turned into gardens and lesosady" but should instead be "saved untouched for future generations" (1968, 26). This purifying impulse, which I examine in the next chapter, defines the forestry establishment's position today. People still graft adult forest trees, mostly apples, but the state does not, and land is taken to bear orchard or forest, never something in between. Many of the trees modified by the lesosad program remain, however, and even failed innovations left their mark. One tract near Arslanbob, for example, is closely covered today in three-trunked walnuts, coppiced but never layered between 1951 and 1954 (Pasechnik 1955) (see Figure 11), while apple trees ennobled in lesosad-making feature in livelihoods. Michurin's name is invoked by village gardeners and orchardists, heirs to a popular hybrid horticulture that still modifies forest trees. Lysenko's name, by contrast, has disappeared, and lesosady have no supporters among Zarubin's successors in research and forest policy.

Figure 11: These forest walnuts near Arslanbob were coppiced in the early 1950s. Their multiple trunks are a legacy of Lysenkoist forest modification. Author photo.

The Geography of Lysenkoist Science

I have narrated the forest–orchard's brief heyday in Soviet Kirgizia, and gestured at its lasting material effects. I have highlighted key actors' adherence to Lysenkoist heredity theory, a science that was both applied and produced in the walnut–fruit forest, its empirical claims standing or falling on the behavior of walnuts, apples, and Sogdian plums. Much of Lysenko's anti-genetic heterodoxy was eclipsed by advances in the scientific mainstream, but the geography of his science still merits consideration. Lysenko argued that heredity science belongs not in the laboratory but in the world at large, a position that brought Lysenkoism and its interest in vegetative propagation to the forests of Kirgizia, with dramatic effect. In this concluding section, I highlight geographical aspects of the previous sections' account, for it is just these aspects that the alliance of political ecology and the geography of science can clarify. Not just Lysenkoist heredity but all field sciences remake geographies. By telling stories of this remaking, political ecologists can better illuminate where and how the doing of science has shaped encounters between people and their environments.

Lysenkoism's geographical innovation was to change the site of heredity science from the laboratory to the field. Reading dialectical materialism to disallow the maintenance of a distinct experimental space, Lysenko held that truth is revealed not through manipulation in controlled settings but in action in the wider world (Roll-Hansen 2005). The lab-bound investigator was blinded by artifice: given the imposed stasis of the laboratory environment, it was no wonder that bourgeois geneticists doubted the ability of Soviet horticulturists to bend plants to their will. Seeing the field as the sole "truth-spot" (Gieryn 2002), Lysenko touted his work in farmers' fields as indicative of true horticultural potential (1953). Surely the scientific innovator should not waste growing seasons at agricultural research stations, but, armed with close readings of Michurin and dialectics, must go directly to the fields of the people (Lysenko 1949, 41).

In favoring the working field over the laboratory and experimental plot, and the plant breeder over the molecular biologist, Lysenko articulated a distinctively-structured "mass scientific research" (1954, 207), one which enrolled many thousands of non-scientists in its circuits of horticultural creativity. In Lysenko's mass science, ordinary plant breeders at "collective-farm laboratories" around the Union would identify promising varieties based on their understanding of plant tendencies and local conditions, then collaborate with state plant-breeding stations to push them directly into widespread cultivation (Lysenko 1954). In Soviet Kirgizia, the walnut–fruit forest was similarly understood as a site for working foresters to do Lysenkoist biology. The experimental infrastructure was repurposed accordingly: instead of pursuing general truths through controlled trials, Lysenkoist-run walnut–fruit forest field stations perfected techniques and maintained materials for building forest–orchards in the world at large. That Zarubin's designs for the walnut–fruit forest were rolled out unsupported by rigorous testing was no accident of implementation, but reflected considered Lysenkoist doctrine.

Kohler has noted that the emergence of modern field biology at a time of laboratory dominance required "practices of place," which allowed biologists to speak rigorously about the complexity of the field (2002b). A field-based science of heredity needed its own procedures, and Soviet biologists developed two practices of place in their efforts to construct rigorous proof of distributed heredity. First, they selected Kirgizia's walnut–fruit forest as a place to make Lysenkoist heredity visible. Kirgizian foresters read Lysenkoist theory, observed that forest trees could be vegetatively propagated, and connected the two in a vision of scientific potential. And second, they developed the technologies of lesosad construction, horticultural tools adapted for silvicultural use specific to the walnut–fruit forest, so that that vision could become reality in the systematic state-led modification of thousands of forested hectares. Zarubin and his colleagues did not achieve their scientific goals; these forest modifications did not have the effects they intended. But their efforts left a material legacy that the emplaced story of this science is uniquely suited to reveal.

The same is true of other sciences in other places: not only Lysenkoist heredity but also more enduring field sciences remake the sites of their production, with implications for landscapes and their inhabitants. Some, like activist instances of the "Edenic Sciences" (Robbins and Moore 2013), make these commitments explicit; they are designed to transform places, not only in their application but in their production too. Monitoring efforts in conservation landscapes (Nichols and Williams 2006), biosecurity measures against invasives (Ginn 2008), standardized packages of methods and ideas in ecological theory (M. J. Goldman 2009)—all are field sciences remaking places and being remade in turn. Others keep the material transformations of their production quiet, and, like field ecology, tell stories of natural settings that rely on hidden and effortful practices of place (Kohler 2002a). In either case, the "laboratories" of these sciences are in and of the world, shaping it and being shaped by it. By looking to the geographical aspects of what field scientists do, political ecologists can better capture the effects of these labors in their analyses.

I have called for bringing geographies of science into political ecology by describing the geographical career of one admittedly odd science, Lysenkoist heredity. Lysenkoism's oddness is not incidental: the sciences that are most visibly local in their operation are those least assimilable to our mental model of normal science, which despite our efforts still floats free in our analyses. Lysenkoism, though, is hard to understand as normal science, both for its heterodox knowledge claims and for its heresies about where science should be done, and by whom. Like science studies scholars who focus on scientific controversy, political ecologists can attend to alternative, dissenting, and otherwise variant sciences, which by their particularity dramatize the particularity of all scientific practice. In defining what he calls dissident science, Delborne notes that "instances of scientific dissent [are] sites where the systems and cultures of knowledge production take shape" (2008, 512). They are also sites where systems of material production take shape, and in the very places political ecologists already study.

Lysenkoist heredity science had a distinctive geography which was enacted in Kirgizia by Zarubin and his colleagues in the lesosad program. The other field sciences have their own geographies, which have affected places in other ways. Political ecologists are well-positioned to tell stories of these sciences in place. Rather than defaulting to the singular, completed, familiar science that in its application populates many political ecologies, we can look to the peculiarities of local science and local setting as they are produced together. By using ideas from the geography of science and so engaging with the broader terrain of science studies, political ecologists can better understand how knowledge production in its many forms shapes the world.

Chapter 5 – Against Forest Grafting: Gene Thinking and Competing Forest Geographies in Southern Kyrgyzstan

In the previous chapter, I traced the history of a Soviet program that seized on the graftability of trees in Kirgizia's walnut–fruit forest, horticulturally modifying them in pursuit of both productivity gains and scientific evidence. Neither of these outcomes materialized, however, and in the last decades of Soviet rule, forest management in the walnut–fruit forest belt distanced itself from the failures of its recent past. Increasingly, policy followed the advice of P. A. Gan, a prominent figure in Kirgizian forest research, that the forest should not "all be turned into gardens and lesosads" but should instead be "saved untouched for future generations" (Gan 1968, 26). In contrast to the lesosad enthusiasts of Chapter 4, Gan held that the graftability of forest trees was a temptation better resisted.

Today, this position against forest grafting is widespread, even dominant, in formal institutions of walnut–fruit forest governance. State foresters, members of the Kyrgyzstani scientific establishment, and the international conservation community all generally subscribe to a position, as British silvologist Gabriel Hemery put it, that "Grafting reduces genetic diversity and has no place in the walnut forests, only in fruiting orchards" (pers. comm., 11/6/11). The graftability of forest trees, for Hemery and those who agree with him, is either irrelevant or positively dangerous, and forest managers should discourage the horticultural interventions that Chapter 4's Lysenkoists pursued systematically (and that Chapter 6's villagers continue to pursue, more haphazardly). This seems straightforward enough. Conservationists and foresters alike might be expected to oppose modifications of the forest trees they care about, especially since such modifications are most often done to improve the edibility of forest fruit, an outcome of little interest to either group. The local history only reinforces this position, and Gan's call to leave the forest untouched found particular support among those who had felt the disappointment of Lysenkoism's failure most keenly. Today, Kyrgyzstani foresters express chagrin that their predecessors gave over so much of the walnut–fruit forest to what one forest researcher described to me as the "grievous mistake" of the lesosad program (pers. comm., 1/22/2012). Forest grafting, for most forest managers, seems like a misguided continuation of that mistake, one which can only degrade an ecosystem very much in need of conservationist protection.

In this chapter, however, I argue that the opposition to forest grafting is not just an outgrowth of Lysenkoism's failures or a corollary of Conservation 101. In particular, I argue that the position against forest grafting is linked to two other positions, each suggested in Hemery's statement and each more obviously consequential for forest management than grafting policy itself. First, antipathy to forest grafting is related to understanding the forest as a molecular object, one which is important primarily for the genes it contains. For those opposed to forest grafting, the technique poses an existential threat to the forest by mixing genetic material that should not be mixed. Second, the anti-grafting position is linked to seeing the forest as a discrete object, fundamentally distinct from the "fruiting orchards" and other land-covers that surround it. In this understanding, the broader landscape is dichotomized, split into forested and non-forested sections, and forest grafting constitutes an inappropriate geographic mixing. For those who oppose forest grafting, then, the horticultural modification of forest trees threatens to blur multiple boundaries that should remain unblurred, with dangerous consequences for the environment of southern Kyrgyzstan.

These two understandings of the forest—as genetic and as discrete—are tightly linked, with forest grafting the key to understanding their linkage. In short, gene thinking creates, maintains, and depends upon one forest geography in the mountains of southern Kyrgyzstan, while forest grafting relies upon another geography that is in direct competition with it. To be clear, forest grafting is not exactly a banner political issue in southern Kyrgyzstan, and other threats to the walnut–fruit forest are far more prominent in environmentalist discourse. I know of no existing mobilization for or against grafting, no public that has gathered around it. Despite its obscurity, however, forest grafting provides insight into the logics that inform forest management in southern Kyrgyzstan. In the remainder of this chapter, I first introduce the conservation situation of the walnut–fruit forest, as context for the discussion of forest management that follows. I then introduce gene thinking and a community that interacts with the walnut–fruit forest in ways that make it particularly explicit. These are international horticulturists, who understand the walnut–fruit forest as globally valuable for the genes within its profusion of crop wild relatives (CWRs). I then explore the conceptualization of the forest as spatially discrete, separate from other land covers that surround it. This is a spatial implication of gene thinking, but it has consequences of its own for the forested landscape. I close by examine what managing the forest as genetic and discrete means for those whose livelihoods depend on the walnut–fruit forest, especially its non-molecular, non-discrete aspects.

Conservation and the Walnut–Fruit Forest

Global conservation thinking touches down in a handful of Kyrgyzstani sites (Heinen, Shukurov, and Sadykova 2001; Ter-Ghazaryan and Heinen 2006), but its imprint is especially apparent in the walnut–fruit forest. This is not a new development—Sary Chelek Nature Reserve was formed in 1959 and inducted into the UNESCO Man and Biosphere Program in 1978, largely because of its portion of walnut–fruit forest—but it has gained momentum since the country's independence in 1991. A 1995 meeting in Arslanbob, entitled "Biodiversity and Sustainable Use of Kyrgyzstan's Walnut–Fruit Forests," initiated conversations between Kyrgyzstani scientists and their western counterparts (Blaser, Carter, and Gilmour 1998), while a 2011 follow-up billed itself as "The 1st International Conference on the Sustainability of Kyrgyzstan's Walnut–Fruit Forests" and included attendees from Kyrgyzstan, Russia, Kazakhstan, Azerbaijan, Switzerland, Germany, the United Kingdom, and the United States.[35] Long-running development projects in the forest have included conservation prominently among their goals (Ulybina 2015; see e.g. Carter et al. 2003; Orozumbekov et al. 2009; Fauna & Flora International n.d.), and local residents describe years of visits from a parade of conservation biologists and environmental researchers. This global attention has been accompanied by at least some domestic response, and Kyrgyzstan's 1998 Biodiversity Strategy Action Plan identifies the "fruit and nut forests" of the country's south as one of the most important ecosystems for national environmental investment (Ministry of Environmental Protection 1998).

[35] Granted, I was the only attendee from the United States. All told, there were fewer than 50 of us there.

In fact, the walnut–fruit forest is one of conservation's favored sites not only in Kyrgyzstan but in all of Central Asia, a region that remains marginal in the global conservation economy. Using a scheme inherited from Conservation International's earlier work (Myers et al. 2000), the Critical Ecosystem Partnership Fund (CEPF) identifies the "Mountains of Central Asia" as one of 36 global biodiversity hotspots in particularly dire need of protection. CEPF includes nearly all of Kyrgyzstan and Tajikistan in the hotspot, as well as smaller extensions into Uzbekistan, Kazakhstan, Afghanistan, Turkmenistan, and China, an expansive definition that seems designed to incorporate enough endemic plants in the territory to qualify it as a hotspot by CEPF's own rules (See Figure 12). But if much of

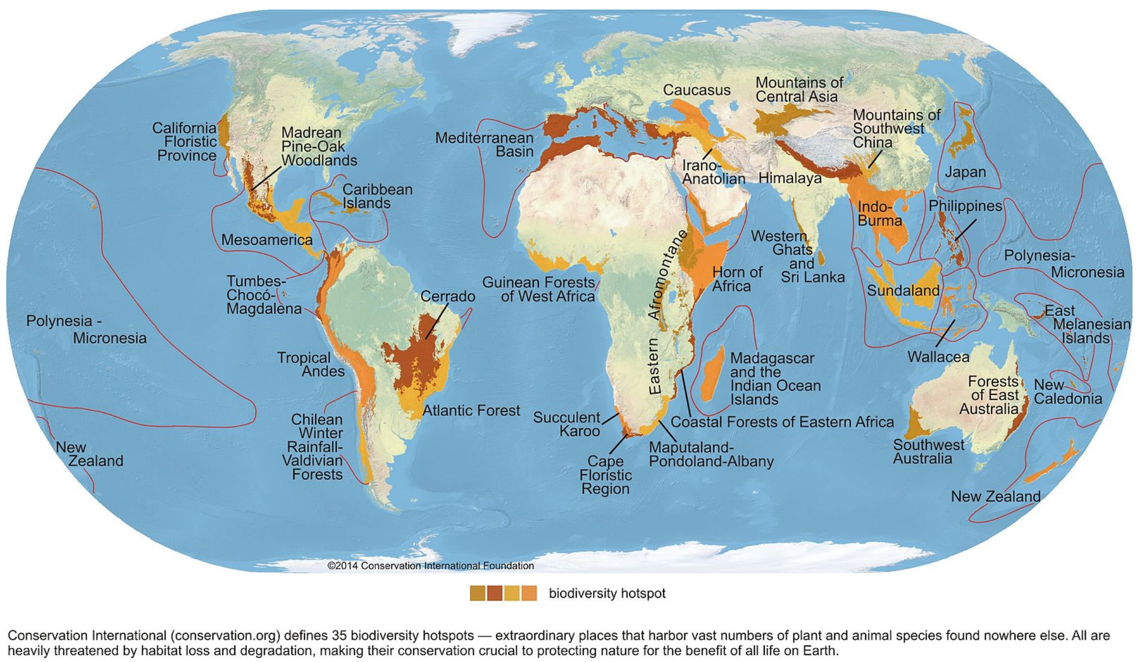

Figure 12: Global biodiversity hotspot map (Conservation International 2014)

Central Asia is thus designated as of conservation importance, the group's online strategy statements leave no doubt as to the walnut–fruit forest's special significance within this territory. The "Mountains of Central Asia" hotspot is summarized as follows: "The hotspot's ecosystems range from glaciers to desert, and include a highly threatened type of walnut–fruit forest, unique to this region, which contains ancestors of domestic fruit varieties and is an important storehouse of genetic diversity" (Critical Ecosystem Partnership Fund 2016). The hotspot, as CEPF defines it, contains 1500 endemic plant species in all, but those 300 that grow in the walnut–fruit forest are treated as bearers of particular conservation value.

Conservationists understand the threat to the walnut–fruit forest to be fairly comprehensive, and fairly alarming. Deforestation is a primary concern, and while the historical extent of the forest is not certain (Venglovsky 2009), the twentieth century likely saw significant forest retreat (Musuraliev 1998; Sherbinina 1998). Further, what remains of it is thoroughly humanized, with anthropogenic factors effectively determining vegetation patterns across much of the walnut–fruit forest belt (Borchardt, Gend, and Schickhoff 2011; Fürst and Blank 2014; Orozumbekov, Cantarello, and Newton 2015). The conservation threat has worsened in recent years, as economic malaise has rendered a steadily growing rural population ever more dependent on primary sector industries (Fisher et al. 2004; K. Schmidt 2007a). This reliance has manifested most severely in increased firewood collection (Sorg 2007; Rehnus, Nazarek, et al. 2013), which strips the forest of trees, and intensified haymaking, walnut harvesting, and grazing (Venglovsky et al. 2010; Borchardt et al. 2011), which prevent their replacement. The result is a "considerably increasing failure of regeneration along utilisation gradients," with some areas showing "no regeneration at all" (Borchardt, Schmidt, and Schickhoff 2010, 270), and a consequent decline in forest biodiversity (Cantarello et al. 2014). Under this panoply of pressures, the forest is thinned out and its understory removed, denser tracts converted into sparser ones that one group of researchers has dubbed “park-like forest” (Grisa et al. 2008).

In walnut–fruit forest villages, many residents are acutely aware of these changes, and readily articulate a litany of forest threats that mostly resembles the professional conservation consensus, though popular accounts tend to deemphasize grazing and walnut harvesting. Instead, villagers pin the primary blame for forest degradation on population growth and firewood use (M. Schmidt and Doerre 2011; Jalilova and Vacik 2012). I heard a very similar, almost conventionalized, account from nearly a dozen residents of three different villages. One neighbor in Kyzyl Ünkür, for example, told me that the village has roughly 1000 households, each of which uses roughly 20 m^3 of firewood each year. Run the numbers and you get an offtake that outstrips the local forest’s annual increment (pers. comm., 6/30/2011). That’s just the mathematics of it, I heard repeatedly, and neither the resource-starved state nor a citizenry more interested in its own economic advancement has the capacity to change it. Catastrophe is inevitable, with desperate people fully conscious of their dependence on forest resources yet left with no choice but to degrade them—a classic tragedy of the commons. This tale was typically offered with a fatalistic shrug, but my neighbor spoke of apocalypse and offered a typology of global catastrophes, ticking them off on his fingers: “1. volcanoes, 2. ice age, 3. comet impact, and 4. this sort of ecological calamity” (pers. comm., 6/30/2011). As a result, in this account, forest reaches that were once too dense with underbrush for a sheep to enter now would let a truck pass. Projected forward, people told me, and barring an unlikely change in mindset or blunting of population growth, even the park-like forest that still survives is bound to disappear within decades, taking today's forest-dependent livelihoods with it.

The conservation of southern Kyrgyzstan's walnut–fruit forest is a hard question, and forest managers disagree about how the people and trees of southern Kyrgyzstan can best achieve a sustainable future together. They all seem to agree, however, that forest grafting does not merit a mention in the documents they produce about it. This is not to say that conservationists view the practice neutrally, but the documentary evidence for their opposition is relatively obscure. In an internal mission report filed in May 1995, for example, Jane Carter, a consultant for the Kyrgyz–Swiss Forestry Support Programme (KIRFOR), describes recent changes to forest leasehold contracts. These were still early days for forest leasing, which had just been introduced by KIRFOR in a handful of pilot villages, and Carter describes a debate among Swiss and Kyrgyz consultants on what contract language would best usher villagers into the era of quasi-privatization. As part of an effort to incentivize environmental stewardship among leaseholders newly responsible for forest tracts, Carter writes, the new contracts should encourage "biodiversity conservation—for example, forbidding tenants from grafting existing mature apple trees, in order to conserve the naturally occurring stock" (1995, 18). The prohibition was not against the technique per se—the transplanting of grafted seedlings into the forest was expressly permitted, in fact—but against its application to mature forest trees. For Carter, grafting forest trees replaces something natural—a branch of a "naturally occurring" tree—with something social—a branch of an orchard tree—and thus erodes biodiversity.

Even this quick reference to grafting is unusual among walnut–fruit forest conservation and development documents. The technique does get an occasional mention in characterizations of local practices (e.g. Marti 2000; Matter 2005; K. Schmidt 2007a), but this is always a description, not a prescription—aside from Carter's report and another by Messerli (2001), grafting does not enter into any of the programmatic statements that define official project action.[36] It was no more prominent in interviews with these organizations' representatives, during which I was invariably the one to introduce the topic and my interlocutors were generally surprised that I had. This silence, like that of the official documents, should not be taken to reflect neutrality. Interviewees were quick to clarify that the risks of forest grafting are in fact so taken for granted as not to need enunciation, especially in the face of so many other, more pressing threats to the forest's well-being. But although forest grafting is invisible in the walnut–fruit forest's conservation prospectuses, the nature of opposition to it illuminates the logics that define more prominent conservation positions. In particular, opposition to forest grafting depends on conceptualizing the forest as genetic and as discrete, conceptualizations which in turn make forest life more difficult for those who depend on its non-genetic, non-discrete processes.

Gene Thinking: Forest Grafting as Genetic Transgression

Forest managers oppose the grafting of forest trees in part because they understand the forest as a genetic resource, and hold grafting to put that resource at risk. As a result,

[36] Messerli's report actually weighs the merits of grafting as a development intervention that might be prescribed in the context of forest–orchards (2001, 66). The author comes to no firm conclusions, but subsequent KIRFOR documents are silent on the topic and the project's consultants, in interviews, were reliably anti-forest grafting.

opposition to forest grafting offers insight into the increasing importance of the molecular scale in how the walnut–fruit forest is managed, as an object of both conservation and horticulture. This *molecularization* is not limited to the forest or to Kyrgyzstan, but is more broadly typical of the current global political economic moment, as geographers have argued. McAfee, for example, contends that the new focus on genes brings a deceptive reductionism, in which biotechnologists have mistakenly understood complex socialities and materialities to be replaceable by databases (2003; see also Rossi 2014). Others note that genes thus catalogued are thereby rendered tradable, and see a process of commodification in the molecular turn. Bioprospecting makes this explicit (Hayden 2003; Neimark 2012), but the trading of genes and genetic science underpins a much broader economy in "bioinformation" (Parry 2006; see also Haraway 1997), in which the molecular content of organisms is isolated from their material bodies and put to economic use. Where the organisms in question are human, critics have raised concerns about what governance of this newly molecularized selfhood might entail (Rose 2001; Braun 2007), and drawn links to societal definitions of race (Nash 2013). Where nonhumans are concerned, molecularization means turning complex organisms into genetic resources, fundamentally isolated from their environments (Lulka 2004; Graddy 2013) and best managed through increasingly biopolitical modes of conservation (Biermann and Mansfield 2014; Hennessy 2015).

In southern Kyrgyzstan, the molecular framing of the walnut–fruit forest goes along with a hierarchy of genetic value. Whereas every forest species contributes equally to the species count that makes the forest a biodiversity hotspot, it is "the genetic diversity of fruit and nut trees"—only a small subset of forest species, in other words—that give the hotspot its "outstanding global significance" (Orozumbekov et al. 2009, 146). Recent genomic research suggests that apple (Cornille et al. 2014), apricot (Decroocq et al. 2016), pistachio (Zohary, Hopf, and Weiss 2012), and walnut (Pollegioni et al. 2014) were first domesticated in Central Asia, making forest populations of these species particularly close relatives of their cropped counterparts. Other tree fruit crops that grow wild in the forest were likely domesticated further east (peach) or west (almond, pear) (Zohary, Hopf, and Weiss 2012), but forest populations of these species may still be close enough to their domesticated relatives to be horticulturally relevant. Scholars of agrobiodiversity have given us a term for this relevance: all of these tree species are crop wild relatives (CWRs), and together they dominate the canopy of the walnut–fruit forest over much of its area.

The importance of genes for biodiversity conservation is a topic well covered elsewhere (Frankham, Briscoe, and Ballou 2002), but the abundance of CWRs in the forest means that the walnut–fruit forest's valuable genes appeal to a different, and broader, audience than genes of conservation interest elsewhere. Hemery and Popov describe the forest's genetic inheritance as effectively dual purpose, calling the walnut–fruit forest "an important genetic resource for *in situ* conservation programmes *and for tree breeding strategies*" (1998, 272, emphasis added; see also Lapeña et al. 2014). Global interest in forest genes reflects this dual purpose: in addition to CEPF and Fauna and Flora International, which support *in situ* conservation, horticulture organizations like the United States Departent of Agriculture (USDA) are also active in the walnut–fruit forest. For them, it is the tree breeding strategies that forest genes might support. By the same token, the threat that grafting poses to forest genes endangers not only conservation strategies of the sort that a Kyrgyzstani park (Rus: *zapovednik*) is designed to advance, but also programs of horticultural improvement that are pursued far away, and with very different aims.

What do horticulturists want from the genes contained in the walnut–fruit forest's CWRs? The basic argument for the importance of CWRs is that domestication, as a process of propagating some alleles (that is, some forms of a gene) over others, entails a narrowing of a crop's genetic base. This is the *domestication bottleneck*: in selecting for alleles that straightforwardly improve yield, for example, domesticators exclude alleles that do not, thus leaving domesticated populations with more homogeneous genomes than their wild ancestors.[37] But these excluded alleles can confer other beneficial traits, including disease or pest resistance, robustness to environmental variation or stress, improvements in fruit appearance or taste, and, when incorporated into hybrid crosses, heterosis or "hybrid vigor" (Harlan 1976; Hajjar and Hodgkin 2007). They may even have the potential to contribute to further yield improvements, despite having been initially excluded by domesticators for not doing so. Perhaps, for example, a given allele increases yields only in combination with other alleles, an interaction too complex to have been recognized in early domesticators' simple cross-breeding experiments (Tanksley and McCouch 1997). In CWRs, not only do these excluded alleles persist but they may also be comparatively

[37] This simple story is somewhat complicated in trees and other perennial species, which show much less of a domestication bottleneck than annuals (Miller and Gross 2011). In apples, in fact, the genomes of wild populations are no more genetically diverse, on average, than those of their domesticated relatives, a somewhat perplexing result (Cornille et al. 2012). Even so, individual genes of interest may have been lost in the process of domestication, leaving the appeal of CWRs intact.

accessible to horticulturists, borne as they are in bodies that easily interbreed with closely-related domestic varieties.

In short, horticulturists hope to identify forest genes that can be inserted into commercial crop populations, most straightforwardly through interbreeding but potentially through other methods of gene transfer, thus increasing the value of commercial harvests. The traits that USDA researchers seek in walnut–fruit forest species are similar to those that CWR work has pursued elsewhere, as described by Hajjar and Hodgkin (2007). So, for example, USDA apple researchers have targeted genes that confer resistance to apple scab, fire blight, and cold hardiness (Forsline and Aldwinckle 2004). USDA walnut work, for its part, focuses on drought tolerance and resistance to soil-borne diseases (Aradhya, Preece, and Kluepfel 2015), while other walnut researchers have prioritized material that might contribute genes for cold hardiness, late spring flowering, high-quality timber, and burl formation (Hemery 1998; Molnar et al. 2011). These are all qualities that early horticulturists might have inadvertently selected against—qualities, in other words, that crop ancestors might have lost as they traversed the domestication bottleneck—but could be recoverable if today's plant breeders can find the right alleles in CWR bodies and incorporate them into domesticated crop populations through artificial selection.

It is not only *artificial* selection that makes genes in CWRs useful—they may help crop populations subject to *natural* selection too. Genetic conservationists call genetic diversity the raw material of natural selection; if environmental conditions change, a genetically diverse population is more likely than a less diverse one to contain individuals with the genetic characteristics required for survival (DeSalle and Amato 2004). While this idea is often used to highlight the vulnerability of endangered wild populations, it is as applicable to crop plants, many of which have, through centuries of inbreeding, been optimized very strongly to present conditions at the expense of their robustness to future change. Domesticated populations of walnut–fruit forest species are among the vulnerable. Hokanson et al. note that the overwhelming majority of commercial apple production is based on descendants of just two cultivars (1997), and cultivated walnuts, while not quite so inbred, could still benefit from incorporation of as-yet "unexploited variability" in wild trees (Germain 1997, 21). Genetic diversity is seen as especially important given the environmental changes that crop populations will encounter in the near future. In the words of two USDA walnut researchers, genetic diversity, and the flexibility it grants, will be needed to "respon[d] to current and future agricultural crises likely to be exacerbated by global climate change" (Aradhya and Preece 2012, 20). Even genes that do not confer immediate commercial advantage may be worth conserving for the greater good of agriculture in a changing world.

Genetic conservation of CWRs in the walnut–fruit forest has been pursued both *in situ* and *ex situ*, though the former is still getting established. In Kyrgyzstan, the project of protecting traditional farming systems *in situ* has been most closely associated with Bioversity International (previously the International Plant Genetic Resources Institute) (Lapeña et al. 2014; see also Currey 2009; Giuliani, van Oudenhoven, and Mubalieva 2011). As part of a project called "*In Situ*/On-Farm Conservation and Use of Agricultural Biodiversity (Horticultural Crops and Wild Fruit Species) in Central Asia," Bioversity

International has documented existing fruit tree varieties, established nurseries, and proposed new conservation areas. It has also moved to empower farmers as agents of agrobiodiversity protection, observing in one document that "On-farm fruit genetic resource conservation is impossible without local communities' or farmers' involvement" (Lapeña et al. 2014, 13). Bioversity consultants argue that the current policy environment does not allow locals to manage for diversity in crop plants and their wild relatives, even as property transformations thrust them into more prominent roles as landowners and managers. They propose governmental support for farmers breeding local varieties, new farmers' associations to ensure better market conditions for rural producers, and a bevy of legal changes to strengthen farmers' rights and access to seeds and information (Lapeña et al. 2014). This work is oriented toward the protection of genetic diversity in wild fruits, especially CWRs, and finds particular value in the fruit tree populations of the walnut–fruit forest.

But while *in situ* protection of agrobiodiversity has only limited institutional support, *ex situ* efforts are far more advanced. In light of the valuable genes potentially at large in the walnut–fruit forest, global horticulturists work to retrieve them through expeditions that relocate tree bodies from Central Asia, in wholes and parts, to sites more suitable for horticultural research. This horticultural bioprospecting recalls the well-known travels of Nikolai Vavilov, whose many seed-collecting expeditions included one to present-day Tajikistan in 1916 and another to northern Kyrgyzstan and the apple forest around Almaty in 1929 (Vavilov 1931; Nabhan 2009). Vavilov's was not the first expedition to visit Central Asia in search of seeds; Vavilov himself notes that the USDA sponsored a collecting trip to

Xinjiang and present-day Kazakhstan by the China-based plant collector Frank Meyer in 1910–11 (Vavilov 1992b; Cunningham 1984). The Cold War halted American investigation into Central Asia's CWRs, but with the fall of the Soviet Union the region has reopened to western expeditions and the walnut–fruit forest has again played host to plant collectors. Most of these have come from the USDA's Plant Genetics Resources Unit (PGRU), which has sent five apple expeditions to Central Asia (Hokanson et al. 1997; Forsline et al. 2004), including several that visited southern Kyrgyzstan (Dickson and Forsline 1994; Volk et al. 2009) (See Figure 13). While the USDA's walnut expeditions have targeted the Caucasus over Central Asia (J. D. Postman et al. 2012), walnut expeditions under other sponsorship have included Kyrgyzstan in their itineraries. These include a 1997 visit by a British silvologist (Hemery 1998) and a 2003 expedition by a team of plant pathologists from Rutgers (Molnar et al. 2011).

How do horticultural expeditions navigate the forested landscape of southern Kyrgyzstan in search of tree genes? Planners of horticultural expeditions must consider multiple scales simultaneously—genes are at once contained in bodies, on landscapes, and in countries, all of which introduce complexities into the horticultural bioprospector's preparation. Visas must be obtained, and governmental suspicions about the unequal benefits of colonial relations overcome. Permission to transport botanical material can be particularly difficult to acquire, with worries about disease transmission inspiring long horticultural quarantines even after the concerns of customs officials are allayed. Expeditions also consider the geography of genes themselves in mapping out their exploratory terrain: Where on the landscape, they ask, are useful genes most likely to be located (Hemery and

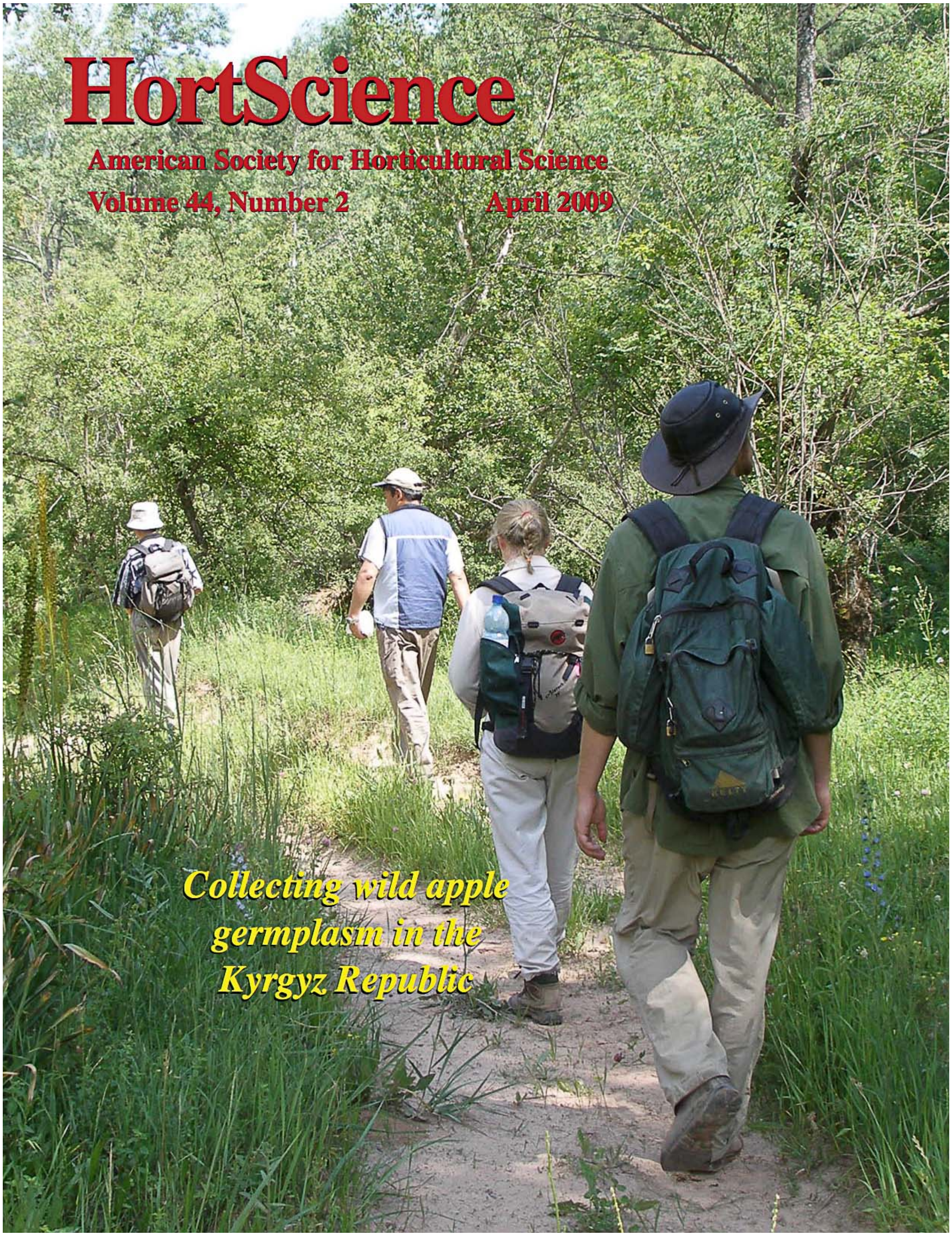

Figure 13: The cover of the issue of HortScience containing Volk et al (2009). Ironically, that's actually me on the right, bioprospecting and being a horticulture journal cover model.

Popov 1998)? Genetically diverse sites have obvious appeal, and centers of diversity often correspond with centers of origin (Vavilov 1992a). Genes for resistance to a pest or disease are most likely to occur where host and pest have coexisted longest, while genes for tolerance to environmental variation are concentrated instead where that variation exerts the strongest effect on natural selection. Walnut expeditions have sought cold tolerance genes, for example, at the highest latitudes and altitudes in the tree's Asian range, in Kyrgyzstan and Kazakhstan (Pollegioni et al. 2014). Finally, people have manipulated gene flow for thousands of years, and expeditions do well to include local inhabitants in their calculations. In many cases, local farmers have in fact already identified the most useful CWRs and interbred them with crops, creating improved landraces that prefigure what the USDA and its expeditions hope to accomplish (Zimmerer 2003).

Having taken all this into account, protocols are required for sampling biological material at the selected sites. Hemery's 1997 walnut expedition followed procedures for collecting woody perennials outlined by the FAO (1995) (since updated by Lars Schmidt (2011)). These involved selecting 10–20 healthy trees per site, with no two of these within 50m of each other "to minimise the risk of sampling maternally related individuals" (Hemery and Popov 1998, 274). Ten seeds were collected per selected tree and eleven sites across the walnut–fruit forest belt were visited, yielding a total of 2349 seeds from 253 parent trees. USDA apple expeditions, for their part, combined random sampling of forest trees with targeting of "elite" wild trees, those that "appeared to possess horticulturally desirable characters" (Forsline et al. 2004, 13), and retrieved 123,589 seeds from 949 trees in the course of five expeditions. Each specimen is then tagged with provenance information that accompanies it overseas. Hemery and his team collected "detailed descriptions of the sites (altitude, aspect, latitude/longitude, soils, associated vegetation) and of parent trees (height, stem diameter, stem straightness, branching angle, crown diameter, leaf and nut descriptors, presence/absence of bur[l]s and basal area)" (Hemery and Popov 1998, 275). The USDA's apple team recorded site information, as well as using 24 morphological descriptors to characterize the trees (phenology, tree size) and apples (russeting pattern, flesh firmness, shape) that bore the seeds they collected (Forsline et al. 2004). In the case of the USDA, accessions are then given a Plant Introduction (PI) number and entered into GRIN, the publicly-accessible Germplasm Resources Information Network (National Plant Germplasm System 2017).

Once acquired, given a provenance, and relocated to the United States, the USDA funnels specimens into the National Plant Germplasm System (NPGS). The NPGS consists of 26 repositories, ranging from the Arctic and Subarctic Plant Genetic Resources Unit in Palmer, Alaska, to tropical stations in Puerto Rico and Hawaii. Many of these facilities are seed banks, which have drawn a fair amount of attention from geographers and scholars of science and technology studies. For van Dooren, for example, seed banks have been central to decades of work in agricultural biodiversity conservation, but they do so by prioritizing genetic diversity to the exclusion of "the expensive and unnecessary biological components within which it is normally found" (2009, 378). Seed banks are, in effect, conservation projects of a molecularized age, only one step removed from the genetic database that, to a molecular reductionist, represents life's true value. However, many temperate fruit trees, including all the CWRs of the walnut–fruit forest, do not breed true from seed. This introduces a layer of uncertainty to the expedition member's task: she seeks useful genes but can observe only the expression of those genes in unpredictable crosses. The best apples of the Kyrgyzstani forest—those elites that the USDA prioritizes—contain seeds that, if planted, will not produce fruit of equally high quality. If seed bankers look to seeds as proxies for the organisms from which they were extracted (van Dooren 2009), the seeds of walnut–fruit forest trees make particularly bad proxies.

The USDA's solution to this and other problems of seed banking has been to establish the National Clonal Germplasm Repositories (NCGR), a sub-system of nine facilities within the NPGS (White, Shands, and Lovell 1989). The NCGRs preserve not only species that do not breed true from seed, but also those with seeds that banking renders unviable (known, charmingly, as *recalcitrant* or *unorthodox* seeds). In the NCGRs, plants are cloned and maintained alive, not in envelopes or cryobanks but in gardens and orchards, where they grow in bodies propagated by grafting and other vegetative methods. Beginning with their third visit to Central Asia, the USDA's apple team began collecting not only seeds but scions as well, branches from elite trees that were shipped in coolers to the United States and grafted to EMLA7 semidwarfing rootstock in upstate New York (Forsline et al. 2004; Postman et al. 2006). Like the seedbanks and laboratories also maintained by the NPGS, the clonal repositories are distributed across the climatic zones of the United States, with apples, including those brought from Central Asia, maintained in the Geneva, NY, repository and walnuts living alongside grapes and other nut crops in Davis, CA (Postman et al. 2006).

These NCGR orchards contain trees that, from the graft site up, are clones of the most horticulturally interesting trees that USDA expeditions encountered abroad.

If clonal repositories preserve some of what makes walnut–fruit forest trees distinctive in a way that seed banks cannot, however, they share with seed banks a fundamental instrumentalizing logic that replaces genetic diversity with genetic resources (van Dooren 2009), subordinating the many processes that make up the standing forest to just those facets of it that provide utility for humans. As van Dooren writes of seed banks, "within this context, conservation is solely about preserving access to a plant's genetic information for future human use" (2009, 379). By this logic, much of what goes on in the walnut–fruit forest is superfluous. Forest trees are reframed as belonging not primarily to ecological communities cohesive in space but instead to spatially discontinuous *gene pools*.[38] A gene pool is the sum of all genetic information contained in a population, but the term is most relevant for groups that actually or hypothetically interbreed. For a breeder, the gene pool defines the universe of possible crosses, and thus the universe of possible genetic futures for the descendants of an organism. For the forest's CWRs, like the apple, the relevant gene pools include crop trees that are grown all over the temperate world, and expeditions seek bodies in Kyrgyzstan that contain genes of literally global consequence. As molecularization redefines the walnut–fruit forest, this consideration of gene pools threatens to swamp other aspects of conservation, turning the standing forest into an adjunct to conservation work pursued elsewhere.

[38] The English term "gene pool" has an interesting history, appearing in 1950 when the Russian geneticist Theodosius Dobzhansky offered it as a loose translation of his mentor Serebrovsky's *genofond*, or "gene fund" (Burian 1994). *Genofond* remains an important term in Russophone science, and many of the Kyrgyzstani scientists I interviewed volunteered it when asked about the sources of the walnut–fruit forest's value.

What's more, so long as that conservation work is defined genetically, there is little possibility for locals to participate in it. This is clear when that work is *ex situ*: expeditions reimagine forests as a genetic storehouse but a basically insecure one, the valuable contents of which are best relocated to more trustworthy locales under professional control. If the forest is a storehouse, locals are cast in the role of security guards, whose meddling with the resources under their stewardship can only degrade their value and whose interactions with forest trees must therefore be minimized. But whereas *in situ* conservation seems to involve locals more actively, it fails to accord them any greater say in project direction. Agrobiodiversity work like that undertaken by Bioversity International leans on locals for maintenance of farming systems, in the process strengthening farmers rights in laudable ways. But so long as genetic resources define the project, local partners can only ever be instruments, working to conservation ends that are defined elsewhere. As Campbell and Godfrey note regarding their own case, "in the case of genetics, the science is highly technical and expensive, with a resulting concentration of expertise at a few key labs in the USA and Europe and leaving little room for outside critique....It is hard to fathom how local people might contribute to understanding genetic identity of individual turtles and related implications for populations" (Campbell and Godfrey 2010, 905). Similarly, residents of southern Kyrgyzstan have much to say about what the walnut–fruit forest means, but their voices can safely be ignored, it seems, if the forest's chief meaning is genetic.

If walnut–fruit forest trees are defined, for horticulturists and conservationists alike, by their contribution to a global gene pool, then grafting them threatens to destroy what is most valuable in them. As described in Chapter 6, forest grafters most often use scions that produce better fruit—bigger, tastier, longer-lasting, and more marketable. In doing so they propagate genes already well-represented in the global gene pool at the expense of others that are much rarer. Grafting, after all, is not sexual propagation but vegetative, and the branch that grows from a scion is genetically identical to the tree from which the scion was taken, ignoring mutations.[39] This means that imported scions are clones of trees grown in other places, and perhaps in *many* other places. One Kyrgyzstani forest researcher asked me to imagine the consequence of using rarities like *M. niedzwetzkiana*, an endemic wild apple that is barely edible but has other traits that interest apple breeders, as stocks for the grafting of scions of Red Delicious, which has better fruit but exists in genetically identical form all over the world (pers. comm., 7/9/11). Clearly, he continued, this entails an unacceptable danger to the genetic riches that distinguish the forest. For subscribers to this way of thinking, forest grafting can only pollute the gene pool, and risks damaging what is globally unique about the walnut–fruit forest for strictly local gain.

That this is articulated in terms of danger and pollution suggests that it is not merely the incremental decrease in genetic diversity brought about by the replacement of one branch's genes with another's that worries forest managers. Indeed, conservationists

[39] It may not be OK to ignore mutations. Many important fruit varieties have emerged not from sexual crosses but from spontaneous mutation—such a mutated fruit is known in horticulture as a *sport*. More abstractly, the accumulation of somatic mutations in the life of a tree and the pattern by which cells give rise to other cells in its body means that branches on a tree may differ genetically from each other, as may scions taken from different parts of the tree (Loxdale and Lushai 2003). These complications are generally ignored by horticulturists, in my experience.

articulate another grafting-related fear, namely that forest grafting poses disease risks to the walnut–fruit forest. Just as the vegetative propagation methods used in constructing lesosady spread fungal heartrot among the forest's walnut trees in the mid-twentieth century (see Chapter 4), grafting forest trees with diseased scions could spread disease today. This is no idle fear; many plant viruses are spread by grafting (Smith 1972), and graft-transmissible diseases are important drags on citrus productivity (Lee and Bar-Joseph 2003). American forestry students learn early about the poor sanitation and inattention to disease risk that assisted the spread of North America's catastrophic chestnut blight, an example that occurred to several foresters I asked about forest grafting. For a forest of global conservation importance, they argued, judicious forest grafting offers no upside that might offset the disease risks represented by a careless recombination of plant parts.

Even if grafting sanitation is impeccable, however, as should be readily achievable for trained horticulturists, the practice gets emotional responses from forest managers. My conservationist interviewees who went silent at grafting's mention then spoke up in opposition to it, but some of them also exclaimed loudly or laughed, as if forest grafting was not just a suboptimal policy prescription but an embarrassing one. I suspect that this response relates to conservation's quest for purification (Biermann and Mansfield 2014), the separation of human from tree for the good of the latter, which forest grafting, in several ways, transgresses. Most obviously, the grafted tree encompasses multiple genetic identities, segregated at the graft site. The grafted organism, hybrid in its origins, is more specifically a chimera, with different parts of its body composed of genetically different tissue. When forest trees are grafted, this most often means that a tree is wild below its graft site and a single domestic variety above it, but other models exist: *double working* inserts a thin section of a third sort between them as an *interstock*; one rarer wild sort gets grafted to another to aid in the conservation of the first; the use of scions of several different varieties on a single stock creates something approaching the old dream of a "cornucopia tree" (D. Lowe 2010). In all cases, however, the falsity of equating a body with its singular genome is made manifest. To a first approximation the parts of the grafted tree remain strictly separate, and pragmatic horticulturists operate secure in the knowledge that, provided they've selected compatible rootstock and scion, the fruit their scion bears will be functionally indistinguishable from that of the tree from which it was taken. This at least limits conservation's exposure, as although the integrity of the gene pool is breached, the pollution is strictly localized, with only the grafted body affected.

This does not exhaust the complexity of the grafted body, however. Grafting can also be used to make trees cold tolerant or disease resistant; by affixing a scion of a susceptible variety to a resistant rootstock, the scion gains the stock's useful trait. This is a phenetic transformation, not a genetic one: the stock does not change the scion's genes even as it transforms its behavior. We might therefore dismiss it: the scion's appearance has been tweaked, yes, but its genetic essence has not, and its seedling descendants will bear no trace of its graft-conferred resistance. But where grafting is a possibility, the grafted trees' descendants can come from its branches, not its seeds, and can be made hardy by the same grafting procedure as their clonal parent. There need never be any seedling descendants to worry about.

This is an intimate enrollment of human assistance into the plant's reproductive processes, one which muddles the natural/social distinction that conservation assumes. Graftable trees can reproduce in two ways, either through their seeds without the help of humans or through their bodies as part of an interspecific collaboration. For conservationists, however, the nature worth saving is the one that arises without the work of people. One conservation project active in southern Kyrgyzstan frames its task as one of "Conserving Eden" (Darwin Initiative 2013). This points most obviously to the fruitfulness of the forest, but it suggests also the way in which the forest is taken as something outside of history, which owes its value to strictly humanless processes. Genes arise in prehistory, and their partisans seek to preserve them for an ever-receding future, the "long term" of evolution. If genetic diversity is our primary concern, then a "natural park" kept free of humans is a plausible policy goal, and locals serve as, at best, guardians of genes that are easily recast as global property (Hayden 2003). But heredity in apples and pears and plums in Kyrgyzstan's walnut-fruit forest is frequently a human–tree partnership, asexual instead of sexual, and structured by interested locals moving clones across the forested landscape.

Gene Thinking Territorialized: Forest Grafting as Spatial Transgression

The prioritization of the genetic has been ably characterized by geographers and scholars of science and technology studies. Less noted by these scholars are the effects of gene thinking on landscapes, but the molecularization described above has distinctive landscape effects in southern Kyrgyzstan. Hemery and Popov write that "The true value of the walnut forests of Kyrgyzstan in respect of their contribution to the global walnut gene pool….may be applied as a new parameter in the selection of areas of existing walnut forest to conserve *in situ*" (1998, 275). In practice, the application of this parameter contributes to management practices that define the forest as a discrete object to be maintained as such, valuable precisely insofar as it is distinct from the non-forest that surrounds it. Two categories of land cover—forested and unforested—come to define the landscape as a whole, which is as a result split between them. Forest grafting is understood, by those who subscribe to this split-landscape thinking, to endanger the landscape by blurring together categories of forest and non-forest that should, in their opinion, be kept separate. Just as it is a transgression against genetic purity, then, forest grafting is also a transgression against spatial purity; opposition to it is about preventing inappropriate mixing not only of genes but also of places.

Landscape categories are familiar things, and there might seem to be little consequence to this opposition between the forested and unforested parts of southern Kyrgyzstan. Categorization should not be taken for granted, however; the splitting of the walnut–fruit forest landscape is produced by certain actors, and affects environmental politics in important and uneven ways. The partiality of split-landscape thinking is suggested by a consideration of Kyrgyz-language terminology concerning the walnut–fruit forest landscape. *Tokoi* is the Kyrgyz word for forest in conservationist publications, development literature, and the name of the government ministry responsible for management of the walnut–fruit belt. For many Kyrgyz-speaking villagers in the walnut–fruit forest, however, *tokoi* is somewhat formal, a "literary word" (Kyr: *adabii söz*) that sounds not exactly foreign to local ears but would more likely figure in an outsider's description of the landscape than in a village resident's. Instead of *tokoi*, the word that locals use for anything outside the village itself is *talaa*, defined in dictionaries as "field" and signifying the unsplit landscape upon which local people make their living. When families move to their leaseholds each fall to harvest walnuts, for example, they are more likely to designate their destination as *talaa* than *tokoi*, whether or not it is under the continuous tree cover that "forest" implies. In other words, the forested–unforested opposition defines some landscape categorizations but not others, and is not common among locals.

One manifestation of this split landscape is in an associated split, between where grafting is acceptable and where it is not. As Hemery noted, grafting is appropriate in "fruiting orchards"—indeed it is necessary to their maintenance—but not in the forest. In the summer of 2011, I saw this place-based distinction—forest grafting dangerous, orchard grafting safe—performed quite explicitly. The United Nation's Food and Agriculture Organization (FAO) "Pistachio and Walnut Development Project" (TCP/KYR/3203) ran from 2011 to 2013, and aimed to increase the productivity of Kyrgyzstan's nut sector through horticultural training, institutional improvements, and transfers of technology. Grafting played a prominent role in the project, especially in the parts of it concerned with pistachio. Although pistachio inhabits a lower and drier band of forests than do walnut and apple, it actually covers more Kyrgyzstani land area than walnut, according to FAO documents, and represents a small but important contributor to agricultural livelihoods in the Fergana Valley. Grafting in pistachios is not difficult, and serves an important function it does not in other walnut–fruit forest trees. Ungrafted pistachios are dioecious—that is, each tree bears either only male or only female flowers—and, as only female flowers bear fruit, the productivity of a plantation depends on the sex ratio of its trees. While half of seedling trees are female and half are male, orchardists can raise yields by grafting female scions onto all those male stocks beyond the 8-10% needed for pollination. Grafted parts retain their reproductive identity; in short, grafted trees are, for the purposes of commercial production, female where it counts. In the Kyrgyzstani pistachio industry, this management of sex ratio has not typically been done, and FAO project officers identified its introduction as a major opportunity.

Accordingly, the FAO organized a two-day workshop on pistachio grafting, which I and about thirty smallholders attended.[40] The workshop, conducted in Kyrgyz at a café in Jalalabad in July, 2011, featured a consultant who'd been flown in from Turkey, where pistachio plantations manage for sex ratio and are much more productive than their counterparts in Kyrgyzstan. Also in attendance were three of the four Kyrgyzstani horticulture professors who consulted on the FAO project. In a series of presentations, the experts walked the rest of us through a handful of methods for grafting pistachios and encouraged the smallholders to share their own orchard-keeping experiences. The Turkish visitor emphasized that his presentation was meant to be a pragmatic aid in increasing pistachio productivity, noting that it had been tailored to reflect the opportunities he'd observed in a tour of Kyrgyzstan's pistachio-growing areas the week before. In an interview, he described to me the poverty that he'd seen in southern Kyrgyzstan, and repeated his hope that grafting might make a material difference. For rural families

[40] The project also sponsored a walnut grafting workshop, but I was not able to attend. Unlike the pistachio workshop, which was pitched at anybody interested, the walnut workshop was targeted at directors and head foresters of state forest enterprises. This was a result of walnuts' comparative ungraftability: only such high officials were likely to have the resources and technology that walnut grafting requires.

struggling to make ends meet, he said, “There is a big opportunity here, an opportunity to make money from the mountains” (pers. comm., 7/20/2011).

It became clear in the course of the seminar, however, that the income growth that the FAO hoped to stimulate was not intended to come from “the mountains” in general, but was more localized. The FAO project, it turned out, was premised upon the notion that grafting and other improvements would happen only in orchards and never in the forest, where valuable genes might be endangered by horticultural modifications, just as Hemery warns. This spatial categorization came less from the Turkish consultant, who confessed he was not clear on the workings of Kyrgyzstani land dynamics, than from the local project officers. They seemed to have an idealized pistachio-based livelihood in mind, one that relied on orchard trees under the control of the horticulturist and subject to no conflicting claims. Their imagined orchardist was, in other words, disconnected from the forest and its overlapping resource allotments; he might as well be orcharding in a landscape that *didn’t* include the largest walnut–fruit forest in the world. For the real orchardists who listened to presentations that day, the project’s grafting instruction was not to be applied to the graftable trees in their backyard forest. I confirmed this position with two of the Kyrgyzstani consultants after the seminar was over: the techniques that the project was teaching were intended for “people’s orchards and nurseries,” they told me, “and absolutely not for the forest” (pers. comm., 7/23/2011).

Workshop attendees were slow to grasp this distinction. In introducing themselves, they described livelihoods based not in idealized orchards but in complicated forest–orchard settings, and they characterized their landholdings without distinguishing between the two. They looked for tree improvement opportunities wherever they might be found, considering the graftability of all of their trees and how that graftability might be put to use. As a result, they issued a steady stream of questions about forest pistachios, inquiring about property institutions, conflicts with grazers on shared forest land, and the legal status of forest grafts. How, attendees wondered, were they supposed to apply the techniques they were learning when the *leskhoz* did not allow any cutting of forest trees? How could the Turkish consultant's advice be made to function amid the competing claims of the forest landscape in which they moved? It seemed a betrayal of the workshop's supposed pragmatism to foreclose upon the possibility of forest grafting, but FAO consultants kept stepping in and directing discussion back toward narrow technical topics in orchard management. This, after all, was precisely what they saw grafting as, notwithstanding that many forest trees are graftable too. Finally, an exasperated FAO consultant attempted to end the persistent distraction, declaring that "Forest problems aren't our topic here."

This is split-landscape thinking in a nutshell: the forest is separate from the orchards that surround it, and forest problems differ fundamentally from orchard problems. The former are molecularized and globalized: in the *tokoi*, trees matter as contributors to global gene pools, and global actors in conservation and horticulture intervene to ensure their proper disposition. This is the same rescaling logic that, whether for nature conservation or historical preservation, makes global heritage out of locally-embedded things, thus dispossessing local owners in favor of distant experts (Campbell 2007). The latter, by contrast, are of primarily local interest and require no plumbing of hidden genetic depths for their proper management. Given this distinction, the problem with forest grafting becomes clear: it is an orchard solution misapplied to a forest problem. For opponents of the technique, it blurs lines between forest and orchard that are better kept clear; it is method out of place. Forest trees, as repositories of genes that may bear global value, must be prevented from interactions with their surroundings that might endanger this. Orchard trees, on the other hand, are of merely local value, and should be treated as commercial resources to be optimized using whatever horticultural tools are available.

Conclusion: The Political Consequences of Gene Thinking

For people living in the walnut–fruit forest, there are distinct consequences to the gene thinking I have outlined, and its landscape-splitting effects. In the next chapter I explore practices of forest grafting undertaken by some of these villagers, practices which depend on human–tree partnerships across landscape categories and with no regard for considerations of the gene pool. But grafting is only one example of this multi-species partnering: village livelihoods in the walnut–fruit forest belt depend on continual interaction with forest trees, as sources of firewood, food, shade, fodder, and companionship. For residents who depend in so many ways on the bodies of forest inhabitants, a focus on the genetic wealth hidden within some of these bodies leads to forest policies that are misdirected at best and actively harmful at worst.

Most notably, the forestry and conservation establishments want to minimize human–tree contact. This has most often been voiced as desire for a new park: from the national 1998

Biodiversity Strategy Action Plan, which calls for the creation of a park by 2004 (Ministry of Environmental Protection 1998), to a 2010 strategic planning document on biodiversity protection, which mentions a similar goal but delays its timeline by a decade (State Agency of Environmental Protection and Forestry 2010), the idea of a walnut–fruit forest preserve has long been a conservationist favorite. In the 2010 report, the park was to be centered on the relatively-intact forest in Dashman (Dörre 2015), a forest reach near Arslanbob (See Figure 14). According to residents of Arslanbob, this proposal came closest to

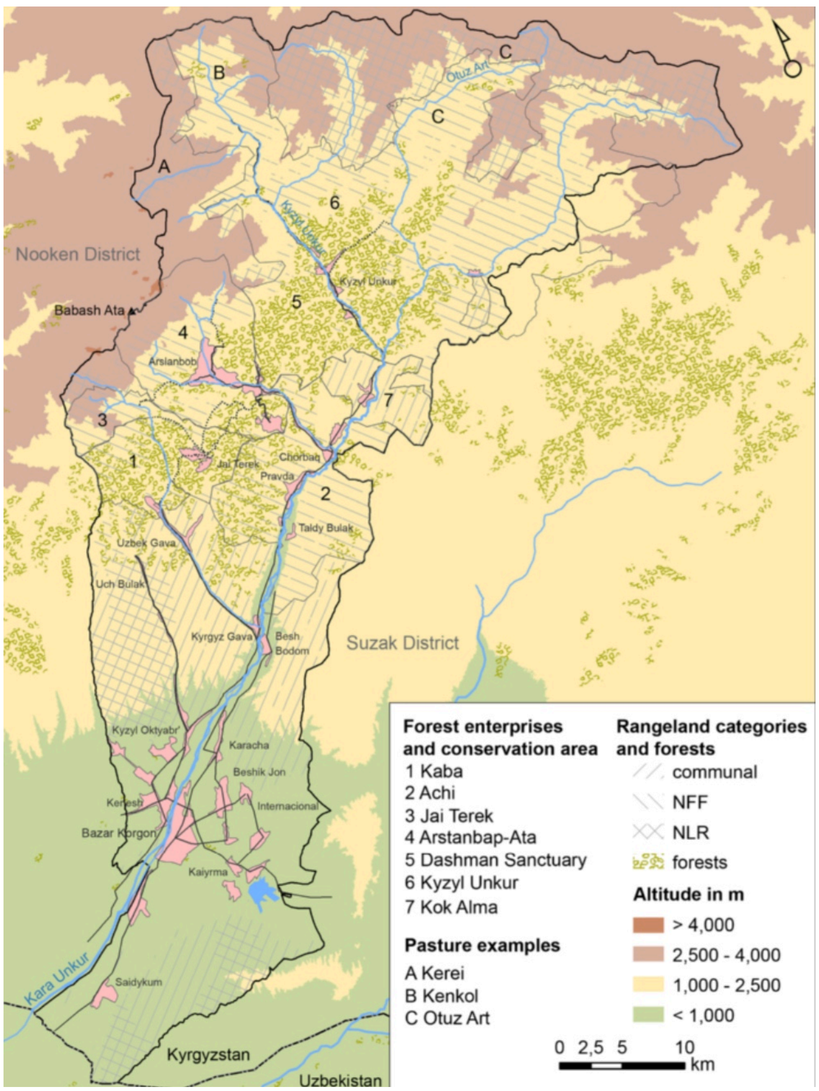

Figure 14: Rayon map showing the location of the planned park at Dashman (Dörre 2015).

enactment when, around 2009, then-Forestry Minister Topchubek Turgunaliev sent a committee of foresters and politicians to the area to do a feasibility study. The Dashman park was to be a *zapovednik*, the strictest level of protection in the Kyrgyzstani system (equivalent to IUCN Category Ia; see Heinen, Shukurov, and Sadykova 2001), and would accordingly allow almost no human activity within its bounds. This designation provides no guarantee of actual protection, of course; the park at Sary Chelek is a *zapovednik* and has UNESCO status besides, yet resources for conservation enforcement there are in chronically short supply and human impact is extensive, in buffer zones and core areas alike (Cantarello et al. 2014). But if the creation of a Dashman *zapovednik* was unlikely to lead to effective conservation enforcement, it would still bring new enforcers, state agents newly empowered to intervene in what might be done on land that was very much in use by local grazers and walnut harvesters. When the committee arrived, local pushback was fierce, and the efforts to create a Dashman park collapsed in acrimony.

In this case, local resistance was able to prevent the splitting of the landscape, and residents' suite of interactions with trees won out over conservationists' focus on genetic facets of tree biodiversity. But though it was not realized, the Dashman proposal is indicative of what is at stake in these competing forest geographies. For conservationists and horticulturists, the walnut–fruit forest is a genetic storehouse, and its riches should be secured behind the borders of formal state-supported reserves or removed from the forest entirely, *in situ* and *ex situ* solutions that each keep trees away from the interventions of interested locals. Forest grafting, as an especially intimate partnership between locals and forest trees, represents a danger to the forest and must be prevented if at all possible. For locals, on the other hand, deep engagements with forest trees—very much including forest grafting, as the next chapter examines—are a crucial part of rural livelihoods.

Chapter 6 – Toward Vegetal Political Ecology: Kyrgyzstan's Walnut–Fruit Forest and the Politics of Graftability

Introduction

Political ecologists have increasingly looked to posthumanism as an important theoretical resource for getting beyond the nature–culture dualism (Robbins 2003b; Keil 2005; Braun 2008). While the resulting posthumanist political ecologies have explored the implications of treating nonhumans as subjects of environmental politics, however, they have largely left plants alone. The clearest articulation of posthumanist political ecology is Sundberg's examination of environmental politics in the U.S.–Mexico borderlands (2011), which highlights nonhuman agency as central to transforming the conduct of humanist political ecology. But although Sundberg demonstrates that boundary enforcement along the Rio Grande involves the active participation of mesquite, rivers, and desert, it is jaguars and ocelots that, by preferring some habitats over others and thus triggering provisions of the Endangered Species Act, most clearly shape political outcomes along the border. By contrast, although Sundberg identifies a "South Texas Thornscrub collective," she does little to make actors out of the plants that most obviously compose South Texas Thornscrub.

Sundberg is not alone in her animal emphasis: drawing on the vibrancy of the "new animal geography" (Philo 1995; Wolch and Emel 1998) and highlighting distinctively animalian traits like mobility and intentionality, other posthumanist political ecologies have investigated animal agency (e.g. Perkins 2007; J. Lorimer and Driessen 2013; Barua 2014a) and animal autonomy (Collard, Dempsey, and Sundberg 2015). Meanwhile, even as botanists and philosophers shed new light on plant autonomies (Garzón and Keijzer 2011; Marder 2012; Trewavas 2014), political ecologists still treat plants primarily as aspects of the landscape against which other human and nonhuman actors move. Mesquites are not only the objects of feline preference, forests are not only the objects of state governance and scientific research (Vandergeest and Peluso 2011), and chestnut trees are not only the objects of conservation biopolitics (Biermann and Mansfield 2014); by failing to theorize plants as always also political subjects, political ecologists ensure that their posthumanist turn is a limited and overly-animalian one. Notwithstanding Robbins's observation that "Trees are political agents" (2007b, 50), political ecologists have rarely written as if that were the case (exceptions include Page 2003; Robbins 2007a; Biermann 2014; and Weisser 2015).

Political ecologists are not the only geographers guilty of what has been called "plant blindness" (Wandersee and Schussler 1999). Head et al. diagnose the same problem in the broader corpus of posthumanist geographies, and propose a "vegetal politics" as remedy (2014). If posthumanist geographies have too often decentered humans only to recenter humans and animals, they argue, then vegetal politics describes a fuller integration of human–plant relations into the multispecies relational ontology that more-than-human geographies trace. Combining insights from botany and horticulture with more familiarly geographical material, analysts of vegetal politics recast plants not as background figures but as actors in their own right (Head, Atchison, and Phillips 2015). Doody et al., for example, theorize weediness, often understood as a human construct, as emergent instead from the joint performances of both people and plants (2014). Pitt, for her part, tracks the effects of expertise on a community garden, but locates that expertise in both human and plant bodies (2015). In accounts like these, analyzing vegetal politics means articulating how 'plantiness'—the set of characteristics and capacities specific to plants—shapes political landscapes and transforms political identities (Head, Atchison, and Gates 2012). These transformations are different than those posthumanist political ecology has so far undertaken; plants take political ecology further from its humanist roots than do the animals that drive existing posthumanist treatments. If posthumanist political ecology has suffered from plant blindness, vegetal politics seems to offer a corrective.

It is not only their own plant blindness, however, that has kept political ecologists from seeing the consequences of plantiness. Indeed, given the attention that political ecologists have lavished on plant materiality under different theoretical frameworks (e.g. Schroeder 1993; Rocheleau and Ross 1995; Zimmerer 2003; Prudham 2005; Kosek 2006), perhaps a better explanation for the gap between political ecology and vegetal politics is the latter's theorization of politics. Three aspects of this theorization stand out. First, vegetal politics has defined its politics to suit the workings of plants, most of which operate slowly and subtly, if not invisibly. In order to lend voice to these "small agencies" (Bennett 2010, 94), scholars of vegetal politics have selected quiet settings, where power relations are muted and louder actors—who occupy the attention of political ecologists—are excluded. Second, and relatedly, the plants examined by many studies live in private gardens and navigate fairly gentle political economic terrain (e.g. Hitchings 2003; Power 2005; Doody et al. 2014; Pitt 2015). Fewer studies in vegetal politics consider political ecology's favored spaces of resource production, economic development, and environmental conservation, where plants contend with stronger flows of power (but see Richardson-Ngwenya 2012; Peltola and Tuomisaari 2015). A final contrast is scalar: the literature of vegetal politics often finds the consequences of plantiness in the mutual "learning to be affected" that close contact across human–plant difference can initiate (Atchison and Head 2013; Brice 2014a). While broader connections are sometimes explored (e.g. Head, Atchison, and Gates 2012), scholars highlight the intimate encounter of bodies, a focus not foreign to political ecology but typically complemented by attention to cross-scale connections and further-reaching chains of explanation (Blaikie and Brookfield 1987; Turner 1999; Zimmerer and Bassett 2003). If political ecologists have been blind to the agential possibilities of plants, then, scholars of vegetal politics have been myopic in neglecting plantiness's broader political ramifications. Given these paired problems of vision, the field between vegetal politics and political ecology remains mostly uncultivated.

In this article I colonize that field, bringing vegetal politics and political ecology together to produce what might be called vegetal political ecology. By this I mean an analysis that shows the impact of plantiness on human–plant encounters, like vegetal politics does, but that further links this impact to resource politics and other broader environmental contestations, like political ecology does. In many cases, as the previous paragraph implies, plantiness resonates most clearly in small spaces, and with small (but real!) effects. With creativity, however, vegetal political ecologists can find cases in which plant agency has weightier consequences on bigger stages. Here, I explore how resource politics in southern Kyrgyzstan's walnut–fruit forest are shaped by the distinctive capacity of some plants to enter into horticultural partnerships with people, specifically through grafting. Grafting is a standard element of the global horticultural toolkit, one of the most important methods of cloning plants by vegetative propagation. The technique involves implanting part of the body of one plant—the scion—into the body of another—the rootstock—and inducing the two to grow together. In the walnut–fruit forest, grafting allows the construction of forest trees bearing high-quality fruit, with domestic scions and wild rootstocks sharing composite bodies. Only some trees have the "graftability" that allows these manipulations: adult walnuts are effectively ungraftable, while forest populations of almond, apple, apricot, pear, pistachio, and plum are more easily grafted. Their graftability is a facet of plantiness, dependent in particular on the indeterminate and decentralized nature of plant growth (Marder 2013, 65). Here, I focus on two domains which together constitute a politics of graftability in the walnut–fruit forest: first, a bodily politics of grafter and tree, and second, a broader resource politics of the graftable forest. This structure mirrors the theoretical gap I have identified: the first domain rehearses established approaches in vegetal politics, while the second models its extension into vegetal political ecology. In each of these two domains, I argue, graftability undermines the hierarchy that otherwise defines them, and contributes to more equitable environmental politics.

My argument for the anti-hierarchical effects of graftability is based on thirteen months of fieldwork, mostly ethnographic, in southern Kyrgyzstan's walnut–fruit forest belt in 2011 and 2012. The walnut–fruit forest is unusual among temperate forests for the fruitfulness of its trees, which include many of the species that grow in orchards around the temperate world. Interested in how the forest's fruitfulness affects local resource politics, I conducted about 120 semistructured interviews with village residents, state foresters, development professionals, forest scientists, and conservationists. I engaged in participant observation, spending most of my time in two forest villages where lives of humans and trees are particularly closely intertwined. There, I ended up focusing especially on those residents who graft forest trees; I call them "village grafters," and more than a dozen figured in my fieldwork. Ethnography is a central method in both political ecology (Moore 1993) and vegetal politics (Head et al. 2014), and its extension into multispecies settings (Kirksey and Helmreich 2010; Ogden, Hall, and Tanita 2013) makes it a strong starting point for vegetal political ecology (see also Pitt 2015). Other methods can help contextualize ethnographic findings, however, and I also conducted a household survey in the two study villages[41] and mapped grafted trees in three forest parcels of varying land use history. Taken together, these data suggest that village grafters enter into a politics that, because of the capacities of the plants who also participate, tends toward the non-hierarchical, both in how bodies relate and in how resources are accessed. After providing background on the two hierarchies that graftability undermines, I discuss how it does so, first in body politics and then in resource politics, before returning to the vegetal political ecology that I propose.

Hierarchies of Bodies, Hierarchies of Resource Access

Graftability undermines two distinct hierarchies, one intersubjective and the other institutional. The first of these is based in the fact that people and plants have hugely different capacities for action. Plants may have autonomy, communicative ability, and intelligence, as some botanists and posthumanists contend, but that does not make them

[41] The survey sampled 156 households, roughly half of these from each of the two villages. All sampled households were randomly selected from one neighborhood in each village, an attempt to strike a balance between casting a wide enough net and allowing me and my two field assistants to conduct the surveys efficiently.

the political equals of humans. Sessile and lacking intentionality and voice, they are readily instrumentalized by the people they encounter, made into tools of agriculture, silviculture, horticulture, and landscaping. This hierarchy defines most human–plant relations.

While I contend below that graftability in Kyrgyzstan undermines this intersubjective hierarchy, several scholars have argued the opposite, that grafting works to support it instead. For Prudham, for example, grafting is a tool for "taming trees," allowing people to extend corporate sovereignty over tree bodies to make them better suit capital's ends (2003). It is *un*graftable trees, like the Douglas-fir his study examines, that resist mechanization and commodification (Prudham 2005). Similarly, from a perspective informed by vegetal politics, Legun characterizes dwarfing, a horticultural technique in which grafting is central, as a circumscription of tree autonomy which has allowed apple growers in the Midwestern United States to assume ever more decision-making power once held by trees (2015). Anna Lowenhaupt Tsing has advanced a similar argument for a related horticultural technique, cutting. For Tsing, modernity is characterized by a drive for scalability, the ability to expand a project without changing its internal relationships (2015). Scalability, she argues, is increased for projects that include plants that can be cloned, as they can be propagated without the uncertainty introduced by sexual reproduction. So, for example, the spread of the European colonial plantation was hastened by sugar cane's clonal mode of propagation—the plant was introduced around the world yet remained a faithful instrument of the imperialist project (Tsing 2012). For Tsing, as for Prudham and Legun, plants that can be cloned are especially instrumentalizable, their reliable propagation reinforcing and extending existing hierarchies. If posthumanist literature has been drawn to the inventiveness of nonhuman life (Braun 2008), grafting and other techniques of clonal propagation seem to represent an unpromising ramification of sameness, repetition without difference.

These authors share with me a grounding faith in the political importance of the specifics of plant propagation, but two features distinguish the grafting partnerships that I describe from theirs, and give graftability in Kyrgyzstan its antihierarchical force. First, unlike Prudham's timber firms, Legun's apple growers, and Tsing's plantation agriculturalists, my village grafters modify the bodies of adult trees. While humans and plants do not meet on equal terms, the human–plant relationship I describe is a *more* equal one, with grafters engaging a handful of trees as something like partners, rather than operating on thousands of indistinguishable propagules. As a result, the graftable trees of the walnut–fruit forest retain more autonomy over their life processes than do the clonable plants considered elsewhere. Second, I describe grafting work pursued in a diverse forest environment, rather than in the agricultural fields and orchards where most horticulture happens. As a result, these plant autonomies are not so easily coopted and instrumentalized as their counterparts in more-humanized environments.

The second hierarchy that graftability undermines, in addition to the one that characterizes most human–plant interactions, is linked to Soviet institutional history. Twenty-five years of post-Soviet change have transformed the erstwhile Second World, but Kyrgyzstani forest governance retains much of its Soviet-era structure. While the country's agricultural and urban land was privatized shortly after independence (Bloch and Rasmussen 1998), the state still owns all of Kyrgyzstan's forests and operates a network of *leskhozy* (forest enterprises, sg. *leskhoz*) to manage the forests and the tens of thousands of people who live in them (M. Schmidt 2008). *Leskhoz* directors are centrally appointed, and work to production targets and other benchmarks set by the state forest administration. In other words, the *leskhozy* are Soviet not only in history and form but in present political disposition as well, retaining "very strongly developed hierarchies and top-down decision making" (K. Schmidt 2007a, 177). Unsurprisingly, this does not sit well with some residents, who grumble about the state's priorities, ridicule the behavior of its agents, and somehow don't get around to paying annual fees and levies. In short, they enact everyday forms of resistance (Scott 1985), and might be expected to seek out alliances—as with graftable trees—that help them further these quiet contestations of state power.

The hierarchical nature of post-Soviet forest governance also does not sit well with the decentralizers of the development industry, and reformers have spent the last twenty years working to transform the annual forest walnut harvest, which figures strongly in local livelihoods. Thanks to their efforts, the state now leases nut-bearing forest parcels to village households, but the achievement of bottom-up governance has proved elusive (Carter et al. 2003, 2010). Forestry administrators and foresters remain wedded to centrally defined plans, and have resisted reforms that might distribute real decision-making responsibility (Kouplevatskaya-Buttoud 2009; Jalilova, Khadka, and Vacik 2012). Notwithstanding the formal delegation of decision-making power to forest lessees, hierarchy continues to define Kyrgyzstani forest governance, with state officials still controlling access to forest resources and participation of other actors figuring more in development prospectuses than lived experience. If hierarchy has persisted, however, this is in spite of tree graftability. In the next two sections, I argue that the graftable trees of Kyrgyzstan's walnut–fruit forest—apples, pears, and plums, but not walnuts—rework the landscape of power on which other actors also move, generally acting not to endorse these political hierarchies but to undermine them. I examine the two hierarchies in turn, first the intersubjective and second the institutional.

Antihierarchy 1: Graftability and People–Plant Relations

Grafting has not drawn much explicit attention in accounts of vegetal politics, but the technique effectively foregrounds the intimate bodily interrelation of humans and plants that that literature most often explores. The task of any graft is to bring into contact the cambial cells in the scion and the cambial cells in the rootstock, so that water and nutrients may be induced to cross the stock–scion boundary and the grafted tree parts may grow together (Garner 2013). For apples and many other graftable plants, this is a straightforward task demanding little more than the ingenuity required to bring two cylinders—each concealed by a layer of bark—in contact with each other. Even when straightforward, however, grafting requires harmonization between human and plant efforts, an attunement achieved only as each partner learns to be affected by the other's actions. This process is routinized in commercial orchards, where seedlings are grafted at industrial scales. For village grafters, on the other hand, who pursue a few partnerships with mature forest trees, human–plant attunement is more involved, and the joint project's outcome depends on both partners taking actions that work well within their negotiated relationship. In the forest work of village grafters, the tree is accorded a small autonomy, one which matters for the circulation of power and the prosecution of interspecific politics.

The process by which village grafters enter partnerships with trees is typified by the experience of a man I will call "Karim." For the last three decades, Karim's family has been managing a tract of forested land one hour's walk from his village. In the mid-1980s, the local *leskhoz* was planting walnut orchards in forest clearings, and Karim's father was tasked with tending the young trees—over two thousand of them, on eighteen hectares. When the area was leased out to village households in 2008, Karim and his household received 2.5 orchard-bearing hectares; he now spends summers there in a tiny mud hut, farming corn and potatoes and managing the walnut trees. Every autumn, when walnuts ripen and villagers relocate to forest leaseholds to gather them (K. Schmidt 2007a), family members join him at his plot to help bring in the nut harvest. In an effort to improve his forest lifestyle, Karim has grafted some of the apple trees that grow in the forest adjacent to his garden.

I first met Karim en route to his plot on a spring day in 2012 when the wild apples were blooming. He was riding a donkey and carrying a bag of grafting supplies, including a bundle of scions from his backyard apple tree. Upon reaching his plot, Karim showed me two trees he had grafted three years earlier, and two others from five years before that. The newer scars were still obvious, but his earlier partners had already accommodated his manipulations, their genetically-disparate parts grown together into bodies that resembled their unmodified neighbors but would, come autumn, give far better fruit. On the day I accompanied him, Karim was grafting three more wild apples, each of which, left to its own devices, would produce only small and bitter harvests. By entering into a horticultural partnership that afternoon, however—a partnership enabled by both the apples' graftability and Karim's grafting ability—these trees would become able to contribute tasty fruit to Karim and his family's spare forest diet.

Karim's grafting ability is not unusual in his village and others near it. According to the results of my household survey, more than 35% of village households contain somebody who knows how to graft, usually the male household head. Most village grafters are either self-taught or learned from their father, and between 7 and 10% of households graft in any given year. These could be seen as small percentages, but they can have large effects. Grafting is not a task that needs doing very often, as a short session with a grafting knife can boost yields for decades. Moreover, a person who knows how to graft can do it for others, and many of those I surveyed sometimes modify trees for their relatives and friends. Even among those who do not know how to graft, nearly everybody knows someone who does, and a small stash of horticulture guidebooks circulates among village households for the use of those interested in teaching themselves. A few households derive a large part of their income from the sale of fruit from grafted trees, but grafting is more often used, as in Karim's case, to improve the homegrown fruit that supplements the family diet.

While most of this grafting happens in backyards and orchards, some of it, like Karim's, modifies forest trees instead, replacing wild apple, plum, and pear bodies with domestic ones, one branch at a time. Forest grafting is rare, being mentioned by only five survey respondents. However, forest mapping confirmed what village grafters told me in interviews: the accumulated efforts of village grafters over time have remade some parts of the forested landscape. In one heavily trafficked forest area of 2 km^2, for example, I found 343 trees, mostly apples, that had been grafted by villagers over the years, in addition to 286 more that were systematically grafted by the Soviet state. Compared to their ungrafted neighbors, these trees flower later and bear larger fruits that taste sweeter, store better, and sell for higher prices. They also contribute different genes, associated with the domestic varieties favored by grafters, to the pool from which new apple seedlings arise. In short, the actions of village grafters have a substantial and continuing impact on the forested landscape.

When village grafters target forest trees, their actions are partly determined by the maturity and size of the trees they engage. Slim year-old shoots grow most vigorously and make the best scions, but pairing them with the thick branches of mature trees can be a geometric challenge. In most cases, village grafters use a technique called rind grafting, which is suitable for this sort of size mismatch (Garner 2013). Karim cuts the shoots he's brought with him (Kyr: *chybyk*) into short sections with three buds each (Kyr: *kalemche*, or "pencil"[42]), and sharpens each section's proximal end into a long paddle to best expose its cambium. After sawing one of the tree's main branches off flat and smoothing the cut with his knife, he makes four incisions in the bark running perpendicular to the cut surface. He pries these perpendicular cuts open with vigorous bodily levering and inserts four of the

[42] The same comparison features in English. According to the Oxford English Dictionary, "graft" shares a root with "-graphy," apparently thanks to the resemblance between scion and pencil.

scions between the bark of the stock and the wood, into the stock's cambium. The chosen branch now terminates not in its own twigs and leaves but in a flat sawn surface with only the four scions protruding. The graft is finished with a trio of protective features: a layer of horticultural wax over the exposed wood surfaces, a scrap of tarp or broad leaf above to keep rain off the wax, and a length of rope around the branch to secure the whole apparatus.

Geometries of plant form dictate some aspects of Karim's grafting, but he responds to other factors too. The graft must be sited well, and the canny forest grafter carefully selects both the target tree and the branch within it. The first choice is easy, as the flourishing wild apples that make good stocks already grow in the same sunny places that domesticated apples can; house apples and wild apples appreciate the same things. The second choice is subtler. Where commercial grafters modify mature trees, they typically do so through frameworking, in which dozens or hundreds of scions are grafted throughout the tree's canopy to replace as much of its body as possible while retaining its basic structure (Garner 2013). Like the seedling grafts Legun (2015) considers, a full frameworking furthers the grafter's productivity goals at the expense of the tree's autonomy. Village grafters, on the other hand, typically replace just one or two branches of the forest tree with domesticated material and make few other modifications—at most, a bit of pruning to help the graft get established. This minimal intervention suits the relationship between village grafter and tree; Karim's wild apple partners, for example, live well out of town and will not receive the regular maintenance that full-time orchardists give their trees. Instead of taking control of the tree's body through frameworking, Karim implants only four scions into one branch, trims some foliage that would otherwise shade the new grafts, and lets the tree take care of the rest.

Grazing livestock also contribute to Karim's choice of which branch to graft. As grazing control has slackened with the weakening of post-Soviet governance, livestock have become more common in the forest (Dörre and Borchardt 2012), forcing village grafters to adjust. Conservationists regard walnut–fruit forest grazing as a serious threat, as livestock eat the seedlings that would otherwise replace aging canopy trees (Blaser, Carter, and Gilmour 1998; Venglovsky 2009). Livestock also eat the tender leaves of fresh-grafted shoots; horses, in particular, will strip the bark and leaves off any new graft they can get their teeth on. Happily for Karim, however, mature forest apples provide many potential graft sites beyond a horse's reach. Whereas commercial orchardists have chased efficiency and convenience in ever-more-intensively-dwarfed trees (Legun 2015), mature forest apples are tall, growing to 8–15 m and fruiting at heights inconvenient to people and inaccessible to horses. Old forest grafts thus provide an incidental record of grazing history: trees that were modified when Soviet policy maintained strict bans on forest grazing were grafted at waist-level or below, to replace as much of the wild tree's body as possible. By contrast, trees modified during periods of laxer enforcement, when livestock roamed the forest as they do today, are grafted higher up the trunk for the scion's protection. More concerned with hungry grazers than with the fine details of tree frameworking, Karim scrambles up into his stock trees to graft upper branches, leaving the rest of their bodies unmodified.

As a result of these considerations, village grafters and forest trees engage each other on relatively equal terms. In effect, village grafters accord their tree partners a degree of recognition that distinguishes the relationship from most agricultural ones. It is, after all, a long-term engagement: a grafted tree can produce decades of high-quality fruit, but only if its grafter chooses his interventions advisedly and relates to its body with care. The partnership is a negotiated reciprocity, which either partner can abrogate at any time by failing to respond appropriately to the actions of the other. This is not full equality, of course, so different are the affordances of people and plants, but it is less hierarchical than most people–plant engagements.

This conceptualization of grafting as a partnership, one which is maintained over time and allows each party some autonomy in its actions, recalls work not only in vegetal politics but also in animal geography. Writing on the ethics of animal experimentation, Greenhough and Roe argue that animals, nonverbal as they are, can meaningfully consent to experimental practices if experimenters work to develop their own "somatic sensibilities" (2011). Rather than treating animals as mere grist for the experimental mill, animal scientists can give their research subjects an effective right of refusal by attending closely to their affect, movements, vocalizations, and other bodily processes. As Greenhough and Roe acknowledge (2011, 62), some of these registers of interaction are specific to animals: trees are too slow to refuse the grafter's manipulation outright and do not deal in affect or vocalization. Even so, the successful graft of an established tree depends on a variety of somatic sensibility in the grafter, who must develop a sensitivity to the tree's being, a learned familiarity with the give of its body and the sources of its vigor that operates in precisely the nonverbal mode Greenhough and Roe advance. The village grafter's somatic sensibility amounts to an accommodation that distinguishes his efforts from the orchardist's, a readiness to work with the tree's actions rather than negating or superseding them. Village grafters engage graftable trees in more equal partnerships than do other grafters, negotiating with them over decades as individual bodies with substantial autonomy while still shaping their growth in fruitful ways.

The distinctiveness of the forest grafter's somatic sensibility is reflected in the Kyrgyz terminology used to describe it. Kyrgyz, like other Turkic languages, is agglutinative; that is, it builds complex words from simple stems by appending strings of morphemes that each shade the stem's meaning. The word for grafting, found in agricultural dictionaries, is just such a complex word, *kyiyshtyr*-, but village grafters use *ula*- instead. When I asked a village grafter about the discrepancy, he told me that the textbook word is too close to *kyi*-, which means "to cut or slice." Indeed, the two are related: the longer word takes *kyi*- as its stem, to which it appends -*ysh*-, a reciprocal morpheme denoting two items acted on symmetrically, and -*tyr*-, a causative morpheme. Etymologically, *kyiyshtyr*- means something like "to cause to be sliced apart." This, the grafter observed, may be what grafting accomplishes, but it is no way for a person to treat a fruit tree. Laughing, he swung both arms in a grotesque hacking motion meant to connote a clumsy horticulturist chopping away with no regard for the tree, no somatic sensibility. By contrast, *ula*-, the locally preferred word, means "to lengthen by bringing end to end." For village grafters, this is a better way of describing what their grafting accomplishes. They find something repugnant about the textbook word, its etymology signaling an inappropriate instrumentalization of the tree's body when intersubjectivity is called for instead.

I do not intend to romanticize Kyrgyzstan's village grafters. They let trees grow in their own fashion partly because they do not have the resources to modify them as thoroughly as commercial orchardists do, and partly because they have no need to modify them so completely. Moreover, intersubjectivity is a common feature of grafters' thinking not only in Kyrgyzstan but around the world (Mudge et al. 2009). On our day in the forest, Karim voiced his desire to graft three different varieties of apple to the same trunk, in order to impress guests. Other village grafters express similar dreams, also with largely aesthetic justifications. How wonderful it would be, they enthuse, if one of my trees bore fruit both red and green, both tart and sweet, both big and small! Yet more wondrous would be the ability to graft multiple species or genera to the same trunk—the "cornucopia tree" that recurs in grafting lore everywhere (e.g. D. Lowe 2010). These visions represent what an infinite somatic sensibility might allow, and they appear not just in Kyrgyzstan's forest but in other settings where horticulturists work with tree bodies in grafting encounters. Wherever they arise, they signal the embodied interspecies engagement that the grafting of adult trees can initiate, a modality of intertwined interrelationship that scholars of vegetal politics have very effectively explored.

Antihierarchy 2: Graftability and Resource Politics

Human–plant partnerships can flourish wherever adult trees are grafted, but Kyrgyzstan's walnut–fruit forest is notable for the extent to which grafting figures in another political register as well, one more familiar to political ecologists. Specifically, the widespread graftability of the walnut–fruit forest figures in its resource politics. In the previous section, I argued that graftable forest trees engage humans as comparatively equal partners; in this section, I contend that graftability engenders an analogous equality in the resource politics of the forest, making graftable trees potential allies in campaigns against state-directed governance hierarchies. Three features of graftability are of particular significance in structuring forest resource politics: the special generosity of the graftable tree, its illegibility to state actors, and the informality of the economy that graftable life inhabits. By considering these effects of graftability on resource politics, I model the extension of vegetal politics into vegetal political ecology.

Graftability as generosity

The graftable fruit tree possesses what Diprose calls corporeal generosity (2002). Each graftable part can generate another instance of its own body, a generativity embedded not in special reproductive organs, as is true of sexually reproducing plants, but in the tree body at large. Just as Clark (2007) finds animal generosity in the relinquishment of control that accompanies domestication, graftability constitutes plant generosity—a pathway of reproduction along which plant material can ramify broadly under human stewardship. This pathway is supplementary in a sense, ancillary to the sexual reproduction that has dominated the evolutionary history of fruit tree lineages. Grafting emerged as a possibility only with the development of horticulture, when the character of graftability, formerly latent within the somatic processes of plant life, became capable of expression. Now, though, graftable trees have two means of reproducing themselves: the sexual, in which generativity is concentrated in the seed, and the vegetative, in which it is distributed throughout the body. In gamely building new bodies from scraps of old ones in response to latter-day horticultural imperatives, graftable plants achieve generosity.

Generosity upends ecological and economic systems of thought, which tend to theorize value within overarching regimes of scarcity instead. The ecosystem services literature, for example, posits selfish actors in competition; its interspecies relationships are transactional, and its objects possess value as resources (McAfee and Shapiro 2010; S. Jackson and Palmer 2015). If grafting is understood primarily as a means of enhancing the productivity of tree resources, it fits this “selfish” model. Prudham, for example, examines grafting’s role in developing proprietary conifers for corporate interests; his trees are machines being optimized to pad capitalists’ wallets (2003). Within the context of Kyrgyzstan’s graftable forest, however, grafting does more than improve individual bodies. Rather, it makes bodies themselves replicable in the forested landscape at large, so that a desirable apple tree can be readily reproduced wherever another apple grows. In the words of one village grafter, “If you see a tree whose fruit you like, around town or in the forest, you can just take a scion from it and have the same tree yourself” a few years later. Seen this way, graftable bodies are not machinic, as in Prudham’s treatment, but dynamic and generative (Jasarevic 2015). Some scholars have argued that all plants are effectively multiple (Firn 2004; Atchison and Head 2013; Marder 2013), but it is in fact only plants that are propagable by grafting and other vegetative methods that contain this embodied generosity, this potential of many in one and many out of one.

Generativity is not unique to the graftable tree; indeed, it recalls that of the seed, which political ecologists have considered at some length. Seeds encapsulate the power of plant reproduction, making seed governance an important political question for agricultural producers (Zimmerer 2003; Kloppenburg 2004; Phillips 2013). Unlike grafting and other methods of vegetative propagation, however, sexual reproduction yields something incrementally different from its inputs. In the case of the many crop plants which do not breed true, plants grown from seed differ substantially from their parents; it is precisely this feature that has made hybrid seeds such potent economic weapons (Yapa 1996). The seed is an obligatory passage point in agricultural reproduction, a bottleneck at which Capital has been able to exert outsized influence over the last five centuries of biotechnological development (Kloppenburg 2004). Grafting, on the other hand, is faithful reproduction. For graftable plants, the possibility of replication is not isolated in the seed, where it can be monopolized, but spread throughout the body.

This distributed reproducibility has remade the forest landscape of southern Kyrgyzstan. In the early days of their systematic modification of the walnut–fruit forest, Soviet foresters transformed one tract into what horticulturists call a "mother garden" (Rus: *matochnyy sad*)—an orchard of high-quality grafted trees, in this case apples, intended to serve as scion sources for nearby grafting projects. Seedlings were brought from Jalalabad, fifty miles away in the Fergana Valley, in 1938, and grafted with imported scions of domestic apples in 1940. Several hundred of these original trees continue to fruit, but they are well past their productive prime. Their twisted trunks are but part of the continuing life of these botanical subjects, however, for the mother garden did its job. Branches and buds were taken off them over the years and grafted onto other trees, in backyards and state-owned forest tracts across the region. Part of each of these grafted bodies is a clone of a tree in the mother garden, and each gnarled body there is by now genetically repeated across the forest, a single individual in discontinuous form. Even as the mother garden approaches senescence, the genetic identities that inhabit it will continue to be propagated indefinitely, for as long as their fruit interests grafters.

This is graftability beyond bodies, a feature of the circuits of life itself, which scatter tree parts across the landscape through the actions of interested villagers. Graftable trees are capable of fragmentation and coalescence, recombination and indeterminacy—they are, in a word, rhizomatic. Whereas the walnut–fruit forest's walnuts operate as isolable individuals, committed to arboreal (and arborescent) bodies from seedlinghood, its graftable trees are instead emergences from a broader field of graftable life. Horowitz characterizes the politics of rhizomatic structures as "loose, flexible, . . . nonhierarchical and highly dynamic" (2016, 169). In the context of the walnut–fruit forest, the rhizomatic performances that graftability enables contribute to similarly nonhierarchical partnerships, the circulation of scions underwriting flatter agricultural politics than the sourcing of elite seeds from state extension officers. By consenting to their own propagation so easily and so widely, the apples that resemble individual trees in Karim's forest plot exceed the "bounded and containable body" (Atchison and Head 2013, 964) of other organisms. With graftability suffused so widely in the walnut–fruit forest, the landscape at large is rendered less bounded and less containable as well.

Graftability and illegibility

Graftable plants are relatively intractable to state management not only for their generosity but also for the illegibility of grafted bodies. James Scott's influential work on governance has long dealt in legibility, from the concept's beginning as "a central problem in statecraft" in *Seeing Like a State* (Scott 1998, 2) to more recent work on subaltern politics. In *The Art of Not Being Governed* (2009), Scott locates some degree of ungovernability in the bodies of crop plants. In particular, he identifies "escape crops," which contribute, by features of their behavior, to the capacities of societies in upland Southeast Asia—what he calls "Zomia"—to evade state control. Plants that flourish at high elevation or in rugged terrain, for example, or which require little labor in their cultivation are good for feeding anti-state movements. Escapability is related to illegibility: crops which can be concealed while growing, or grown quickly and hidden, or which store well underground, easily escape the gaze of the state, a boon to communities trying to do the same. Taken together, escape crops figure in "appropriation-resistant forms of agriculture," which allow Zomian societies to evade the state rule that subsumes the "appropriable landscapes" of the lowlands (Scott 2009, 207–8).

Trees—visible, long-lived, largely above-ground—do not generally yield good escape crops. In Kyrgyzstan's walnut–fruit forest, however, graftability confers upon trees a sort of processual illegibility, allowing easily-seen bodies to make a difference in hard-to-see ways. In a forest of fruit trees, swapping out one branch for another leaves limited traces. As a result, for villagers hoping to get more out of their allotted leaseholds than the nut harvest to which they are legally entitled, or for those with similar ambitions but without any leasehold at all, forest grafting represents a more escapable option than unauthorized field cropping, orcharding, or haymaking. Even if a tree's grafting is detected by a state forester or conservation officer, it is impossible to tell who grafted it and difficult to prevent its happening again. Forest grafts are completed in a matter of minutes and sporadically revisited, a low-maintenance mode of horticulture that fails to maximize tree productivity but saves on human labor. The traces that grafting leaves are long-lasting, but identifying old grafts by sight is time-consuming and uncertain, as I found when I set out to map the grafted forest. Grafted trees are readily identifiable to residents of forest villages, who know and remember the sources of high-quality fruit, but finding them without local help is not easy. As a result, the grafter's work easily escapes the state's gaze.

To be sure, grafting does leave *some* trace. It takes several years for scions and stocks to grow together and conceal their union, and big eating apples do not resemble the small wild fruits they replace. Less obviously, many domestic apple varieties have lighter leaves than wild trees, or flower later, or branch at different angles and yield trees of distinctive shape. Where the scion grows faster than the stock, grafted trunks can develop distinctive overhangs as decades pass. These all *can* give away a graft, but even the most visible of these is far subtler than other interventions people make into forested landscapes. As a result, the grafted forest tree does not lend itself to responsibilization or propertization; state officials cannot easily lay the modified tree in the middle of the forest at the feet of any villager. The graft, in effect, does not give up its grafter, allowing for the quiet pursuit of forest horticulture out of sight of the state. And while forest grafting does not currently contribute to any anti-governing campaign to rival Scott's Zomia, it still eases villagers' pursuit of forest interventions which state agents would prefer to prevent. In his sweeping history of Africa's encounter with maize, McCann finds maize to be "the ultimate 'legible' food and crop, one that holds attraction for ambitious governments of large-scale projects" (2005, 205). By contrast, the graftable tree excels, like Southeast Asia's Zomian communities, in the art of not being governed.

Graftability and informality

The grafted tree's generosity and illegibility contribute to the informality of southern Kyrgyzstan's grafting economy. Long gone are the horticultural brigades of the Soviet era (see Chapter 3), as formal an instantiation of grafting as can be imagined. Although recognizably descended from such institutions, grafting in Kyrgyzstan today has become a technique of folk horticulture. One village grafter insists that grafting techniques have no names—"We haven't given them names. It's all 'grafting'," he tells me—while another says he doesn't know "the names the government gives" the different varieties in his apple orchard. If names belong to the government, practical know-how acquires a populist flavor and a moral economy to go with it. Village grafters boast that they learned the skill from their fathers, with no hint of formal instruction, and see their work with forest trees as rooted in informal institutions of ethnicity (Kyr: *Kyrgyzchylyk*), religion (Kyr: *Musulmanchylyk*), or community (Kyr: *jamaat*). By grafting the forest and making it more fruitful for those who live in it, they demonstrate a culture of localized hospitality, they contend, and stand against new formal systems imported from outside the village. Several grafters are described by their neighbors as "professors without degrees," horticultural experts not beholden for their authority to state or market. Within grafting's informal moral economy, this makes them reliable, and the scions they offer their neighbors are judged much more trustworthy than those sold at bazaars in the valley.

One factor in the ascent of grafting as an informal institution of populist horticulture is its descent in the formal realm of forest policy. In fact, the very legality of grafting in the forest is murky, the casualty of a law designed to ban walnut logging that seems to have criminalized grafting too. Kyrgyz politicians have found a source of nationalist pride in the world's largest walnut–fruit forest, with some demagoguing the cutting of walnuts as an affront against the nation–state. In 2006, Decree of the President of the Kyrgyz Republic #331 imposed a blanket ban on cutting in the forest over the protests of forestry scientists, who would prefer to incorporate selective logging of over-dense walnut stands into management regimes (Venglovsky et al. 2010; Kutueva 2012). Grafting entails some cutting, although presumably not of the sort to inflame nationalist passions. Would the ban on forest cutting actually be enforced against grafters? I got a variety of answers to that question from state foresters and village grafters, with most suggesting that forest grafting was probably legal but that grafters should obtain permission from the *leskhoz* for their forest work. Of course, with the practice as illegible and informal as I've been arguing, this does not much happen. As one grafter asked rhetorically, "Who's going to see?!" The following exchange with another grafter—himself a state employee—was representative:

> JF: If you want to graft in the forest, do you have to ask anybody's permission?
> Aibek [immediately]: Yes, the leskhoz.
> JF: So, when you grafted this March, did you ask the leskhoz's permission?
> Aibek [immediately]: No.

To be sure, there are plenty of other activities about which this exchange could be had in rural Kyrgyzstan. In the case of grafting, however, this garden-variety state weakness is exacerbated by the material performances of graftable trees. Easily replicable and difficult to target with state action—generous and illegible, that is—graftable trees engage humans informally. Grafting law remains unsettled partly because graftability ensures the difficulty of settling it.

One day in spring 2012, I ventured into the forest with Almaz, the most prominent grafter in one forest village. Almaz showed me a forest tract where more than 100 apple trees have undergone bodily improvement at his hands. Other than one graft of a domestic plum on a wild cherry, the trees that Almaz had grafted here are all wild-growing apples fitted with domestic scions brought from orchards in the village two kilometers away. Almaz told me that he grafts only ten trees a year here, picking those with good sun and southern exposure, youth and vigor, good erect habit, and tall enough that the graft can be sited beyond a horse's reach. Why only ten trees a year? Because grafting is against the law, he explains, and the woody refuse that each graft's preparation produces, if multiplied by too many grafts, may attract attention. Worse, a failed graft can leave a tree stunted or dead, which will further draw the gaze of state foresters. As a precaution, Almaz has grafted only a few apples a year, modifying forest trees carefully and keeping to the informal realm that most partnerships between village grafters and graftable trees inhabit.

Conclusion

I have argued that the graftability of many trees in Kyrgyzstan's walnut–fruit forest predisposes its environmental politics away from hierarchy. I suggested that this effect is due both to the mode of intersubjectivity that forest grafting engenders and also to the generous, illegible, and informal operations of graftable life in the broader politics of the forested landscape. The first of these, which can lead to a sort of somatic sensibility, arises from the long collaborations that village grafters enter into with forest trees; it concerns an embodied interrelating that has been well investigated by scholars of vegetal politics. The second of these, on the other hand, extends the consequences of graftability into topics of greater interest to political ecologists, including resource distribution and state–local relations. In doing so, I contribute to the construction of a political ecology more alive to planty considerations—a vegetal political ecology.

This is a fairly speculative argument, and there are several complications I should acknowledge. First, the reality of the state in rural Kyrgyzstan is intermittent at best (Reeves 2014), so the capacity of graftable trees to evade state control is not often tested. Moreover, it is ungraftable trees—walnuts—that feature most prominently in local livelihoods, circumscribing graftability's political importance. Finally, plants can do more than participate or not participate in grafting. The political lives of apples and walnuts grow not only from their modes of propagation but also from their size, their longevity, the range of conditions and exposures and altitudes in which they consent to grow, and the quality, taste, transportability, and marketability of the fruits they produce. As actors with particular ways of being and doing—only one of which is graftability—trees inhabit some positions in political assemblages more easily than others. This exploration of the political consequences of graftability should be understood, then, not as an exhaustive reckoning of vegetal politics but as a sketch of one facet of that reckoning.

While Kyrgyzstan's walnut–fruit forest is today governed by a strongly hierarchical state forest apparatus, its general graftability may impel future forest governance away from that hierarchy. Graftability is, in short, a small biological determinism in favor of decentralized politics, a material specificity that allows the partnership of human and tree through the horticultural capacities of interested people and the somatic capacities of generous plants. Thanks to graftability, botanical material more easily crosses the lines of control the state seeks to impose on the landscape between orchard and forest, and between different parcels of forest. As a result of the biophysical capacities of the plants that can do it, graftability embeds a weak tendency toward autonomy in the bodies that possess it, and in the partnerships and assemblages that include them. By exploring these broader relations of graftability, I have worked toward vegetal political ecology, in which the consequences of plantiness are extended into political ecology's terrain.

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