FOLK VALUATION OF CHESTNUT DIVERSITY IN TURKEY: TOWARDS LIVELIHOOD-CENTERED CONSERVATION

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FOLK VALUATION OF CHESTNUT DIVERSITY IN TURKEY:

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The recent increase in disease pressure on chestnut populations in Turkey compromises the livelihoods of thousands of growers, erodes the genetic diversity of the species, and threatens the viability of culturally important traditions around food and environmental maintenance. Currently, a number of endeavors are being attempted to conserve chestnut resources in several locations throughout the country. However, only a small percentage of the total number of trees can benefit and there is no method in place for the strategic selection of tree varieties or regions for the implementation of blight control. The geographic region of highest genetic diversity, domestication and longest-standing cultivation of the European chestnut is in Eastern Turkey and the Caucasus. This research will explore the features of local genetic stewardship in the face of a disease epidemic by considering ethnographic, genetic, epidemiological, plant morphological and ethnobotanical attributes of a single species in a single region, the European sweet chestnut (*Castanea sativa*) in Turkey. The four chapters of this dissertation, respectively, 1.) argue for consideration of folk value – defined as value to cultural cohesion and survival – in agricultural plant conservation; 2.) capture an instance of humans-as-landscape-members through documentation of immediate human niche construction and, its corollary, cultural resilience, in the form of community actions to tailor plant populations to conditions of increased pest and disease pressure brought on by economic globalization; 3.) demonstrate a method of engaging the muted biological knowledge of women and other marginalized groups; and 4.) demonstrate the power of folk value to motivate widespread biological conservation and to characterize ecological knowledge. These research products will inform on-going chestnut conservation activities, and in doing so, highlight the necessity and feasibility of conducting conservation programs which reinforce the livelihoods and cultural survival of local managing communities.

BIOGRAPHICAL SKETCH

Jeffrey Robert Wall Junior was born in Denver, Colorado and grew up in Irving, Texas, the eldest of four boys. He completed his undergraduate education in Anthropology and Geology at the College of Charleston in South Carolina in 2004. He later moved to Cairo, Egypt and taught English composition and history to fifth and sixth grade Egyptian children. After marrying, Jeffrey was employed for several years in the organic vegetable farming sector in upstate Pennsylvania and the Southern Tier of New York State where he worked as a cultural facilitator and translator for Egyptian field crew at Norwich Meadows Organic Farm and helped to establish the Ant Hill Organic Farm in Honesdale, Pennsylvania. He completed Peace Corps Service in Azerbaijan in 2011 in fulfillment of a Master of Professional Studies in International Agriculture and Rural Development at Cornell University. He enrolled in the M.S./PhD Program in the Department of Natural Resources in 2012. During his studies, Jeffrey became the proud father of two sons.

DEDICATION

Dear Shira,
I am rich in the way you show me the world
In your belief and yearning, I am who I always was,
I remember why I became in the first place,
Because you.

ACKNOWLEDGEMENTS

This work would not have been possible without an endless supply of blind generosity. My gratitude is endless, or as they say in the Turkish, *sonsuz*. First, I thank my family. My sons, Ben and Asher, and my wife, Shira, have, at all times, and in every way, showered me with happiness and inspiration. I thank my colleagues at Istanbul University and Hacettepe University for their trust and generosity. In the implementation of this work, they absorbed substantial risk. They did so fearlessly. I thank my committee. They have shaped and enriched this work with unfathomable expertise from disparate fields. Their expansive and hopeful world-views have given this work oxygen it needed to live. I am indebted to my advisor, Shorna Allred, and the confidence and competence she brought to this research. I am thankful for all of the support offered by the Cornell University Department of Natural Resources, Istanbul University Forestry Faculty, Hacettepe University Department of Anthropology and the Turkish National General Directorate of Forestry, especially their provincial offices. I am incredibly thankful for the American and Turkish sponsors of this work including the Cornell College of Agriculture and Life Sciences International Programs Office, the Scientific and Technological Research Council of Turkey, the American Research Institute in Turkey, the Turkish Fulbright Commission, and the Borlaug Fellows Program.

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INTRODUCTION

The recent increase in exotic pest and disease pressure in Turkey compromises the genetic diversity of the European chestnut species and the viability of the livelihood traditions which maintain it. As is increasingly common for forest species around the world (Desprez-Loustau et al., 2016), exotic pathogens for the European chestnut in Turkey have increased in number, in prevalence and in severity. In chronological order, ink disease caused by the oomycetes *Phytophthora cambivora* (Petri) Buisman and *Phytophthora cinnamomi* Rands (Erdem, 1951), the chestnut blight caused by the fungus, *Cryphonectria parasitica* (Murill) Barr (Akdogan & Erkman, 1968), and most recently, the gall wasp, *Dryocosmus kuriphilus*, Yasumatsu (Cetin, Orman, & Polat, 2014) all now take their toll on the European chestnut populations in forest, naturalized and highly managed contexts alike. The Turkish State General Directorate of Forestry (OGM) as well as independent scientific, and international organizations are all presently taking measures to conserve the species population. However, all trees cannot benefit, and there is no method in place for selecting the optimal trees for conservation. Further, these efforts have no means of accounting for the cultural value of specific chestnut traits, cultivars and geographic populations to the chestnut-utilizing community of Turkey.

This dissertation introduces a novel methodology of folk valuation to address this timely need. Derived from economic, ethnobiological, plant pathological, and geographic methodologies including folk classification, ethnography and value chain (*filière*) analysis, this work enlisted individuals, households and livelihood-communities in a joint exploration and learning effort to identify the most valued traits, cultivars and populations of the European chestnut (*Castanea sativa*) for Turkish people. Results of this work will 1.) contribute to scientific literature pertaining to anthropogenic maintenance of biological diversity in the

Anthropocene; and 2.) give voice to value and care for chestnut traits, cultivars and populations held by 'muted' social categories so that these can characterize on-going efforts to conserve chestnut resources. This effort outlines an important approach to equitable prioritization of biological resources for conservation in the growing urgency of the Anthropocene.

Anthropogenic Maintenance of Biological Diversity

The extant genetic diversity of crop and semi-domesticated species is perhaps the most enduring evidence of traditional maintenance of biological diversity (Altieri, 2004; S. B. S. Brush, 1995; Food and Agricultural Organization, 1973; Harlan, 1992; Jarvis et al., 2008; Thrupp, 1998; Vavilov, 1926). These plant resources in their entirety, whether maintained in-situ in farmers' fields, or ex-situ in gene banks and botanical gardens, are known as Plant Genetic Resources. The International Treaty on Plant Genetic Resources (PGR) for Food and Agriculture defines PGR as "any genetic material of plant origin of actual or potential value for food and agriculture" (Food and Agricultural Organization, 2009). A century of international effort to monitor and protect these resources has demonstrated that smallholder farmers, whose knowledge and practices maintain the highest crop genetic diversity in the world, are essential allies (Altieri, 2004; S. B. S. Brush, 1995; Food and Agricultural Organization, 1973; Harlan, 1992; Jarvis et al., 2008; Thrupp, 1998; Vavilov, 1926).

Ethnoscience studies of the mechanisms of this maintenance turn up a striking array of practices at a range of spatial scales. Traditional agricultural communities maintain and employ crop diversity in a number of agronomic forms such as seed mixtures (Allard, 1961; Smithson & Lenne, 1996; Woldeamlak, Bastiaans, & Struik, 2001; Woldeamlak, Grando, Maatougui, & Ceccarelli, 2008), poly-cultures (Clawson, 1985; Tuxill, Reyes, Moreno, Uicab, & Jarvis, 2010; Watts, 1987) and complex parallel and staggered sowing and harvest schedules for various crops

and landraces (Asfaw, 2000; Cockram et al., 2007; Ehlers & Hall, 1997; Ferguson & Mkandawire, 1993). Traditional approaches have been observed to consciously facilitate gene flow between crops and their wild relatives on the farm (Jarvis & Hodgkin, 1999) and over a landscape scale (Beebe et al., 1997).

At the level of landscapes, considerable research suggests that pervasive cultural management of low to intermediate intensity maintains, and may even increase biodiversity in space. Apart from direct utilization, small scale societies both past and present have historically implemented widespread and periodic disturbances as a deliberate act of livelihood. Across the eastern seaboard and west coast of today's United States (K. Anderson, 2006; Blackburn & Anderson, 1993; Rostlund, 1957; B. D. Smith, 2009), in the Mediterranean (Behr, 1990; Blondel, Aronson, Bodiou, & Boeuf, 2010), British Columbia (Johnson-Gottesfeld, 2016), East Asia (Pimbert & Pretty, 1995), and Australia (Hill & Press, 1994; Roberts, Jones, & Smith, 1990), environments characterized by routine and widespread anthropogenic disturbance, typically fire, maintain biological diversity. It is subsequently argued that the creation of landscape mosaics, by fire and other means, can increase species diversity via the multiplication of edge space advantageous for certain biological communities (Lewis & Ferguson, 1988; B. D. Smith, 2009; E. A. Smith & Wishnie, 2000).

A considerable number of studies in ecology and pathology have attempted to flesh out the role of biological diversity in community susceptibility for pathogenic infection and spread. There is a growing consensus that risk of disease is reduced with increasing biological diversity and that this can occur through several mechanisms at different scales. At the community level, transmission of pathogen fatal to one species often occurs via other species for whom the pathogen is not fatal. Increase in the presence and diversity of such species has been observed to

cause a dilution effect (Levi, Keesing, Holt, Barfield, & Ostfeld, 2016). Increasing diversity of community assemblages acts to decrease the likelihood of transmission to the most competent hosts (Johnson, Preston, Hoverman, & Richgels, 2013).

At the level of the individual species, genetic diversity has been correlated with disease resistance in populations through a few approaches. First it is well established that inbreeding results in decreased reproductive fitness (Frankham, Briscoe, & Ballou, 2002). This mechanism has been demonstrated to work through the mutation of specific loci necessary for disease resistance (Spielman et al. 2004:446; Pearman and Garner 2005). Further, spread of infection has been correlated with lower genetic difference with individual neighbors (Altermatt & Ebert, 2008). Many principles from this ecological literature, unsurprisingly, have been shown to be at work in agro-ecological systems, primarily at the level of fields and farms. Polycultures, cropping systems involving two or more co-crops in cultivated space, have been demonstrated to imbue disease and pest resistance through various and intricate means (Letourneau et al., 2011; Powers, 1987; Upadhyaya, Ortiz, Bramel, & Singh, 2002). For example, varietal mixtures, have been shown to offer protection against disease advance in populations (Gibson 2009; Smithson and Lenne 1996;Ssekandi et al. 2016). Also, at the scale of the variety or landrace, studies verify a correlation between intraspecific genetic diversity and disease resistance (Leur, Ceccarelli, and Grando 1989;Naegele et al. 2014; Singh 2002).

These insights are coming into port simultaneously with near-total confirmations of humanity's aggregate threat to biological diversity. It is indisputable that anthropogenic influence has ushered in an era of unprecedented decrease in biological diversity (Soule, 1991; Wilson, 1988). The planetary extent of human influence has led to calls for the identification of a new geologic era known as the Anthropocene (Crutzen, 2006). Part and parcel of this new era is

the looming sixth mass extinction of biological species, sometimes called the Holocene extinction (Barnosky et al., 2011; Ceballos et al., 2015). Less well-known, however is that significant correlation has been observed between decreasing cultural diversity and biological diversity(Loh & Harmon, 2014). This has led to calls for calls to conserve biological and cultural diversity in tandem, and to conceive of these resources as coupled (Rapport & Maffi, 2010). In light of these realizations, pathogenic spread through globalized trade demands studies which address the biocultural implications. This is equally true in a global context where forest pathogens continually increase in prevalence and severity (Brosius, 1997; Desprez-Loustau et al., 2016; Ghelardini, Pepori, Luchi, Capretti, & Santini, 2016).

Threat to Chestnut Value

The European chestnut (*Castanea sativa*) is a tree species of considerable cultural and economic importance throughout Turkey. It is found today in the total geographic range allowed by its physiology, thanks to 9000 years of anthropogenic maintenance (Conedera, Krebs, Tinner, Pradella, & Torriani, 2004; Krebs et al., 2004; Claudia Mattioni, Cherubini, Micheli, Villani, & Bucci, 2008). Everywhere, it is prized for its nuts and timber in addition to a surprising diversity of other uses (Avagyan et al. 2009; Bobokashvili and Maghradze 2009; Diamandis 2009; Mujic et al. 2009; Russel 2009; Soylu et al. 2009). As the Greek traveler Xenophon documented, chestnut was an important food for the people of Eastern Turkey and the Caucasus as long ago as the fourth century B.C. The tree and its use spread from this region around the Black Sea and eventually to mainland Europe.

Across Turkey, Chestnut populations are maintained through a wide variety of approaches that optimize provision of various benefits. In the dense forests of the Eastern Black Sea, chestnut is logged heavily along with numerous other hardwood species. Seasonal

production of honey from the chestnut inflorescence vastly outweighs the collection of chestnuts in household importance. In the Western Black Sea as well as western Marmara, chestnuts are collected predominantly after falling naturally to the forest floor and collection amounts to a minor household income activity. In contrast, in Aegean and eastern Marmara chestnut cultivation is practiced in orchard settings and represents a premier economic activity. The vast majority of trees are grafted with favored cultivars. In the Aegean sites and throughout most of eastern Marmara, nuts are collected in the husk after being knocked out of the tree with a stick just prior to natural ripening.

In Turkey the chestnut blight is the most noted threat to the European chestnut species. However, two other significant pathogens, which came before and after chestnut blight respectively, are ink disease and the gall wasp. Ink disease is caused by two species of the oomycete Phytophthora family, *cambivora* and *cinnamomi*. Affected specimens exude a black compound at the base of the tree which colors the soil black, as the name suggests. The affected zones of the collar and root suffer from the onset of necrosis, which in turn leads to damage to stems leaves, crown and bark (Vannini & Vettraino, 2001). The disease was first observed in Spain in 1726 (Crandall, 1950), and has since spread to numerous surrounding countries including Turkey where it was observed in 1925 in the Black Sea Region (Bicici & Cinar, 1990).

The origins of the chestnut blight fungus, *Cryphonectria parasitica*, so famous for its ravages in North America, are in East Asia. On the tree, *C. parasitica* develops into the characteristic rupture in the bark known as a canker, from where it girdles and kills the trunk. In Turkey, the first observations of chestnut blight were made in 1967 in the Marmara Region (Akdogan & Erkman, 1968). Blight was observed in the Black Sea region much later in 2001 (Çeliker & Onoğur, 2001). However, there is recent evidence to suggest a much earlier and

seemingly less virulent introduction of the chestnut blight fungus in Georgia to the east of Turkey (Prospero, Lutz, Tavadze, Supatashvili, & Rigling, 2013). Adding to the complexity of the epidemiological environment, the natural presence of what is known as *hypovirulence*, has been observed throughout Turkey (Akilli et al. 2013; Akilli et al. 2009), especially in the Black Sea region (Omer Erincik, personal communication). Hypovirulence occurs when a naturally occurring virus, which also originally from East Asia, infects the chestnut blight fungus and diminishes its virulence. Currently, there is no consensus on where or the degree to which hypovirulence is mediating blight severity.

The gall wasp, *Drycosmus kuriphilus*, is native to China and has been inadvertently introduced to Korea, Japan, and the United States in the 1970's and later to Continental Europe in 2005 (Quacchia, 2014). The gall wasp causes galls on new shoots which leads to drastic decline in tree health and production levels. Larvae develop within the galls and emerge in the spring to start the cycle anew (Graziosi & Rieske, 2014). This pest was first observed very recently in Yalova and Bursa in 2014 (Cetin et al., 2014).

Who Cares? ‘Who’ and ‘Care’ as Core Research Themes

Turkey is a large, modern upper middle income Republic (World Bank, 2015). As such, an issue attention cycle as described by Downs (1972) is at work regarding a range of ecological issues. 'Who cares about chestnut trees in Turkey?' is not just a legitimate question in this context, it is a valid and challenging research question. This research effort turned on two core themes which stemmed from this question: 1.) Who and 2.) Care. This investigation made the theoretical assumption that the response to this question would be ‘vocalized’ in the form of specific conservation action, or the absence thereof. In this sense, many actors are making their voices heard on this issue. Government ministries, international agencies, local scientists and

university staff, acting sometimes independently, and sometimes in concert, comprise the most robust voice on this issue, and their actions translate into immediate consequences for the likelihood of survival for many traits, cultivars and populations. European-Asian hybrid scions are being grafted onto native rootstock in many areas of the country. Biological control trials, some concluded and others ongoing, maximize the survival chances of specific trees in specific places, some privately and some publicly-owned. These activities represent statements of valuation for particular trees, particular kinds of trees and particular traits.

Determining 'who cares, but is not being heard?' was an issue of considerable importance to research design and took several forms. These were seen to be interconnected. A first form was identifying participants based on their known practices. Purposive sampling, or sampling with purpose, was employed to find specific people who utilized chestnut trees. By first launching the program with rural villagers and, from there, working towards building perspective on ecological dynamics, policies and value, a primary inversion of voicelessness was achieved, whereby rural smallholder voices were heard before urban technocratic ones (Tas & Lightfoot, 2007). Second, by employing a gender-distinct protocol in half of village sites, we made great strides to engage another commonly muted social category. Third, by purposefully engaging villages, households and individuals known locally for their association with chestnut, we achieved an on-the-ground vantage point for engaging care. Finally, it was individual rural smallholder participants who defined the path towards others for ethnographic and value chain research.

Each chapter found herein can be understood as an investigation pivoting on both 'who' and 'care' with an overt goal of creating knowledge to characterize conservation activity. Chapter one introduces the idea that conservation is curation in the Anthropocene. Thus, this

theoretical work overtly conceptualizes conservation as a process of care and/or value. In the midst of a veritable infinity of extant biological resources to conserve, some are inarguably eligible. Plant Genetic Resources (PGR) enjoy such status. I show how the value and care of rural cultures who have stewarded these resources into the present, may very well be neglected and lost in contemporary PGR accession and management procedures. Drawing on insight from environmental ethics, anthropology of value and the ontological turn in the social sciences, this chapter reflects deeply on the sociality of PGR conservation. The results indicate that the PGR conservation mission, according to its own statements of purpose, and according to more global common-sense expectations of its purpose, should reflect deeply on the operating conceptions of plant value.

Chapter two is a unique investigation of dimensions of biological care rarely seen. With footing in Human Niche Construction Theory, this chapter investigates human ecological maintenance at the landscape-level under a period of pronounced disease and pest pressure. What complicates any social research that might assume human niche construction is the issue of human agency. At the landscape level we see that certain anthropogenic factors, along with environmental factors, are correlated with high tree health. At the level of the household, we see that the cultural resilience attributes of memory, learning and connectedness act as important regulators of successful, disease mitigating, niche construction. What emerges is a lucid picture of cultural resilience and niche construction as mutual forces, together fueling local and national-level responses to disease and pest pressure on the chestnut species in Turkey.

Chapter three describes an ‘extra’ effort to engage women’s knowledge of the chestnut species in this very same context. In its inception, it thus represented a who-centered investigation. Our results indicated that women’s reported knowledge, derived from forty-eight

women-only interviews, was very different from men's. Specifically, we demonstrated that women care about the chestnut species in very different way than men. The piece is full of examples which bring texture to the concept of care and value. For instance, women were infinitely more likely than men to report chestnut-related riddles, poems and songs, along with narratives of the special importance of these to their life histories. This chapter described its results in light of intersectionality theory, which states that marginalization and voicelessness occur through triangulating forces that act upon the various identities individuals hold. While we argue successful approaches to engaging women's knowledge is a great first step for disciplines like ethnobiology, extra effort may also be required to investigate the various, muted knowledge of different ethnicities, religious minorities, and more.

The central goal of chapter four is to demonstrate an operational folk valuation, as advocated in chapter one. In other words, this work attempts to expansively engage the people who value, or care about, the chestnut species across Turkey and to methodically engage that care. Bringing together methodological approaches from ethnobiology, participatory plant breeding, value chain studies and multi-site ethnography, this chapter documents an attempt to study value for the chestnut species in Turkey. A key association in the chapter is knowledge and value. Expanding on established approaches for investigating cultural significance in ethnobotany, knowledge is engaged as a proxy of care, or value. Specifically, this chapter turns on the study of traits reported in ethnobotanical interviews with numerous chestnut value-chain groups including collectors, growers, carpenters, boat-builders, basket makers, timber millers and more. Results reveal a substantial amount of care away from the sites of population maintenance. Also, results demonstrate that value characterizes knowledge in a myriad of ways, depending on a number of contextual factors. Ethnographic material sheds light on how this deep

geographic, cultural and historical context characterizes interplay between knowledge and value. As a whole, chapter four outlines an approach to taking stock of the value of threatened biological resources under the severe uncertainty of the Anthropocene. This approach, by methodically including voices that are traditionally muted by market and central government-dominated approaches to characterizing biological value, represents a window into the timeless biological care which predates industrial modernity and may outlive it as well.

From Participatory Action Research Principles to Concrete Research Objectives

This research set out to learn from those who are not traditionally asked. This is a common approach for the researchers and practitioners intent on changing the world or their phenomenon of interest. Habermas reasoned how such action can be a central feature of research behavior in his work, Communicative Action (1981). Here, and in later works, he lays out a new category for understanding the role of communication, with special attention paid to its oppressive and its emancipating potential. He proposed communicative action as an alternate mode to instrumental or strategic action, that research traditionally associated with dominating social tendencies. Communicative action, by contrast, is "oriented towards 1.) mutual understanding, 2.) unforced consensus about what to do, and 3.) making a communicative space." (Kemmis, 2001:103) This dissertation, and all of its parts, are oriented around this aspiration to communicate differently. Our approach was to develop robust methods to purposefully identify and engage those who care deeply about the tree species at this timely juncture. We then sought to engage and give voice to their care in the realms of ecology, ethnobotany and biological conservation.

CHAPTER ONE

The Case for Folk Valuation of Plant Genetic Resources

ABSTRACT

This work brings together evidence from the historical, ethical and cross-cultural dimensions of Plant Genetic Resource (PGR) conservation to argue for an accounting of folk value in the collection and safeguarding of plants humankind needs to survive well. I devise the term folk biological value to refer the constellation of values for the living world that are vital to cultural cohesion and survival, as opposed to individual well-being. I argue that PGR conservation began in the Soviet Union committed to defending both biological and cultural, or biocultural, diversity. Without this commitment, I argue, today's singularly utilitarian valuation of PGR risks eroding the cross-cultural value which stewarded PGR into the present, and which continues to motivate plant conservation around the world. By accounting for folk value, PGR maintenance and conservation can safeguard more optimal plant collections while bolstering the world's persistent and diverse cultures of plant conservation. Such an approach is congruent with the scientific truth for which Nikolay Vavilov stood and for which he was killed: that we shall not survive meaningfully without biocultural diversity.

Keywords

Plant Genetic Resources (PGR), conservation ethics, Nikolay Vavilov, anthropology of value

INTRODUCTION

Ours is an era of immeasurable biological loss caused by the human species. The dawning, twin, realities of the Anthropocene (Crutzen, 2006) and the Sixth Mass Extinction (Barnosky et al., 2011), taken together, reveal that those parts of the biosphere not bolstered by anthropogenic forces, face accelerating risk of extinction. In this context, identifying and supporting enduring and complex conscientious biocultural associations – or meaningful patterns of interaction, exploitation, and maintenance between a people and a biological community – represents a premier strategy for conserving biological richness and complexity. This framing aptly contextualizes recent ambitions such as coupled-human and natural systems (CHANS) (Liu et al., 2007), cultural landscapes (A. Phillips, 1998), and socioecological resilience research (Adger, 2000).

However, there are urgent and critical constraints on this approach. For one, cultural diversity is also in steep decline, and this decline, through a mist of under-studied mechanisms, is inextricably related to the loss of biological diversity (Loh & Harmon, 2014). Likewise, the provision of cultural erosion is not random; it is the cultures most intensively associated with their local ecologies, namely indigenous and tribal peoples, who are most likely to face cultural extinction (Fleming & Ledogar, 2008). These factors, and many more, demonstrate the necessity of achieving simultaneous biological and cultural conservation which meets certain standards of ethics and efficacy. Yet the languages and models of biological conservation and cultural conservation are uniquely incompatible. To illustrate, asking what it means for a culture to survive and for an individual survive conjures entirely distinct modes of thought. In the first case, an individual is thought to be surviving, in conventional wisdom, if their heart is beating, though they may be comatose. In other words, individual survival is commonly known as a

medical if not mechanic diagnosis. A culture, on the other hand, is thought to be surviving if some unknowable recipe of its institutional, linguistic, culinary and aesthetic traditions are being maintained by a number of individuals deemed sufficient. The designation of cultural survival, rightfully or not, lends itself to more interdisciplinary modes of thought. This essay deals squarely with this dissonance through a theoretical consideration of the global biological conservation program to conserve the plants humankind needs to survive. This large interconnected endeavor to collect and safeguard the seeds and tissues of valuable plant species is known as plant genetic resource (PGR) conservation.

In this work, I bring evidence from the historical, ethical and cross-cultural dimensions of PGR conservation to argue that meaningful consideration of folk value for these plant materials will lead to better germplasm collections, characterized as they are by a singular utilitarian value. Folk biological value is a term I have devised to refer to the constellation of values for the living world that are vital to cultural cohesion and survival, as opposed to individual well-being. I begin constructing this argument by briefly reviewing the historical conditions in which PGR conservation was first conceived and implemented. The scientists who achieved this, in particular one Nikolay Vavilov, were invariably persecuted and killed. Through my review, I show that the initiation of PGR conservation by plant scientists in the Soviet Union explains this martyrdom as occurring on behalf of a deeply motivating ethnobiological, rather than a merely biological truth. This truth can be stated simply: both biological and cultural, or biocultural, diversity is necessary for meaningful human survival. In the second section, I show how the practice of PGR conservation, led by Post World War II European and American powers, began and carried on explicitly without this core, original, charge of defending biocultural diversity, and instead charged itself with a strictly biological, utilitarian mission. I show how this approach

has led to notable internal contradictions that are ethical in nature. Drawing on environmental ethics, I argue that to resolve these contradictions, PGR conservation must broaden the horizons of recognizing value, or valuation, for plant materials in both collection and maintenance practices. In the third section, I account for the expansive geographical, cultural and historical diversity of PGR past and present by drawing on the discipline of cross-cultural research, anthropology. considering their value in the light of ethnographic record of value in general, and plant value in particular. I conclude by drawing all this evidence together to show how PGR conservation and management that internalizes multiple equally weighted value systems can become an invaluable resource for a survival worth aspiring to.

ORIGINS OF PLANT GENETIC RESOURCE CONSERVATION IN THE U.S.S.R.

Figure 1 Top left, Svalvard Global Seed Vault in the Norwegian Arctic (Global Crop Diversity Trust). Center, Vavilov and peasant woman collecting wheat samples in remote Daghestan (photograph taken within the Vavilov Institute in St. Petersburg 2013, courtesy of the Lee-Hickey Laboratory, University of Queensland, Australia). Bottom right, aerial view (Google Earth). of Mexico's Chihuahua Canyons, a secondary center of maize diversity in today's Mexico (Perales & Golicher, 2014).

When expansive cultural and institutional change arrives in new lands, it is often adopted in substantially altered form. The enlightenment for instance, the ideological well-spring for early democracies in western Europe and North America, has been said to have "arrived in central and eastern Europe as a centralizing, rather than a liberating force." (Gellner, 1994:14) In this section, I show how much the same occurred with the arrival of plant genetic resource (PGR) conservation in post-World War Two Europe and North America. PGR conservation was first developed and undertaken by scientists in the U.S.S.R. in order to salvage the extensive and diverse agricultural seed and tissue holdings of traditional peasant communities in the Soviet Union, and all around the world. Then as now, these materials were an invaluable resource for plant breeding, and they were disappearing rapidly in areas under rapid industrial agricultural development. What is easy to overlook, however, is that this scientific program was insubordinate to a Soviet government set on the wholesale delegitimization and elimination of the peasantry (Fitzgerald, 2003; Scott, 1998). This is because PGR conservation represented iron-clad proof of the necessity of diverse cultures and ways of life at a time when the state was deeply invested in implementing programs of peasant dispossession and collectivization throughout its territories.

The Soviet Government read politics into any and all societal developments. The two major political liabilities of the creation and implementation of PGR conservation were the science of genetics and agrarian policy. The science of genetics, and its development in the U.S.S.R., was of existential interest to the communist party under Stalin. Secretary P N Yakovlev explained this interest crisply, "ethnic minorities are, of course, inferior to us in every respect…but after two or three generations of living under the conditions of socialism, their genes will have so improved that we would all be equal" (in Nabhan 2009:184). On-goings in

genetics were screened, censored and engineered by the communist party in order to ensure support for the social engineering of a new breed of human, *Homo sovieticus* (Gessen, 2017). The regime was critically invested in the promotion of Lamarckian theories of heritable change, and fought to suppress evidence of evolution by natural selection. These dynamics gave rise to one of the most well-known stories in the history of biology, the orchestrated defeat of the Mendelian geneticist Nikolay Vavilov through Stalin's scientist-puppet, and Lamarckian geneticist, Trofim Lysenko (Joravsky, 2010).

Nikolay Vavilov (1887-1943) is the legendary founder of the theory and practice of Plant Genetic Resource (PGR) conservation (Figure 1). Many of his prognostications and prescriptions for preserving the world's PGR for food security, laid out in the classic work, *Studies on the Origins of Cultivated Plants* (1926), have been validated over the last century (Harlan, 1992; Nabhan, 2009). These were founded on several original and interdependent assertions. First, each of our domesticated species is the descendent population of a selection event which occurred in a discrete geographic area. This specific geographic place of selection, he called, 'the center of diversity' for that crop. In other words, the highest phenotypic and genotypic diversity for a domesticated species could be found in the region where they were domesticated. Second, this genetic diversity in this place was invaluable as a resource for plant breeders in their continual search for novel traits, such as disease resistance and tolerance to climatic stress. Yet, the notable advances of industrial agriculture, driven in part by the replacement of old crop varieties with the newly bred, were rapidly levelling this invaluable diversity. Third, it was essential to conserve this diversity by means of scientific intervention, primarily through the collection and maintenance of seeds. Vavilov demanded that seed collection protocol entailed a thorough and recorded exchange of knowledge with the human communities that actively and consciously

maintain landrace varieties, as well as habitat for wild relatives in surrounding landscapes (Nabhan, 2009). This final, necessary, point is often muted in narratives of Vavilov's scientific contributions, even though these public overtures to peasants in the U.S.S.R. and abroad represented substantial legitimization of their ways of life. This protocol exposed Vavilov and practitioners he trained to significant political liability.

Regarding agrarian policy, Lenin and his successor, Stalin, actively eroded the diversity of cultures and livelihood practices in the agrarian U.S.S.R (Fitzgerald, 2003; Fitzpatrick, 1996). They each did so according to their own definition of "the greatest good for the greatest number" (Bentham, 1776), the fulcrum of any utilitarian calculation. For Lenin, urban industrial life was the ideal in quality of life, and he saw it as imperative to bequeath this lifestyle to as high a proportion of the population as was possible. Peasant life was decidedly not part of this grand vision (Kingston-Mann, 1983). Stalin, in his turn, prioritized population growth (see Stalin 1934), while actively lowering the basic sense of entitlement to quality of life for the masses he cultivated (Fitzpatrick, 1996). Neither interpretation boded well for deeply historical agrarian communities throughout the U.S.S.R., who were so central to Vavilov's work.

Vavilov served in the powerful position of director of the Lenin All-Union Academy of Agricultural Sciences, a vast nation-wide system of agricultural research and field facilities charged with maintaining food security in the U.S.S.R., between 1924-1935. This tumultuous period saw the transfer of power from Lenin to Stalin, the perennial rampages of rural collectivization (Fitzpatrick, 1996; Scott, 1998) and Stalin's accelerating tyranny and murder. His techniques for human slaughter included weaponized famines (Applebaum, 2017) such as the infamous Holodomor in 1930's Ukraine, which took more than three million lives (Boriak, 2008).

Vavilov's seed collecting work demonstrated that the world's most valuable plant resources were thankfully preserved by affiliation with traditional agricultural livelihoods. In his hands, the enduring cultural value of peasant life became wedded to a substantial utilitarian instrumental value. Because Soviet ideology under Stalin was anchored on the total interchangeability of all individuals and all cultures, this proof of the value of biocultural diversity required packaging so that it did not draw the wrath of the central government. For this reason, the defense of diverse peoples and their ways of life was concealed, while the utilitarian mission, goals and objectives were advertised. Vavilov revealed as much to his trusted friend, the plant scientist Theodosius Dobzhansky, when they were walking together in the privacy of Sequoia National Park, California in October of 1930. He truly believed that,

> *the opportunities for serving mankind which existed in the USSR were so great and so inspiring that for their sake one must learn to overlook the cruelties of the regime*. (Dobzhansky, 1947:229)

In his understanding, he was "employed by the Communists to work for the welfare of the people of the USSR, but…still free to judge what is best (quoted in Shantz 1978:8)." Judging from his approach to his work, he had high regard for the heterogenous and disparate agrarian people of the U.S.S.R and beyond. Despite their stigmatized existence in Leninist and Stalinist ideologies as vestiges of petit bourgeois society, Vavilov travelled five continents to be with such people, to be seen with them, to admire, understand and share in their plant holdings and their livelihoods (Nabhan, 2009).

Despite the political liability at its core, PGR conservation survived in the U.S.S.R. due to its durable utilitarian rationale. For the purposes of this essay, I interchangeably use utilitarianism the moral theory –meaning the ethical philosophy which prioritizes above all "the

greatest good for the greatest number" (Bentham, 1776)– with the more conventional concept of utilitarianism –"having regard to utility rather than beauty" (Etymology Online, 2017). I do this because it does appear that the quantitative mandate central to the former, lent itself inevitably to the rudimentary latter, and in short time. Regarding PGR conservation, this utilitarian rationale consisted of three nested claims which resemble, in their relations, that of a mission, goal and an objective. The mission was the pursuit of "the greatest good for the greatest number" (Bentham, 1977). In service of this greater good, the express goal of PGR conservation was the prevention of famine. In service of this goal, the key objective of PGR conservation was the preservation of sufficient genetic diversity for maintenance and improvement – through plant breeding – of the world's food plant species. While this formulation allowed for the survival of the practice in its native political environment, it was not the full motivation behind its creation and implementation and it could not, in and of itself explain the heroic and well-documented martyrdom of its founding practitioners. What is missing from this formula is this central tenet of PGR conservation which remained muted due to absolute necessity: both biological and cultural diversity, or biocultural diversity, are necessary for survival.

Vavilov's political talent could not save him from this intrinsic conflict between his motives and the feverish demands of the regime. He strove to survive by mastering the art of generating rhetoric that would be pleasing and approved by ideologues and authorities while shielding the nature of his work. He made an art of accentuating the authentic convictions he held which were in utter agreement with the Soviet enterprise. Vavilov was clearly a sincere believer in and proselytizer of modernization, for instance (see Vavilov 1997). He made this rhetorical survival skill explicit in his letters recruiting scientists from abroad to join his efforts in the U.S.S.R. (Pringle, 2008). Yet, in the end Stalin personally saw fit to order Vavlilov's arrest

and starvation in 1942. Many of Vavilov's devoted staff were similarly punished (Pringle, 2008). Others from his staff starved to death while guarding the seed collection from hungry looters during and following the Nazi Siege of Leningrad (Nabhan, 2009). For this heroism, Vavilov and his devoted colleagues have rightly been described as "martyr[s] for scientific truth" (Dictionary of Scientific Biography, 1978). In the next section, I trace the ethical implications of treating this truth as strictly biological, as opposed to embracing its ethnobiological roots.

CONTEMPORARY PGR VALUE: CRITICAL INTERNAL CONTRADICTIONS

By plucking the mission to defend biological diversity from the original mission to conserve ethnobiological diversity in the U.S.S.R., PGR conservation in the modern era has struggled to suitably acknowledge the deep role of cultural diversity in the conservation of plant genetic resources. This has led to serious ethical turbulence. A most prominent and heated ethical critique of PGR management surged in the wake of Pat Mooney's 1979 publication, Seeds of the Earth (Mooney, 1979). PGR, as they were then being appropriated and managed, were transparently benefitting the global north at the expense of the global south. This movement triggered a chain of social and institutional events. Two developments are pertinent to the present essay. Firstly, the velocity of the recoil of the scientific community from these accusations cannot be understated. Many founding thinkers and practitioners of the PGR movement, though trained in plant and crop sciences, understood their work as plainly ethical and moral. Accusations suggesting that their principles were exploitative came as a terrific shock. Their counter maneuver was well orchestrated (Kloppenburg, 1988). They argued that such claims were based on erroneous understanding of the nature of germplasm, plant breeding, and the natural histories of cultivated plants (Harlan, 1988).

Following these episodes, tremendous effort was made to cast the national breeding

programs, the network of ministries, universities and seed companies in each respective country, as capable partners in the world germplasm accession, management and exchange network. These national programs, it was implied (Boyd-Orr, 1966; Harlan, 1988), were the natural channel between their countries' populations and the benefits of the PGR management system. Importantly, these institutional changes dealt with the issue of justice for the poor farmers who stewarded plant diversity through the requirement of standard material transfer agreements (SMTA). SMTA's theoretically allowed for revenues derived from particular accessions, defined as collected materials, to make their way back to their original plant stewards. However, internationalized germplasm exchange under the SMTA mandate has been observed as frail and overwhelmingly complex from the vantage point of human resources(Chang, 1994), law (Correa, 2006), and enforcement (Hayden, 2003).

This ethical vulnerability of PGR conservation stems from several internal contradictions found within the strict biological utilitarian rationale minus the original commitment to the defense of biocultural diversity. First, there is incongruence between the value for diversity and the limitations of accession and maintenance. In Vavilov's footsteps, accessions seek to capture, as much as possible, genetic diversity, defined as the total number of genetic characteristics in a population. In a sampling event, much like the thousands of instances where Vavilov acquired plant and seed accessions, the way to capture diversity is to randomly select samples from the random geographic locations. Yet, these were always instead selection events. For certainly,

> *One has to take into account the climatic conditions under which plants introduced were growing, and whenever possible, to select varieties from regions more or less similar climatically to our country.* (Vavilov, 1951:45)

It is logical and realistic that collectors were charged with demonstrating applications for their centralized institutions. This inherent feature of collection was exported to Europe and the West intact.

The understood value of PGR following World War II was a confluence of such selection priorities, each hailing from specific geographies and interest groups. As Pistorius documents, without overtly known values of its own, the values which have remained most influential for PGR conservation practitioners are those of the international plant breeding complex (Pistorius, 1997). The world's main orchestrator of PGR conservation, the FAO, exhausted its broad-spectrum collection strategies early on. By 1957, they declared,

> *The days of massive and random collection of hundreds or thousands of samples which completely swamped the limited facilities of plant introduction gardens are surely over*. (FAO, 1957)

The decades that followed saw the FAO and collaborating bodies forego any internal valuation, instead adopting collection procedures to perpetually select for and meet the demands of the breeders (Pistorius, 1997).

A second contradiction stems from acknowledging that collection events are not random, but are instead moments of selection and favor. This is the ethical problem of using people for a 'greater good' they do not necessarily benefit from. It is well known that plant varieties not collected at accession events may or may not survive the large-scale forces of genetic erosion. The failure to preserve the plant varieties which plant stewards would nominate in favor of those plant breeders would nominate, provides an opening for a lasting critique of utilitarianism waged by philosophers such as John Rawls and Robert Nozick. This is called the 'separateness of

persons' problem for utilitarianism. In short, utilitarianism may justify and even mandate using a person if that would bring about the 'greatest happiness.' As Nozick observed, however, this neglects a fundamental fact of existence.

> *To use a person [to benefit others] does not sufficiently respect and take account of the fact that he is a separate person, that his is the only life he has. He does not get some overbalancing good from his sacrifice.*(1974:33)

If plant collectors do not conserve the materials most valuable to their owners, but instead preserve those materials most valuable according to their own operating concept of "greatest good", then it is quite possible that such an owner, and his property, were being unduly used.

Finally, at an aggregate level, utilitarianism is incompatible with universal aspirations for good survival. This is nowhere made more clear than in Josef Parfit's pains-taking review of utilitarian population ethics and his 'repugnant conclusion.' This conclusion states that, a pursuit of the greatest good for the greatest number must grant that:

> *For any possible population…, all with a very high quality of life, there must be some much larger imaginable population whose existence, if other things are equal, would be better even though its members have lives that are barely worth living.* (Parfit, 1986:387)

In this perspective, the best outcome for all concerned would be for as many individuals as is possible to exist, each enjoying a quality of life just above that which would certainly trigger suicide (Figure 2). In this would-be optimal scenario, very little plant diversity beyond one or two resilient staple crop species would be required from our PGR to achieve this dreadful per capita quality of life. Likewise, it is clear that no cultural diversity would be necessary for this

outcome. It is beyond apparent that no such scenario is the aspiration of PGR conservation.

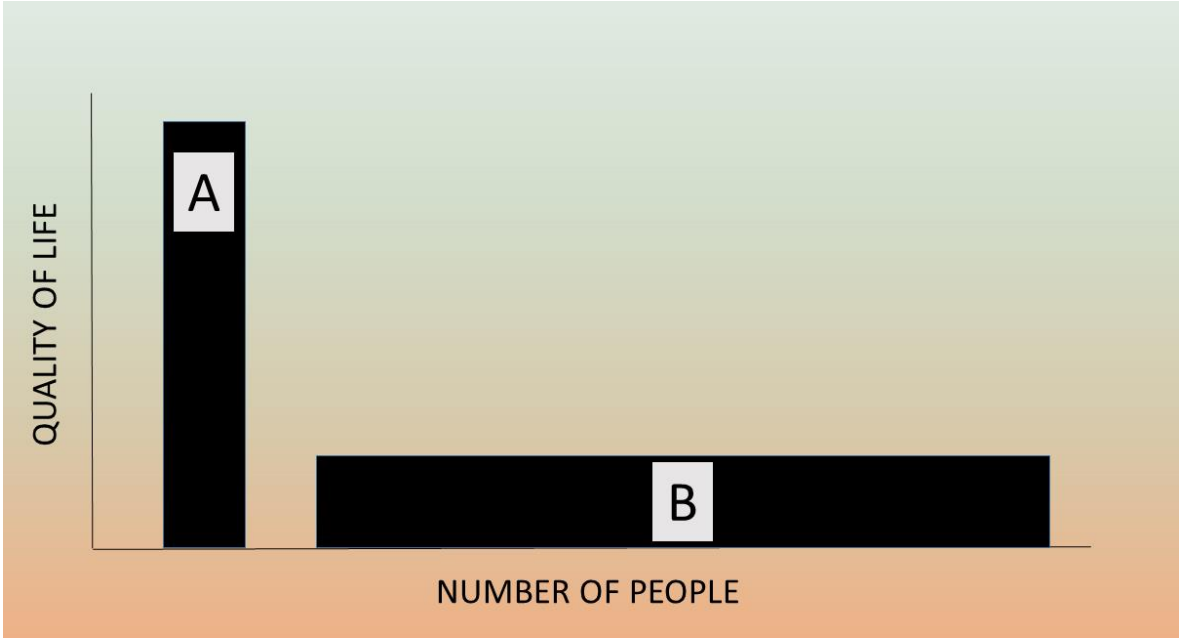

Figure 2 Josef Parfit's repugnant conclusion. Area covered by A and B represent total well-being for each population.

The internal contradictions we have raised in regard to PGR conservation, may each be resolved, at least in part, through a PGR conservation which is committed to defending biocultural diversity. Once again, considering the context of Vavilov and his colleagues proves illustrative. On the issue of sampling, it may be assumed that Vavilov was present at accession sites, in part, because he believed it would vindicate the livelihoods of his accession donors. It is very likely that he was aware that his prominent position would bring legitimacy to the agrarian citizens he courted for their holdings. This motive would have softened the instrumental nature of the sampling approach and allowed for a more generous inclusion of grower-preferred germplasm. In the same vein, any assertion that he may have used these individuals and communities would become less tenable since his presence and involvement were beneficial, however marginally so, to their cultural survival.

All this is to show that assigning substantial value for cultural survival may have strong

precedent in PGR conservation and support in environmental ethics. Looking beyond plant genetic resources, environmentalism, though forged in the virtue ethics rhetoric of the Transcendentalists, was similarly given to snatching at economic justifications for conservation within utilitarian economic theory (Hargrove, 1989). Efforts to quantify the monetary equivalent of natural value have varied wildly (see Carson & Hanemann, 2005; Costanza et al., 1997). However, from the perspective of ethics and its insistence on bulletproof justification, this approach has never shown as much promise as resort to virtue ethics and aesthetics (Hargrove, 1989; Passmore, 1974; Sober, 1986).

Eugene Hargrove develops a unique argument for conservation by arguing that existence is a necessary attribute of natural and artificial beauty, the definition of which varies substantially between groups, and therefore to destroy or to allow the destruction of such beauty is unethical. Still, since conservation is inherently an effort to salvage objects of value, there is an important skill to be applied in discrimination.

> *Mere existence is therefore a necessary but not sufficient reason for preserving a natural object or natural system. To provide a basis for discriminating between and ranking candidates for preservationist action, we need to go beyond mere existence to the values associated with it*. (1989:178)

It turns out that a thorough accounting of values associated with PGR, due to their diverse cultural geographic history, is a very anthropological endeavor.

ANTHROPOLOGY OF VALUE AND IMPLICATIONS FOR PGR

An anthropological approach to value differs from economics chiefly due to its inherent endeavor to engage, understand and interpret the perceptions and contexts of those whose culture

is different from the community of inquirers. It is important to state here the often-stated fact that PGR have been sourced primarily in societies other than modern Western societies. These materials were developed over millennia in a dynamic with the values of their associated human communities. What is important about an anthropology of value to plant genetic resource valuation is its illumination of value heterogeneity in the ethnographic record. Insights from ethnographic evidence, render anthropology of value a formidable foil to assumptions that *homo economicus* existed in pre-industrial society, and tailored their plants and landraces with the respective premium on high yield, disease resistance, and acceptable qualities.

Branislow Malinowski, Marcel Mauss and Karl Marx represent the pantheon of such an understanding of value. Malinowski is the famous marooned anthropologist, whose visa quandary during World War II caused him to reside over two years with the Trobriand Islanders of today's Papua New Guinea. During this time, Malinowski had ample time to observe, ponder and document the elaborate and mystifying exchange of *Kula*, decorative strings of shells, which were exchanged between households and communities, but rarely if ever worn. What struck Malinowski, and what is an essential data point for an anthropology of value, is that this exchange system provided a rival model of currency to that which held in modern economies. Trobriand Islanders, with Kula, as well as with other resources such as livestock and garden space, put a premium on pains-taking aesthetic efforts which stanched productivity and efficient accumulation. The engine of Kula exchange, according to Malinowski, was not material accumulation, it was the prestige accrued through impressive, elaborate public giving in combination with heroic and risk-intensive ocean travel (Malinowski, 1922).

Mauss fixated on the transubstantive phenomena by which value came to inhabit media. One of his most famous bodies of work on this subject, The Gift, dealt with the strong

undercurrents within gift exchange which bid the recipient of a gift to reciprocate. His approach to understanding this power was to review the available ethnographic accounts of three cultural cases, the Kula Ring on the Trobriand Islands, the Potlach of the Northwestern North American indigenous Kwakiutl, and the gift giving traditions of the Maori people of Aotearea. His central assertion was that gift objects are everywhere perceived/known to absorb and carry some piece or amount of their owner. Therefore a gift, once given, exerts a desire to return to its owner while simultaneously embodying the interests and sentience of the giver as long as it remains in the possession of the recipient. He further posits, much like Malinowski, that those hoping to identify with the germ of *homo economicus* in pre-industrial exchange will come away empty handed. An enduring contribution of Mauss regarding value was to show that the sterile and conclusive exchange model central to utilitarian economics, if it is to be found at all in the ethnographic record, can be traced to the class of trade relations between enemies, or between those to whom the other's fate is of no importance (Graeber, 2001; Mauss, 1954).

Marx, in his ponderous studies of industrial capitalist economies, provides a third leg to an anthropological theory of value. His theoretical approach was founded on his labor theory of value; namely that value could be known as the proportion of a society's labor devoted to the manufacture or maintenance of a good, service or other entity (Marx, 2012). Marxian Anthropologists have carved out a niche for themselves by seeking such principles at work in 'pre-industrial' societies. United by an evaluation of societies according to production and labor, this research is responsible for a noteworthy insight. Across much of the world, in societies most peripheral to globalized markets, the highest proportion of labor is devoted, not to commonly understood 'economic' endeavors like food production and item manufacturing, but is instead devoted to the manufacture of satisfactory persons. In other words, child-rearing, facilitation of

rites of passage, celebrations and the like commonly occupy much more social time and labor (Fajans, 1997; Munn, 1986; T. Turner, 1979). The vast majority of officially-recognized labor in capitalist societies is devoted to the manufacture of commodities and to the delivery of services. Thus, while the production of human persons is no doubt necessary in this system, their value is redeemed in the form of commodities and services. Marxian ethnography has uncovered that the vast majority of pre-industrial societies demonstrate the precise opposite pattern; namely, labor which has been devoted to the "economic" is redeemed in the form of socially-determined quality persons.

A meticulous study of more-than-utilitarian plant value may not just benefit from an anthropological theory of value but may in turn strengthen such theory. The ethnobotanical record offers countless observations of values other than utilitarian instrumentalist ones that actively drive plant selection and drive plant modification. Three stand out. The first is cosmological value. Management and selection of specific varieties often take place for religious and cosmological purposes. For example, in West Java, Soemarwoto documents how landraces are linked to unique individual and household identities based on perceived similarities in what might be described as personality traits (Soemarwoto, 2007). Here, selection of rice varieties for planting is decided through consideration of the variety's 'affective,' or emotive, qualities (2007:91), followed by the physiological, and culinary. Affective traits include the thoughts, ideas and personal styles attributed to the rice variety that determine the variety's suitability for use in certain rituals performed in various life stages of the plant and crop. In highland Argentina, Quechua farmers in the Andes cultivate the *culli* landrace of maize exclusively as a crop and household protector against malevolent spirits. To perform its function, this variety is planted in small plots adjacent to the larger crop, and later, pairs of cobs, bound together by their

husks, are hung on the doorframe of the household kitchen (Hilgert, Zamudio, Furlan, & Cariola, 2013). In early colonial Tenochtitlan, it was observed that incredible premium was put on the earliest ripening varieties of amaranth for the manufacture of idols cannibalized ritually in the harvest festivities (Early, 1992).

A second insight elicited from diaspora ethnobotany, is that plants hold irreplaceable value in a people's memory of their history. The botanical holdings of diaspora groups which originate in peoples' native lands are understood to represent a quintessentially valuable selection of flora for the translocated groups. With the example of African populations in the Americas, plant holdings which originate in Africa are often found in the plant-use repertoires of maroon, freed slave, and other African descended communities (R. Voeks & Rashford, 2012). Such plant species, which were brought in the face of tremendous hardship and risk, commonly have a multiplicity of properties including nutritional, ecological and spiritual. Examples include two native African tree species that are now well established in the new world, the African oil palm (*Elaeis guineensis*) and the Baobab Tree (*Adansonia digitate*). At the dawn of the slave trade, indigenous coastal West Africans, especially those groups around the Gulf of Guinea, held the African oil palm as an invaluable species for nutrition and spirituality. Similar circumstances evolved in the Brazilian region of Bahia, where the locally prominent Afro-Caribbean religion of Candomblé features a number of specific uses for materials from the tree (Watkins, 2011, 2015). The Baobab tree has been observed in a number of African diaspora geographies in the Americas. In addition to a number of edible parts, including fruits, seeds and flowers, the tree's physiology manifests a completely distinctive ecology which houses bees, attracts bats, collects and holds water in its trunk, and, in otherwise bare landscapes, provides copious shade. The tree is integral in numerous folkloric and spiritual traditions in both Africa and the new world

(Rashford, 1987a, 1987b, 2015). These trees and similar plants are inscribed on newly settled landscapes as a recording device for people's history.

The obvious and unique value for the Baobab may also lend support to a third insight from the ethnobotanical record and that is that aesthetic value for plants, including crops, was and is a pervasive value. The Baobab's appearance, distinct and touching by any account, makes it a revered icon of the African savannah landscape (Rashford, 2015). This undoubtedly played a role in its urgent selection for transport to the new world. Aesthetic properties have been integral to crop selection and evolution throughout history (Hawkes, 1983; McCouch, 2004). Aesthetics remain the most significant historical driver of exotic plant trade in the modern era (Mack & Lonsdale, 2001). Returning to amaranth, Aztec royalty demanded beauty from the crop to such an extent that the transfixed Spanish transported amaranth to Spain, initially as an ornamental, apparently unaware that the crop was one of four grain crops acquired as tribute from Aztec territory (Early, 1992). This pattern of mandating beauty in crop selection has been observed with crops throughout the Americas (Debouck, 1989). Stepping back from the ethnobotanic record, it is a matter of common sense that the physical appearance of plants, including food plants, is of considerable day to day value. In fact, the extensive, informal, and decentralized conservation program that undergirds decorative horticulture all over the world bids a very weighty question: is the general neglect of aesthetic value in PGR conservation in harmony with the commonsense morality of the endeavor? One important way to address this question is to interrogate what it is that PGR are understood to be, in other words to contemplate their ontology.

PGR Ontology

Simply beginning with the variation in available definitions, a broad ontology, or

conception of being, for PGR can be readily acknowledged. There is an abyss to explore between the definition of PGR as "the raw material used by plant breeders to create new crop varieties" (FAO, 2007) and something like the 1996 Via Campesina claim that,

> *Genetic resources are the result of millennia of evolution and belong to all of humanity. They represent the careful work and knowledge of many generations of rural and indigenous peoples* (Via Campesina, 1996).

A project to revisit the very being of PGR resonates soundly with the recent 'ontological turn' in the social sciences for both conceptual and ethical reasons. The 'ontological turn' refers to the surgent influence of ontology on anthropology, science and technology studies, archaeology and many other disciplines. In essence, post-humanist philosophical projects to deconstruct and revitalize concepts of "the human" (Bateson, 1972; Latour, 1991) have sent fissures through conventionally held distinctions between humans and the nonhuman, i.e. humans and things, humans and nature, as well as kinds of humans. Important works in this field have endeavored to reinstate the social consideration of material things (Amiria Henare, Holbraad, & Wastell, 2007) which Olsen argues have been "marginalized" and "stigmatized" in the previous century of social theory (Olsen, 2010:2) In other works, various species and creatures have been reified as social agents, even inspiring an entire genre of ethnographies of nonhuman organisms known as multi-species ethnography (Kirksey & Helmreich, 2010; Tsing, 2012).

Martin Holbraad articulates how the principle improvements of all of these maneuvers has been ethical. In anthropological and archaeological theory, the turn to ontology was precipitated by the acute need for more reflexivity in encounters with alterity, or otherness.

Holbraad argues that acknowledging the ontology of the other does more work towards achieving just interaction between cultures than does acknowledging the culture of the other. To illustrate how the concepts of culture and ontology diverge on the "analytical issue of how to make sense of things that seem to lack one," (in Alberti et al. 2016:902) he gives the example of a research participant declaring that a stone is a person. Acknowledging the participant's culture can readily let this dissonance be understood as a disagreement which results from the researcher and participant having different beliefs. A concept of ontology can do more, and can provide more guidance by logging this dissonance as resulting from the researcher and participant talking about entirely different things. Importantly for the present case, recent work in ethnobotanical theory can further illustrate the value of ontological approaches to difference.

For a discipline such as ethnobotany, that has always dwelt and toiled in the interstices of cross-cultural human-plant mutualism, the ontological turn has brought a windfall of validation. It has always been the goal of the discipline to develop and spread awareness for the existential importance and ubiquity of human plant relations. Reflexivity was always a strong suit in the discipline. Substantial regard for the knowledge of cultural others led to the bold declaration of 'folk taxonomy,' 'folk biology,' and 'folk systematics' as legitimate fields of knowledge exploration for the western academe (Berlin, Breedlove, & Raven, 1966). Yet, as described above, acknowledging another's differing ontology requires a researcher to go further, to react to any 'senseless' testimony, say assertions that certain landraces have human personalities, by knowing that they themselves are the one confused, not necessarily the interviewee. For ethnobotany, this means acknowledging substantial difference in how others "perceive, conceptualize, and value plant-life," factors certain to influence forms of interaction and manipulation (Daly, French, Miller, & Nic, 2016:2). As Lewis-Jones has observed, such an

approach can even reveal the influence of any number of non-utilitarian values which motivate the professional duties of plant conservation practitioners themselves (Lewis-Jones, 2016).

CONCLUSIONS

There is deep tragedy in the realization that Nikolai Vavilov, and many of the colleagues he trained, died of starvation. The Soviet Union also did not survive. Though it may be a pressing question, the extent to which ethics motivated Vavilov's science may never be known. It cannot be known if Vavilov recognized an ethical rivalry with Lysenko beneath the scientific one. Vavilov was motivated by the real threat of famine. He was also motivated by the real threat of persecution of himself and colleagues, brutal tyranny of his compatriots, as well as genocide of his agrarian charges. When the severity of Vavilov's circumstances, and the depth of his perception, as a scientist and scholar under Stalin's reign is truly considered, it becomes infinitely more feasible that Vavilov foreswore his own survival to ensure the survival of something he deemed profound. Mythologically, a hero's death ensures the survival of what is truly good in a culture.

Similarly, the scenarios of survival which have motivated PGR conservation in the modern era do not resemble those illustrated by Parfit's repugnant conclusion. It is clear that, even at its inception, mere metabolic survival for a maximum number of human persons was never a sufficient motivation for PGR collection and maintenance. Underneath the rhetoric, a base level of cultural survival has always been ethically assumed. The essential value of plants in supporting cultural cohesion through cosmology, memory, and aesthetics may be baked into the aspirations that motivate PGR conservation, both professionally and across cultures. However, due to the sheer acceleration of biological loss and the global economy, overt language and practices which validate these existential values are more necessary than ever. It is clear why

Vavilov muted such discussion; what is not clear is why it is so muted today.

Ethnobiology and derived methods are integral in the accession and curation of indigenous knowledge required under international protocol like the Convention on Biological Diversity, and the Nagoya Protocol. Appropriately, the canon of ethnobiological methodology offers numerous techniques, in a range of intensities that can be deployed to study and engage local values associated with collected germplasm and in-situ conservation programs. More time consuming and qualitative work is always recommended and may be necessary to achieve certain goals. For instance, to allow for folk value to characterize the maintenance of collections such as in the prioritization and scheduling of grow-outs, when seeds are planted and grown out to produce new seed, values associated with physiology, phenology, and cultural survival would benefit from rich ethnographic context. In the digital age, data quantity is hardly a restriction. The restrictions more certainly turn on the perceived value of such an approach, and to the ways in which we envision our survival.

CHAPTER TWO[1]

Human Niche Construction, Cultural Resilience and Community Adaptation to Chestnut Pest and Disease Outbreak in Turkey

ABSTRACT

This paper investigates the underlying cultural motivations for diverse chestnut-livelihood activities as well as their effect on the health of chestnut trees experiencing multiple exotic pest and disease outbreaks across Turkey. Presently, livelihood access to chestnut-dominated landscapes is partly restricted due to the state position that smallholder activity is detrimental to forest health. To document the diversity and motivation of livelihood practices which pertain to the chestnut species, we conducted 142 semi-structured interviews with chestnut-utilizing households across Turkey's Black Sea, Marmara and Aegean provinces. We also conducted chestnut tree health evaluations in 97 participant-identified georeferenced forest and orchard areas. We statistically characterized the effects of environmental, physiological and anthropogenic factors on tree health and contextualized results of this analysis with interviewee reports of cultural resilience. Our results show that cultural resilience is integral to the performance of livelihood practices which have a significant positive effect on tree health. Our findings suggest that communities that are most culturally resilient characterize the environment for chestnut trees in a way that defends tree health.

Keywords: *Castanea sativa, human niche construction, cultural resilience, generalized linear mixed models*

INTRODUCTION

Numerous frameworks in ecology and conservation biology have endeavored to understand the beneficial role humans can play in environmental health (see Coupled-Human

[1] Co-authors on this manuscript include Çoşkun Köse, Taner Okan, Nesibe Köse, Elif Aksoy and Shorna Allred

and Natural Systems (Liu et al., 2007); Cultural Landscapes (Haber, 1995; Ramsay, 2015); Human Ecology (Hawley, 1981); and Traditional Ecological Knowledge (Berkes, Colding, & Folke, 2008). Such research has shown that across time, nations and cultures, small-scale societies, also known as tribal, indigenous or traditional peoples, are distinct for their tendency to maintain sustainable existence within the environment. Contrary to widespread colonial tropes such as the noble savage or ecological Indian (Krech, 2000), small-scale societies do have tremendous impact on their local environment. It has been shown many times over that humans, at any mode of production, from hunting and gathering to agriculture act as an ecological keystone species, unmistakably characterizing the fabric of the ecologies and landscapes they inhabit (B. D. Smith, 2009).

If it is granted that human nature *is* perpetual and substantial ecological alteration, the next, necessary cognitive step for biological conservation in the Anthropocene is to identify, understand, support and replicate conditions where human communities are verified to be acting "as integral components,"(Ramsay, 2015:653), of healthy environments. Here, we present the results of a study which achieves this timely objective. In this paper, we document real-time, effective community adaptation to disease outbreak on European chestnut, a tree species central to vast cultural landscapes across Northern and Western Turkey. The chestnut tree in Turkey (*Castanea sativa*) exists in a wide range of geographic and anthropogenic conditions, from naturalized high-precipitation forested landscapes to dryland irrigated orchards. Today, the entire chestnut population endures the compounding effects of multiple exotic pathogen outbreaks introduced variously throughout the last century, including ink disease (Erdem, 1951), the chestnut blight (Akdogan & Erkman, 1968), and most recently, the gall wasp (Cetin et al., 2014). Turkish state programs for the conservation of chestnut populations are implemented by the

General Directorate of Forestry (OGM). While forest management programs are diverse and locally adapted, OGM generally upholds restrictive policies for chestnut-related livelihood practices other than nut collection and beehive placement (TNGDF, 2013). Such policies are justified by a government position that human activities can only worsen disease dynamics.

In this context, we ask, how exactly are livelihood practices affecting the health of chestnut trees and what role does cultural resilience play in the enactment of the livelihood practices we observed? We employ a combination of human niche construction (Lewontin, 1982; B. D. Smith & Zeder, 2013) and cultural resilience theories (Lalonde, 2005; Longstaff, Armstrong, Perrin, May, & Hidek, 2010) to answer this research question through analysis of data we collected from observations of both physical factors -such as tree health and evidence of silvicultural practices – as well as qualitative ones – such as interviewee narratives. We understand human niche construction as human programming of the environment with characteristics that benefit human intergenerational survival. This is achieved through the cultural transmission the ecological inheritance (K N Laland & Feldman, 2001). In the case of chestnut trees in Turkey, we take human niche construction to be the most appropriate way to understand the presence and distribution of the tree across space, as well as contemporaneous community adaptation to pest and disease pressure. We take cultural resilience to be a social group's ability to "absorb a disturbance while retaining its essential functions," and social memory, learning and connectedness to be its key, observable attributes (Longstaff et al., 2010:4). We sought to learn whether cultural resilience would influence a community's performance of livelihood practices that corresponded to meaningful differences in tree health.

There are two main reasons why cultural resilience and human niche construction theories need each other. First, works in human niche construction theory have yet to illustrate

how culture, specifically, influences intergenerational transfer of ecological inheritance. The geneticist Richard Lewontin introduced niche construction theory (NCT) to argue against a model of natural selection whereby the organism is a mere influence-taker from its external, inviolable environment (Lewontin, 2001). Organisms, it follows, are born into an ecological inheritance which influences them and which they, in turn, continue to influence. Humans have been described as the "ultimate niche constructors'' (Odling-smee et al. 2003:28), and culture is assigned a prominent role in the transmission of ecological inheritance, especially in terms of learning (Kevin N Laland, Odling-smee, & Feldman, 2000; B. D. Smith & Zeder, 2013). Yet, a broader investigation of culture is not commonly achieved in such studies.

Landscape-level studies over large time-scales have provided the clearest evidence of ecological benefits to human niche construction. Small-scale societies, both past and present, have implemented widespread and periodic disturbances as a deliberate act of livelihood (Hill & Press, 1994; Rostlund, 1957; B. D. Smith, 2009). The creation of landscape mosaics, by fire and other means used by small-scale societies, has been shown to increase species diversity via the moderate multiplication of edge space advantageous for certain biological communities (Mckechnie, Thomsen, & Sargent, 2017; Moreira, Ferreira, Rego, & Bunting, 2001). There is a growing consensus in ecology and pathology that risk of disease is reduced with increasing biological diversity (Altermatt & Ebert, 2008; Johnson et al., 2013). In agro-ecological systems, use of polycultures (Letourneau et al., 2011; Powers, 1987; Upadhyaya et al., 2002), varietal mixtures (Gibson, 2009; Smithson & Lenne, 1996), and genetically diverse landraces (Leur et al. 1989;Naegele et al. 2014) have been demonstrated to imbue disease and pest resistance. Our quantitative study component was designed to observe real-time niche construction in the form of community adaptation to disease pressure in a range of landscapes. To this end we conducted

a rigorous study of the effects of numerous silvicultural, environmental and physiological factors on chestnut tree health across Turkey.

Second, theories and studies of cultural resilience are grounded in a psychological perspective and are often not accompanied with data collection about people and their environment maintenance of the ecological resource base. They thus fit poorly in contexts where humans actively maintain historically anthropogenic landscapes. In our era of rapid globalization, a very high proportion of cultural resilience work focuses on the threatened culture –i.e. language, beliefs and knowledge – of those communities most dependent on and knowledgeable of local ecology: indigenous and tribal peoples (Hilhorst, Baart, van der Haar, & Leeftink, 2015; Ulturgasheva, Rasmus, Wexler, Nystad, & Kral, 2014). Longstaff et al., writing within disaster risk reduction literature, have made important headway in developing a framework for 'community resilience' that accounts for the ecological resource base (Longstaff et al., 2010). In this framework community resilience is a feature of resource robustness in combination with adaptive capacity (Longstaff et al., 2010:22). Particularly, these authors propose a rich cultural texture to adaptive capacity, arguing that "institutional memory", "innovative learning" and "social connectedness" are its major attributes. Still, their working definition of resources, "objects, conditions, characteristics, and energies that people value" (Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008:131) fails to acknowledge the deep human influence on the presence, distribution, abundance and temporal availability of ecological benefits that is central to human niche construction theory.

Sakakibara (Sakakibara, 2017) extended the reach of cultural resilience studies by positing place (Basso, 1996; Goldstein, 2012) as an integral component in cultural resilience. He did this by demonstrating the central role local ecological relations to the cultural resilience of

Iñupiaq communities in North Slope Borough, Alaska. His work illustrated a process where threats to the viability of whaling for these people triggered a re-doubling of engagement with whale-bound traditions of music, stories and hunting. We followed Sakakibara's approach to focusing on culture in moments of ecological threat, but instead sought to perceive the other end of the cycle. We sought to learn whether the cultural dimensions we observed were playing a role in the tree health dynamics we observed. To this end, we employed a qualitative research component to study cultural resilience across the various communities whose trees we diagnosed. In the body transcripts from 142 semi-structured interviews, we coded for content that demonstrated the resilience dimensions of social memory, learning, and connectedness. This body of knowledge complemented our direct, bio-physical observations of disease pressure and associated silvicultural, environmental and physiological factors.

MATERIALS AND METHODS

Study Context

In Turkey, the chestnut species is distributed across 262,000 hectares of the Eastern Black Sea, Western Black Sea, Marmara and Aegean provinces (See Figure 3), and occurs across a wide variety of elevations, precipitation levels and temperature regimes (TNGDF, 2013). In the Eastern Black Sea, chestnut is found primarily in mixed-forest in high year-round precipitation, in steep topographic zones above 400 meters above sea level (MASL). In the Western Black Sea region, wet summers and dry winters predominate, and the terrain is less mountainous, with naturalized chestnut groves present in state governed forest between 20 to 600 MASL. The chestnut population in the arid Mediterranean climate of western Marmara is mainly found in state governed land at elevations higher than 600 MASL. In the famously mild and high precipitation environment of eastern Marmara, grafting is practiced. Grafting is the act of

splicing a favored plant cutting onto an already-grown specimen. Orchards of chestnut are present along the southern coast of the Marmara Sea at elevations as low as 20 MASL. Finally, the warm dry Mediterranean climates of the Aegean region host the most substantial grafted chestnut production in Turkey, all above 800 MASL. The tree has been maintained in these geographies for several thousand years (Xenophon, 1917) and remains invaluable to Turks today.

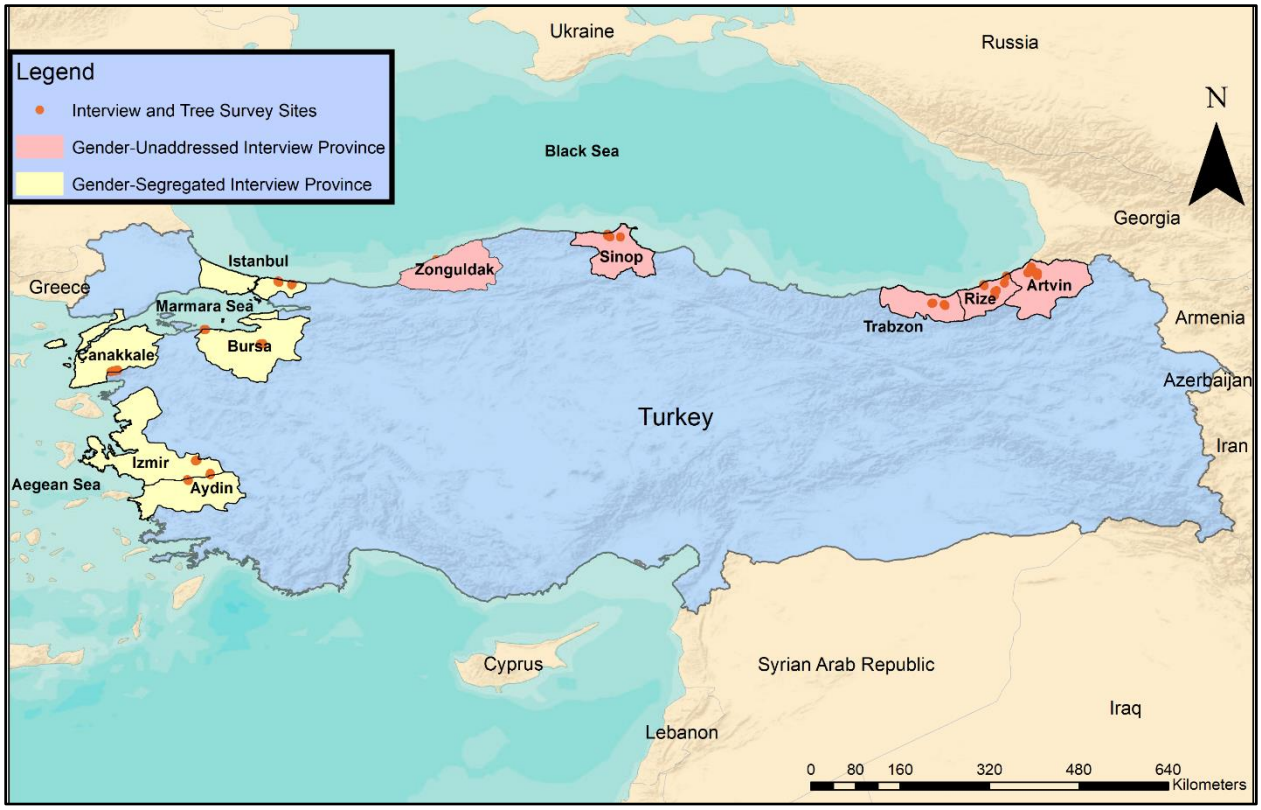

Figure 3 Map of Turkey and research sites. Provinces of sites identified with respective gender interview protocol indicated by color (explained below).

Field Work

Research was conducted during the summers of 2015 and 2016. In all, ten provinces were selected that represent the geographic distribution and diversity of habitat for chestnut. In each province, 8-10 households were selected using purposive sampling (Miles & Huberman, 1984) to identify households known to engage in chestnut-related livelihood activities. This process was greatly assisted by local forestry officers, followed by locally-elected village representatives,

known as *muhtars*. The *muhtar* is an independent overseer and representative of community interests. Their locally understood role is to negotiate with, and if agreeable, assist visitors from external institutions. As part of our oral informed consent process, households were assured that participation was entirely anonymous and that our study took no stance on the validity, efficacy, or environmental beneficence of the livelihood practices that would be discussed. To account for gendered knowledge, in five of the ten provinces, female household members were interviewed in privacy by someone of the same gender. Semi-structured interviews facilitated discussion of chestnut resources and livelihood practices in the following areas: 1.) memories; 2.) perspectives of present challenges; 3.) strategies for adaptation and 4.) endeavors and prognoses for conservation. Interviews were conducted in Turkish and recorded manually before being transcribed, translated and coded.

Each interviewee household would designate a place where we conducted a disease-severity evaluation on each chestnut tree in a 20x20 meter georeferenced plot. Understood as the inverse of tree health, disease severity was defined by the proportion of diseased plant tissue with characteristic symptoms of ink disease, chestnut blight or gall wasp infection. Respectively, these symptoms included root and whole stem death, cankered and/or blighted trunk, stem and/or branches, and drooping dying leaves with galls on the stems. Severity evaluation was adapted from the procedure of Tizado et al. (Tizado, Terrón, & Núñez-Pérez, 2012). Each chestnut tree with diameter larger than 5cm would be provided a disease severity score between 0-5 at the main stem (A), the lower crown (B), the mid-crown (C) and the high crown (D), where 0 represented no diseased plant tissue, 1 represented <10%, 2 represented 10-25%, 3 represented 26-50%, 4 represented 51-80%, and 5 represented > 80%. In addition, the location of each tree within the plot would be recorded using meters forward and meters to the left or right. This data

allowed for a later calculation of a geo-coordinate for each tree. Each tree would be measured for diameter at breast height (DBH), height, and crown width. Each tree was inspected for evidence of several silvicultural procedures. We recorded the presence and absence of three silvicultural practices on trees. If the tree was grafted, coppiced, or if major limbs had been removed, this information was recorded. Grafting is the act of joining a favored cultivar with an already rooted and less favored cultivar. Coppicing is the act of cutting the main stem of a tree in order to allow for multiple, narrower stems to form. These are harvested routinely to keep the process going.

Data Analysis

The first phase of data analysis was deriving environmental factors. A series of values for each tree was extracted from secondary datasets in ARC-MAP. Elevation, slope and aspect for each point were derived from a Shuttle Radar Topography Mission (SRTM) generated Digital Elevation Model (DEM) at 30x30 meter resolution, housed by United States Geological Service (USGS) Earth Explorer. We converted aspect into a continuous variable using the heatload value using the Geomorphometry and Gradient Metrics Toolbox (Evans, 2017). This tool derives a continuous variable which quantifies the relative southwest position of aspect to indicate heat exposure, as south and southwest facing slopes are known to be warmer than north and northeast facing slopes. We extracted the mean of three previous years of Normalized Difference Vegetation Index (NDVI) data (2013-2015) for each geocoordinate from National Aeronautics and Space Administration (NASA) Earthdata at 250x250 meter resolution. The NDVI is a satellite image derived index indicative of living vegetation presence and of wetness. Finally, we used data for roads and waterways available from Open Street Maps at 20x20 meter resolution, to derive a ‘distance to waterway’ and ‘distance to road’ value for each tree.

In addition to descriptive statistics, we followed Tizado et al.'s approach of using Multiple Correspondence Analysis (MCA) to better visualize the variation of disease severity in the surveyed sites. Severity scores for all tree parts (1-5 at A, B, C&D) of all trees and site number were evaluated as categorical factors in MCA. MCA illustrates relationships between many categorical variables, representing correspondence using proximity in a two axis plane of constructed dimensions (Le Roux & Rouanet, 2010).We then sought to characterize the effect of specific factors by using generalized linear mixed models (GLMM). GLMM allow for the analysis of the effect of multiple variables when 1.) data exists in subsets which inherently compromise independence, such as trees in proximity to each other in a disease outbreak and 2.) when a response variable is irregular or non-normal (C. J. Anderson, Verkuilen, & Johnson, 2012). We assigned plot number (N=97) as a random effect nested in site number (N=10). We began this stage of analysis by generating a binomial variable derived from the median severity for each tree with 'low' being less than 2.5 and 'high' being greater than 2.5. We then screened all covariates for correlation with themselves with a step by step determination of variable inflation factor (VIF), removing factors with a VIF score above 3 (Zuur, Ieno, & Elphick, 2010).

For qualitative analysis, interviewee transcripts were analyzed according to the cultural resilience themes of memory, learning and connectedness. These thematically coded reports were then further analyzed to determine integral categories of locally operating livelihood memory, learning and connectedness. We made note of report consensus, when reports were repeated by households within the same site and between sites.

RESULTS

Quantitative Results

In all, 1,500 trees on 97 plots in 10 sites were scored for tree health. Shown in figure 4a and 4b, we first verified variance in tree health between sites. Variance could not be explained simply. Three clear groups of low, medium and high disease severity are illustrated in the MCA output. Upon preliminary inspection, these tree health groupings fail to correspond to environmental factors (Table 1). For example, by the medium and low groups elevation is an especially broad range. The highest and lowest tree health were recorded at similar low elevations in Bursa and Şile, respectively. Correspondence between tree health and silvicultural and agronomic factors is also unconvincing. While high tree health was observed in areas of intensive cultivation in İzmir, Aydin and Bursa, high tree health was also observed in Zonguldak, where grafting was non-existent and collection small-scale. Low tree health was observed in the low-intensity collection zones in sites of Çannakale, Şile, Sinop, Trabzon, Rize and Artvin.

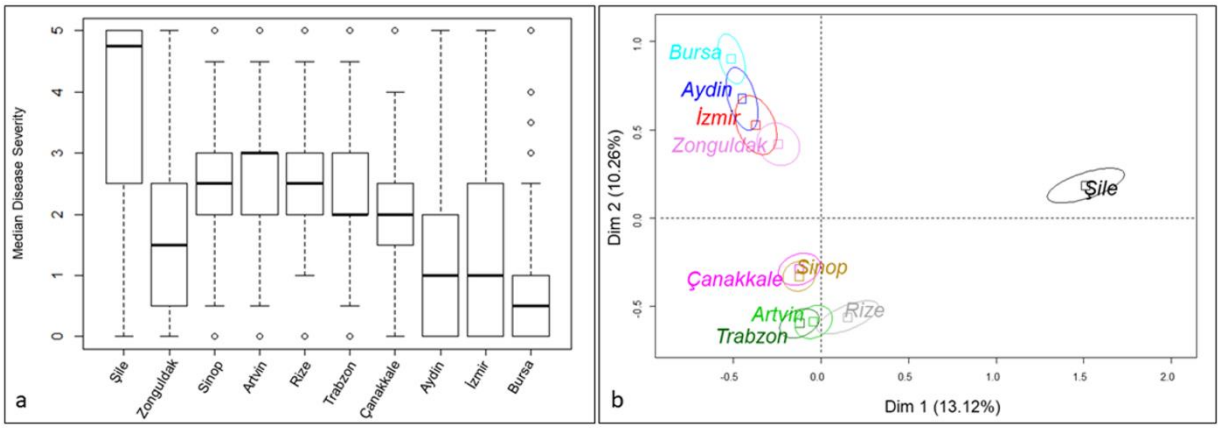

Figure 4 a) boxplot of median disease severity scores of chestnut trees by site number; **b)** results of multiple correspondence analysis of all disease severity scores and site number, with site indicated by a 95% confidence ellipse. Percentage of variance explained indicated by dimensions one and two of the axis.

Table 1 Summarizing statistics for recorded factors for blight severity groups as determined by MCA.

		Diameter (cm)	Elevation (m)	Slope (m)	Wetness (NDVI)	Grafted (%)
HIGH	Average	13.8	138	7.5	6016	
	Standard deviation	6.5	36.0	6.6	1541	0
	Range	5-33	102-222	1-19	1321-7082	
MEDIUM	Average	40.4	592	18.4	6959	
	Standard deviation	37.6	253	9.2	600	2.6
	Range	5-320	134-1178	1-44	5392-7950	
LOW	Average	37.5	551	18.8	6328	
	Standard deviation	36	436	6.6	966	58
	Range	5-241	40-1356	3-32	4497-7503	

Our next stage of analysis aimed to disaggregate factors and characterize their effect on tree health using analysis by GLMM. Results of analysis are shown in Table 2. Figure 5 is a simple visual representation of the relative effects of each factor determined by the model, with significance indicated. Z-score is the test statistic for determining the likelihood that a hypothesis positing zero relationship is correct. The value of the z-score reflects the number of standard deviations away from the mean a given result is, in other words its significance. Importantly, no significant effect on disease severity was determined for the nearness of roads or water, elevation, aspect, coppicing, or pruning. We see a significant positive effect on disease severity by tree diameter and slope, meaning as tree diameter and slope increase so does the likelihood of high disease severity. We see significant negative effects on disease severity by grafting presence

and wetness – indicated by NDVI – meaning as these variables increase in value the likelihood of trees having high blight severity decreases.

Table 2 Results of GLMM model exploring the effect of all factors on disease severity as a binomial high or low. Factors listed in order of significance. AIC = 1625. Factors displayed in order of significance. Significance indicated as probability <0.001 '***', <0.001 '**',< 0.01 '*', <0.05 '.'

Factor	**df**	**Chisq**	**Z- Value**	**Pr(>|z|)**
Tree diameter	1	37.8359	6.151	7.7e-10 ***
Grafted	1	7.7861	-2.790	0.00526 **
Wetness	1	4.3792	-2.093	0.03638 *
Slope	1	3.1451	1.773	0.07615 •
Distance to Road	1	1.9748	-1.405	0.15994
Elevation	1	1.3206	-1.149	0.25049
Aspect	1	0.8769	-0.936	0.34905
Limb Removed	1	0.7524	0.867	0.38572
Coppiced	1	0.1122	0.335	0.73766
Distance to Water	1	0.0053	-0.072	0.94223

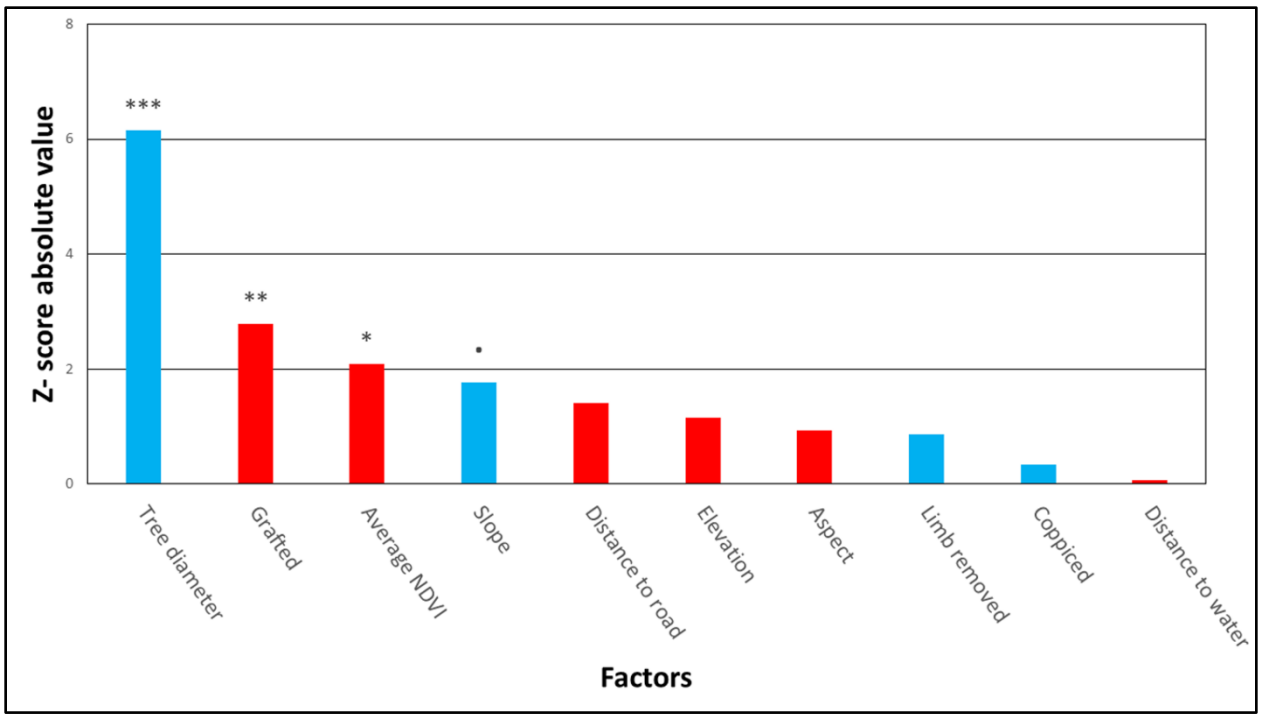

Figure 5 Effect of all factors on disease severity for trees as represented by absolute value of z-score generated by GLMM. Blue indicates a positive relationship and red indicates a negative relationship. For both charts, significance indicated as probability <0.001 '***', <0.001 '**',< 0.01 '*', <0.05 '.'

Results from Interviews

We determined the following cultural resilience themes within interviews: 1.) Two types of memory: Ecological and Livelihood, 2.) Learning, and 3.) Four types of connectedness: Local, Non-local Formal and Non-local Informal (Table 3). In addition, interview responses show the cumulative contribution of institutional memory, innovative learning and connectedness to acts of chestnut resource maintenance, with distinct regional dynamics.

Table 3 Categorization of interviewee reports relating to adaptive capacity

Cultural Resilience Theme	Sub-Category	Nature of Report
Memory		
	Ecological	Cause, dynamics and bio-physical impact of diseases
	Livelihood	Cultural, economic, agronomic, horticultural impact of diseases
Learning		
		Observations, diagnoses and experiments in agronomy, horticulture, ecology, economics and government relations
Connectedness		
	Local	Identity, Generational
	Non-local Informal	Information, Skills, Resources, Technology
	Non-local Formal	Influence over on-the-ground Forest Policy

Participants retrieved memories of the disease differently, but a significant number began with a hypothesis of the cause of chestnut-related diseases. These we categorized as ecological memories. There was significant regional variation in the causes offered by interviewees. Many participants in Şile paired the advent of mining with the advent of disease. As one participant succinctly described it, “mines, tree cutting, then disease” (*Madencilik, ağaç kesimi, daha sonra hastalık*). A set of interviewees in the province of Trabzon all reported that the chestnut blight arrived in the wake of a state-sponsored grafting trial in the area. Across the Black Sea region, multiple participants cited the nuclear catastrophe at Chernobyl as a likely cause. Livelihood memories were attempts by participants to sketch disease impact through recall of concrete details from the past. Notable consensuses from these reports vary by region. In the especially blight-ravaged Şile, interviewees recalled the former presence of numerous chestnut-affiliated

traditions which are now gone including the local chestnut bazaar, a trick-or-treating like event for children with cheerful demands for roasted chestnuts from neighbors, and the commonplace sight of children on their way to school with pockets bulging with roasted chestnuts.

A very different consensus emerged from the southwest of Turkey, where numerous women participants bemoaned the difficult transition that came with regional intensification of chestnut production. Commercial chestnut production entails a number of unique difficulties. Labor is difficult, dangerous and urgent. Trees, often very high ones, must be climbed and each long limb must be scrambled up to ensure no nut is lost. The harvest comes on quickly and must be dealt with immediacy due to foraging such as dear and boar. The harvest must be managed strictly due to the same foraging wildlife as well as post-harvest rot. One woman reported that the death of her husband came about due to stress related to the chestnut harvest period.

In both Izmir and Aydin, pre-commercial chestnut maintenance was more fondly remembered. For instance, several interviewees missed certain cultivars of chestnut which had been abandoned in favor of meeting the demands of wholesale purchasers. These were missed for their flavors, aromas, peeling characteristics and more. Cultivar types were also observed to reposit other, common memories. For instance, cultivar names in Aydin and Izmir retained the names of their place of origin. In one case, the name (*Belembolu*) was the Greek name for a village (*Balyambolu*), which has long since been reassigned the Turkish name of Beyköy.

Interviewees reported learning via observations, diagnoses and experiments related to challenges to livelihood practices and chestnut resources. For instance, multiple reports from Trabzon identified the cause of declining chestnut tree health as the significant decrease in the number of people available to maintain chestnut groves by pruning trees, clearing brush and dead limbs. Participants decried that economic out-migration has led to too much shade, too much

understory, and too much leaf litter. One interviewee argued that failure to remove chestnut leaf litter led to unfavorable ecological conditions in chestnut-dominated forest. As he stated, "Everyone knows that chestnut leaves have poison" (*Herkes biliyor ki kestane yaprakların zehir var*). These reports show awareness of the local ecological effects of rural abandonment.

A very unique picture emerges from the site of Çanakkale. Here numerous participants made known that even though most chestnut trees were unmanaged on state land, grafted trees were rapidly growing in favor. All graft materials were apparently from Bursa, as they were called "Bursa" and no other variety was reported. Local favor is expressed in numerous references to grafted trees as "smart" (*akıllı*), and un-grafted trees as "insane" (*deli*). Favor for the chestnuts from grafted trees is also strongly manifest in this site. In Bursa, the majority of trees are grafted and located on villager-managed state land. Here, several interviewees reported on their recent efforts to engage with local government and university programs to acquire elite grafting materials including reportedly European-Japanese blight resistant cultivars.

Several interacting layers of connectedness appear to be relevant to participant ability to draw from memory to successfully observe, diagnose, experiment and conserve chestnut resources. One layer appears to be identity, or a perceived shared history. As one participant in Izmir stated, "We are Yörük and so we use chestnut" (*Biz Yörük olduğumuzun yüzünden kestane kullanırız*). Yörüks, or Turcoman, in Turkey may be understood as an identity subset within Turkish identity known for nomadic and traditional living. This statement is given an interesting twist by a consensus from this very village community that chestnut cultivation is by no means a permanent livelihood fixture. Before chestnut was cultivated here, apple and grape were. Now that chestnut is suffering from diseases, several interviewees report they are replacing it with other tree crops. What is a fixture for this Yörük community is the modern version of mobility:

the desire for two houses, one in the nearby town and one in a remote highland location. As one woman whose household had recently replaced several chestnut orchards with various fruit trees, “If our trees had not dried (died from blight), we could buy a house in Ödemiş in 17 years” (*Ağaçlarımız kurutulmazsa, 17 yıl içinde Ödemiş'te bir ev alabilirdik*).

Another community consensus argued that local identity diversity diminished solidarity and trust within the local population. Interviewees articulated two main ways that this occurred. First, these local communities, divided amongst themselves, felt that they struggled to speak to local forest bureaucracy with one voice. By their reckoning, this resulted in unsatisfactory relations with local forest authority. For example in Şile, numerous state programs had occurred since the end of the Ottoman Empire to settle Turkish populations returning from former Ottoman territories such as Bosnia and Circassia. The resulting populations were less than congruous with each other and with surrounding populations. Interviewees argued that this was a key factor in aggressive state programs to clear cut forest and implement mining in their vicinity. Second, norms of access and rights to harvest were weak. For many, this destabilized the livelihood and sapped the motivations behind it. For example, in the famous chestnut-growing district of Bursa known as Cumalıkızık, a consensus in reports claimed that the chestnut livelihood was particularly threatened by harvest theft by outsider groups. This phenomenon of theft was consistently reported to be associated with locally residing migrant laborers from within Turkey, particularly Kurds.

Generational connectedness emerged as a theme in participant reports. This dynamic can be discerned between comments made by older participants such as, “chestnut is our home in life and death,” (*Kestane hayatta ve ölümde evimizdir*) and that of a younger interviewee, “Everything from old times is chestnut” (*Eski zamanlardan her şey kestane*). Another telling

account is that of a young mother-in-law who, in marriage negotiations with the groom's family, fought for and won her daughter the right to be excluded from chestnut labor. These observations and many more hint at the substantial generational changes occurring in rural livelihood contexts across Turkey.

Non-local connectedness – or connectedness with larger region and even, national social networks – can be seen as a capstone factor in local capacity to channel memory, learning and local connectedness into chestnut resource conservation. We observed two main themes in non-local connectedness, informal and formal. Informal connectedness is made up of skills, information and resources garnered from outside networks. The practice of grafting is perhaps the best example of this. The need for local experts in grafting is immense. These highly-sought individuals acquire and distribute premier grafting materials along with knowledge of ecological suitability and perform expert grafting service. Other examples of Non-local informal connectedness include Facebook and Whatsapp groups that are truly interregional. These networks provide inspirational messaging as well as real-time agronomic advice and best-practices. Typically, younger ambitious growers are the main participants but, through them their parents query the networks as well.

Non-local formal connectedness is primarily represented in a community's level of exchange of influence with the local OGM office. This is often the limiting factor for local community's ability to act on the memory, learning, local connectedness and non-local informal connectedness that propels chestnut resource conservation. Mentions of the importance of this influence are prominent throughout the country, as almost all land reported to be used for chestnut collection and cultivation was state land. A strong regional trend can be observed from

interviewee testimony. The general rule is that sites in the Aegean and Marmara experience less OGM restrictions than in the Black Sea Region.

DISCUSSION

In the framework we employ, human niche construction may be understood as a program, contingent on a community's adaptive capacity, to leverage available resources in order to maintain functioning ecological inheritance (Figure 6). Cultural resilience acts as the wellspring of capacity to enact this program. Provided local culture has such capacity, the constructed niche is continually programmed to sustainably support resource availability for people.

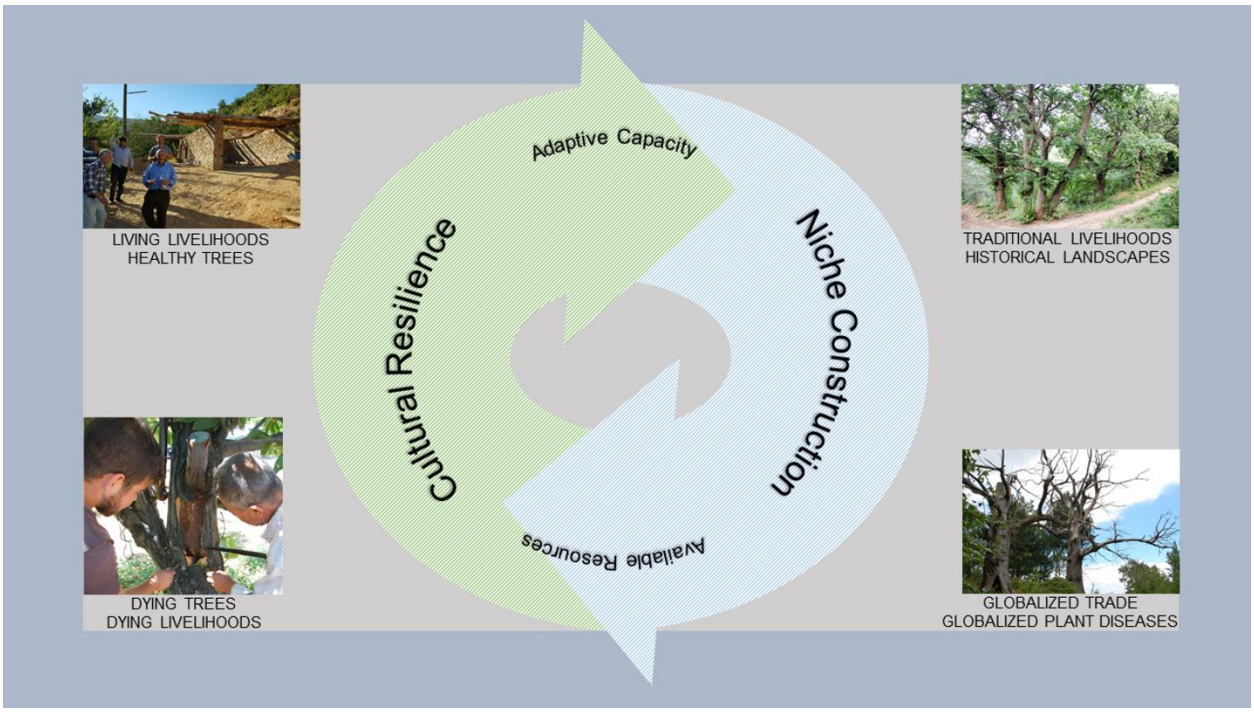

Figure 6 Mutuality of cultural resilience and human niche construction illustrated by the history of chestnut-dominated landscapes and adaptation to recent, compounding pest and disease pressure.

In combination, these theories can help determine how and when the sustainability of anthropogenically maintained ecologies depends on the viability and vitality of local human communities *and* vice versa.

This study shows how communities have inherited and have, in turn, acted as integral components of, their local ecology (Figure 6). In this discussion it is important to emphasize that even plainly biophysical factors such as tree diameter, wetness, and slope can best be understood as expressions of cultural resilience. In orchards and forests alike, we clearly observed the role of livelihood in shaping tree physiology and environment. Take for example, the fact laid out in Table 2 that the size of trees with low disease severity are found in the middle range. This reflects the reality for more managed trees. Those trees that are grafted, pruned, and made rid of natural competition are also likely to be culled when their value in wood exceeds their value in nut harvest. In areas where wood can be more readily acquired from species with no mast or nut production, chestnut may be less likely to be culled for its wood value. Slope also factors into local landscape arrangement. Especially steep slopes are difficult to work on and so are least likely to be the sites of tree and orchard maintenance, let alone collecting. Where gradual arable slopes are at a premium value, as is the case with tea producing regions such as Rize, steep inaccessible slopes of gorges and valleys are common habitat for the chestnut tree.

The dynamic association of grafting and wetness is lucidly illustrated in our findings on memory, learning, and connectedness. This association provides a clear illustration of how niche construction and cultural resilience fuel each other. As is commonly known – and as our data show – wetter habitat is optimal for chestnut tree health. Yet the historic practice of selection by grafting has made it possible to cultivate the tree at the driest extremes allowed by its physiology. Grafting has been common with chestnut since at least the Greco-Roman period (Conedera et al., 2004). Historically, chestnut production was dominated by Bursa, known for its wet and temperate conditions. Today, however, in the wake of ink disease and chestnut blight epidemics, this region produces just .02% of total national production today (TNGDF, 2013).

While growers in Bursa are avidly experimenting with horticultural solutions, production power has mobilized and migrated to the southern and western areas of Turkey. The provinces of Aydin and Izmir together produce nearly 48% of Turkey's chestnuts (TNGDF, 2013).

Figure 7 Clockwise from top left, a) Bursa province grower in his seventeen-year-old grafted orchard of blight resistant European-Japanese Hybrid and b) new lands of the 49 year leases (*kırk dokuzluk*) in Aydin; c) *Sayvan*, huts found in maintained chestnut groves on state land in Zonguldak province and d) chestnut inflorescence in the highlands of the eastern Black Sea province of Rize.

This enormous transfer of production power represents a noteworthy case of non-local formal connectedness. A drier environment is more inhospitable for fungal species like *C.*

parasitica and *Phytophthora cinnamomi* (I. M. Smith, Dunez, Phillips, Lelliott, & Archer, 2009). This new production has been facilitated by the innovation of a unique policy arrangement with the OGM: the 49-year leases (*kırk dokuzluk*). Growers in all surveyed villages in southwestern Turkey have leased land in this way for the last several years. In the high elevation regions of Aydin and Izmir, much highland terrain is under the control of the OGM. However, these new leases, negotiated by triage between chestnut growers, large chestnut firms and the OGM, allow reforestation of these spaces in the form of entrepreneurial chestnut tree planting. These leases and this production can be understood as an expression of local cultural resilience, particularly non-local formal connectedness, because not every community has been similarly successful at lobbying local regulators.

Zonguldak, where disease severity was the lowest of the Black Sea sites, also shows how essential local and non-local connectedness are to adaptive capacity. In Zonguldak, no grafting was observed, but average DBH was closer to Aydin and Izmir sites. In combination with its especially high tree health, Zonguldak stands out for its notable influence on local policy. Alone among Black Sea sites, in Zonguldak we observed the *sayvan*, a small shed constructed at the site of collection. In other sites, such marks of human maintenance were prohibited. Thorn species (*dikenler*), leaf litter and rhododendron (*orman gülü*) were not observed in the plots. Another very interesting feature of Zonguldak situates these findings elegantly. In Turkey, this region is infamous for the pollution associated with coal production. It is likely for this reason that chestnuts from Zonguldak fetch the lowest price in the national markets (Okan, Köse, & Wall, 2017). Yet, unlike other Black Sea sites which were studied, the coal industry ensured that desirable jobs could be found in these rural spaces. The most evident implication is that many younger families can be found in the villages.

CONCLUSIONS

Our findings suggest that communities that are most culturally resilient characterize the environment for chestnut trees in a way that defends tree health. Precise knowledge of the most important biophysical factors and environmental conditions for the tree species can support state conservation efforts and local livelihoods. Yet, the most original implications of the study pertain to cultural resilience and its capacity to drive livelihood practices that optimize the local environment for the pest-ravaged tree species. One of countless challenges to rural viability brought on by economic globalization, the increased movement and severity of exotic diseases and pests endangers the cultural resilience of rural peoples such as chestnut growers and collectors. We document here how the cultural resilience of rural chestnut-livelihood practitioners is, in turn, important for the resilience of the chestnut tree population in Turkey. Policy which supports on-going engagement with the chestnut population by nearby stakeholders is therefore recommended.

CHAPTER THREE[2]

What Women Know That Men Do Not About Chestnuts Trees in Turkey: A Method of Hearing Muted Knowledge

ABSTRACT

Decades of ethnobotanical observations have shown that knowledge varies significantly by the identity attributes of participants such as their religion, occupation, status, income level, geographic origin, and gender. Ethnobiology shares the imperative of all social science disciplines in tailoring gender-responsive methodologies and operating epistemologies. Particularly, researcher identity, performance, and preference for kinds of knowledge may have significant consequences. Here, we present a study centered around an extra-effort to engage women's knowledge of sweet chestnut in Turkey. In Turkey's Black Sea, Marmara and Aegean regions, we conducted 142 extended ethnobotanical interviews with chestnut-utilizing participants using three distinct protocols: gender-unaddressed, men-only and women-only. Based on participant contributions, we developed and analyzed a dataset which accounted for total reported uses, varieties, direct and indirect plant traits, as well as unique and cultural reports. We compared the findings from these distinct protocols using Correspondence Analysis and two-way Analysis of Variance. Our results show that the knowledge reported by women-only was significantly different from, and especially more diverse than, knowledge reported under men-only and gender-unaddressed protocols. This significant difference was most readily attributed to the higher frequency of unique and cultural knowledge shared during women-only interviews. Also, considering the routinely mixed-gender conditions under the gender-unaddressed protocol, our findings suggest that male presence in any form can mute, or render

[2] Co-authors on this manuscript include Elif Aksoy, Nesibe Köse, Taner Okan and Çoşkun Köse

inadmissible, women's ethnobotanical testimony. These findings challenge the community consensus model of ethnobotanical knowledge and field methodologies that do not account for in-field gender dynamics. In conclusion, we articulate a way to amplify insights from intersectionality theory using ethnobotanical approaches.

Keywords: *knowledge, marginalization, anthropology of gender, Castanea sativa, muting*

INTRODUCTION

The ethnosciences pioneered the cross-cultural study of biological knowledge in the modern era (Berkes, 2012). It is becoming clear that such knowledge is maintained differently and irregularly between various members of a community, with various knowledges held more expertly by certain 'kinds' of people (Baumflek 2015; Müller, Boubacar, and Guimbo 2015; Voeks 1996; R. A. Voeks and Leony 2004). This emerging consensus is energized by growing recognition that identity attributes, such as religion, occupation, status, income level, geographic origin, and gender, all play a role in social marginalization and voicelessness (Crenshaw, 1991). The study of ethnobiological knowledge associated with gender is illustrative of the challenges presented by emerging realizations that knowledge is variable between social categories (Kothari, 2003; Müller et al., 2015; Pfeiffer & Butz, 2005; R. A. Voeks, 2007).

Study of gendered knowledge of the biological world presents a unique challenge for researchers for several reasons. First, due to the worldwide prevalence of patriarchy (Mies, 2014), women are one of the most reliably marginalized social categories everywhere (Ortner, 1974). This has led to a cognitive rut in which women's perspectives have historically been perceived by researchers as "inarticulate" (E. Ardener, 1975). Second, in response to decades of various methodological challenges, ethnobiology has, with notable exceptions (see Reyes-García et al. 2007, Vandebroek 2010), settled on a community consensus model which states that

ethnobiological knowledge in a community is a homogenous medium which accumulates within people over time. According to this theory of knowledge, with enough elderly reporting, the community consensus can be appropriately recorded (Müller et al., 2015). Finally, insight from research tailored to engage women's knowledge demonstrates that it can be not only quantitatively different from men's but qualitatively different (Pfeiffer and Butz 2005; Voeks 2007; Müller et al. 2015), a fact with large implications for methodological strategy.

Marginalization occurs through triage of multiple identity factors depending on the social context, in a dynamic known as intersectionality (Crenshaw, 1991; McCall, 2005). This suggests that researchers with just about any identity attribute can, knowingly or not, activate oppression within the research activity and generate "muted groups" (S. Ardener, 1975). This pattern has been especially well documented in the male-centrism of ethnobotanical literature on shamanism in cultures throughout South America (Kothari, 2003). Colfer (1983/2017) describes this process as the preclusion of the expression of models of reality and argues that perception-disqualification applies to any context in which "unequals" are interfacing. In short, women's, and any other relatively marginalized person's model for the world, may be muted in research environments. This mandates divergent and/or parallel methods for research. For women, Pfeiffer and Butz (2005) argue for "extra effort" to account for the knowledge of single households, where women, men, the old and young cohabitate and work together while knowing the biological world differently and holding varying degrees of power.

In this paper, we present such our study of gendered ethnobotanical knowledge of the sweet chestnut tree, *Castanea sativa*, in households across Turkey, where palynology (Conedera et al. 2004; Krebs et al. 2004), genetics (C Mattioni, Martin, Cherubini, Taurchini, & Villani, 2010) and history (Xenophon, 1917) suggest that the tree has been anthropogenically maintained

for millennia. When asked if we could send our female research team members to speak with the women of the household on the same subject which we were discussing with men, we were routinely answered with some variation of, “Sure you can speak with them, but they won’t know anything about chestnuts.” (*Tabii ki onlarla könüşabilirsiniz ancak kestane ile ilgili hiç şey bilmezler*). It was surely the case that shortly after this warning, we would find ourselves listening to women speaking fluently, insightfully and cleverly about chestnut trees. By sending our attention back towards our own sense of what qualified as knowledge, this recurring suggestion was, in the end, a very helpful road sign. We conducted the present research with a null hypothesis that knowledge would not vary qualitatively or quantitatively by our distinct gender research protocols.

Study Setting

The territory of Turkey (Figure 8) straddles a small portion of southeastern Europe and the whole of Anatolia. Within this area, suitable habitat for *Castanea sativa* is found at elevations of 100 to 1400 meters above sea level, all along the northern coastal mountains which run along the Black Sea coast, around the Marmara Sea, in the highland areas in the Aegean region, and in patches of the southern Taurus Mountains. The tree thrives in mixed-hardwood forest near the Black Sea and around the Marmara Sea. In low-precipitation Mediterranean climates of the Aegean province, chestnut trees require human maintenance. While presence and anthropogenic maintenance of chestnut in the Eastern Black Sea and the Caucasus date back millennia, extensive distribution and intensive cultivation of the tree, along with grafting, was initiated during the Greco-Roman period (Conedera et al. 2004; Mattioni et al. 2008).

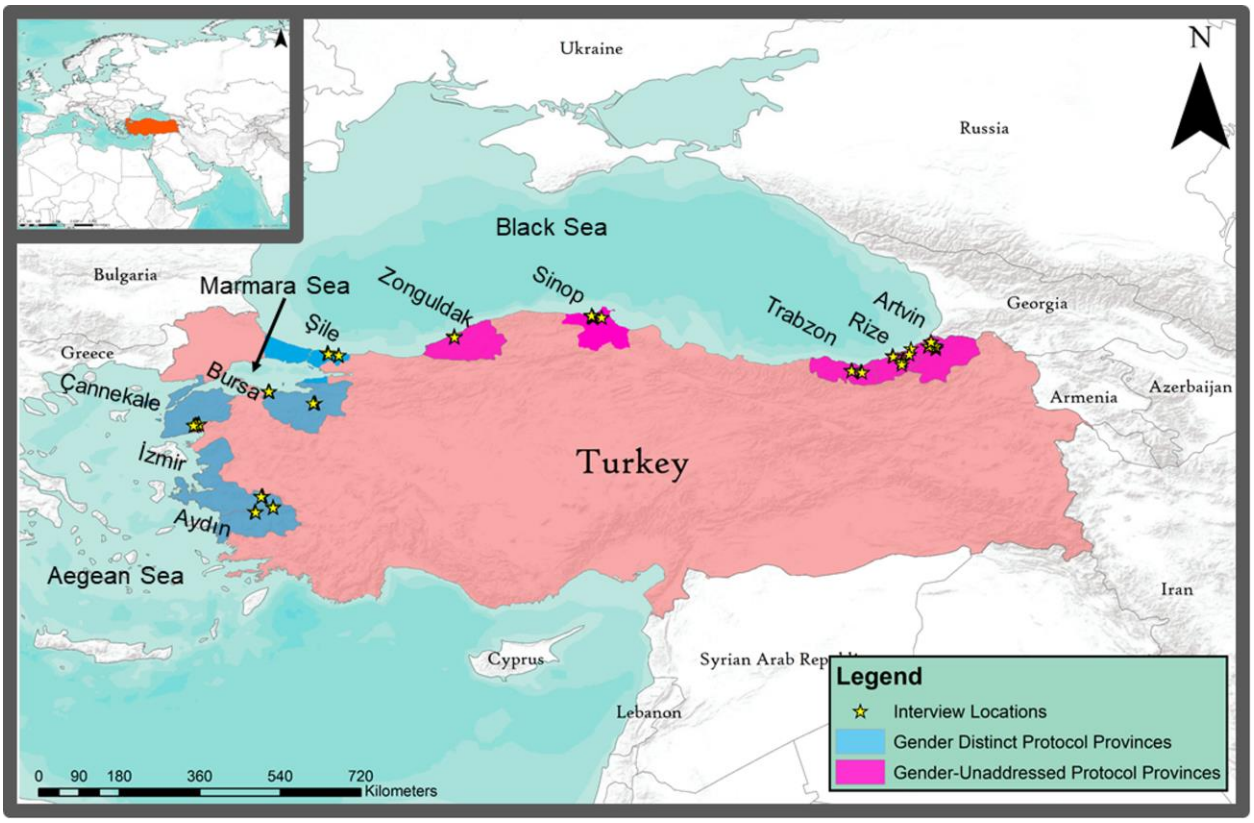

Figure 8 Turkey, research locations, and provinces.

Today, livelihood associations with the tree vary geographically. In the eastern Black Sea, where highland settlements are situated in dense temperate forest on steep terrain, timber and chestnut flower honey are substantially more important to livelihoods than chestnut fruit. In much of this territory, widespread, government-sponsored tea production has both incentivized deforestation and dis-incentivized numerous other livelihood activities such as collection of chestnuts for income (Burrell & Kurzweil, 2007). In the central and western Black Sea, the terrain is gentler and chestnut collection is more prominent, while timber and chestnut flower honey are also important. In these areas, chestnuts are most typically collected after falling naturally. Spaces of collection are typically informally maintained stands on state land where ownership is not allowed, but where traditional household claims are exercised to some degree. Some traditional chestnut management practices in traditional claims are legal, provided fees are

paid to the General Directorate of Forestry (OGM). Legal practices include chestnut collection and honey beehive placement. Commonly practiced, but illegal acts include brush clearing, animal grazing, prescribed fire, pruning and coppicing. The chestnuts from this part of Turkey are considered a specialty item. They are small, easy to peel and famously tasty, but their size and sheer volume cannot satisfy the demands of Turkey's two biggest chestnut-based markets: preserved sweet chestnuts (much like *Marron glacé*), and the urban sale of street-roasted chestnuts.

Supply for these markets is largely met by production in the hot and dry southwestern provinces of İzmir and Aydın – two of our study sites – where chestnut is cultivated commercially, using grafted cultivars, on a mix of land-ownership systems. As one of the only species of locally available hardwood, chestnut timber is also uniquely important. In select highland villages of the Aegean, the cultivation and sale of chestnut fruit is the premier economic activity. Chestnut orchards are maintained rigorously with the aid of irrigation, pest and disease control, and in some cases fertilizer.

Bursa, a province south of the Marmara Sea, and another of our study sites, is famous for its extensive cultivation of chestnuts. However, the onslaught of exotic pathogens, including ink disease, chestnut blight and gall wasp, has caused production to fall precipitously since the 1970s (Food and Agricultural Organization 2013; TNGDF 2013). Growers here pursue livelihood practices similar to those in Aydın and İzmir, but under conditions of high rainfall and with an overall young tree population. Bursa is unique in that many blight resistant Asian-European hybridized cultivars are used. Also within the Marmara regions, the western province of Çannekale has a Mediterranean climate where the chestnut tree is generally encouraged to survive in less-disturbed state forest settings along with various established conifer species.

Where do women fit within this diverse livelihood context? To be sure, in Turkey, rural populations, by and large abide by much more stringent gender roles than their urban counterparts (Arat 2009; Smits 2006). These roles are reinforced powerfully by the high value of women's labor to both family and commercial farming. The demands on women's time make up a web extending from male spouses, fathers, and brothers to sisters, in-laws and businesses near and far (Morvaridi, 1992). The role of coercion in the maintenance of this social labor system is well-documented in Turkey (Cengiz Özyurt, Deveci, Ozyurt, & Deveci, 2011; Kocacık, Kutlar, & Erselcan, 2007). Village space is also highly gendered, with the home and other spaces owned or used by the household and kinship network being more appropriate places for women to be than public places like village cafes, shopping areas, and businesses. The archetypal village in Turkey has a prominent café (*kahvehane*) in the village center where only men are usually found, while women and young children can be found in nearby homes, gardens, orchards or fields.

MATERIALS AND METHODS

Field Work

We applied an effort to engage men's and women's knowledge of chestnut trees using three distinct protocols. The first, we call "gender-unaddressed". In this protocol, a mixed gender research team approached households and conducted exercises with whomever from that household could be coaxed to join. The second, we refer to as "women-only". In this protocol, a team of female researchers visited exclusively with women to conduct research exercises in a venue of the participant's choosing. The third, we call "men-only". In this latter protocol, an all-male research team conducted exercises exclusively with males in a venue of the participant's choosing.

Research activities were conducted during June, July and August of 2015 and 2016. Ten provinces were selected for fieldwork based on the known range of sweet chestnut and on the suggestions of the Turkish National General Directorate of Forestry regarding areas where the tree has livelihood importance (Figure 8). Participant households were identified through a purposive sampling technique (Miles and Huberman 1984; Patton 1990) that was intent on engaging those families regarded locally as active and interested in chestnut-based livelihood activities. This was often, though not always, facilitated by a *muhtar*, or locally elected village representative. Where multiple persons were present for interviews, researchers directed questions to the household members. In the few cases when non-kin persons were present, these individuals were kindly asked to refrain from answering questions. We noted that age could be a strong determinant of voice. For this reason, we saw fit in some instances to facilitate participation from those of various ages.

Ninety-six households participated in ethnobotanical interviews. Of these, forty-eight participated in our gender distinct protocol in which two, gender-exclusive interview events took place per household. These took place in Bursa, Çanakkale, Aydın, İzmir and Şile (shown as blue in Figure 8). Women-only and men-only participants belonged to the same households. Participating women were kin of the male participants. They were usually spouses, but mothers-in-law, maternal and paternal aunts and others also participated. For our gender-distinct protocol, men were contacted and met with first, as this was the most welcome approach. As part of our informed consent process, our female research team would request to interview females of the household. This request was generally a surprise, but, once men got their bearings, they would happily agree to facilitate these meetings and provide a gentle warning that the women in

question would likely not know anything about chestnuts. Upon meeting with women, our women-only research team garnered informed consent for further research activities.

Interview environments diverged along traditional gendered lines. Men would suggest interviews take place in the cafe or in the yard, often with male kin and neighbors present, while women researchers were most often invited into the privacy of the home, where, similarly, visiting female relatives and neighbors were often present. The approach that evolved for our men-only protocol was to conduct interviews at the outset. This allowed for more comfortable socializing afterwards, during which follow-up questions and walks around the property would be made. For women, it was generally apparent that official research activities were unsettling and so researchers engaged in extended lengthy conversations filling in interview themes slowly.

Regarding our gender-unaddressed protocol, our routine insistence that any kin available at the household should join and participate was a welcome gesture, but interview dynamics generally gravitated towards the male head of household being the arbiter of the group's submitted responses, even in circumstances where women were present. Of the ten sites, households in Zonguldak, Sinop, Artvin, Rize, and Trabzon (shown as pink in Figure 8) were approached by our team of mixed-gender researchers, and invited to participate in our ethnobotanical survey after giving informed consent. No specific effort was made to include, exclude or arrange participants and researchers by gender. In many cases, these interviews were conducted at the home of participants, and included women. In other cases, only women participants were present. In still other cases, as per tradition for more formal activities instigated by outsiders, villagers often requested to host research activities at the central café, or *kahvehane*, a by and large male-exclusive venue.

Semi-structured interview focused on the same themes in all protocol. Researchers sought to encourage extensive participant elaboration on four main themes 1.) any and all uses for the chestnut tree and the plant parts required for each use, 2.) specific traits important for each use, 3.) kinds or types of chestnut-materials (chestnuts, wood, flowers) integral to each use, and 4.) cultural value for the tree and its products embodied in rituals, personal stories, legends and other cultural topics. While we allowed for parallel protocol to evolve into different styles along gender-divergent social milieus, interviewers tasked themselves with diligently locating and stoking the participant's interest in each theme.

Data Analysis

After data collection and the assembly of the dataset, several categories of reported knowledge were identified. As shown in Table 4, these were unique reports, or reports made within just one interview, traits, uses, cultural reports, or reports of plant use or meaning in stories, and number of typologies, or distinctly mentioned typologies of chestnut materials (i.e. early versus late ripening fruit cultivar, yellow versus black wood type). Some of these categories were not mutually exclusive. Any report, except for stories, could be unique as long as it was made just once within the dataset. Further details on the characterization of reports can be found in Table 4. What is important to note here is that all categories were weighted equally in analysis. Based on counts of reports in these categories, analysis was conducted to determine if reported knowledge gathered through gender-unaddressed, men-only, and women-only protocols were significantly different. Two methods were applied to this end: correspondence analysis (CA) and two-way analysis of variance (ANOVA). CA has been utilized extensively for visualization of relations within various dimensions of cultural knowledge (A. K. Romney, Moore, Batchelder, & Hsia, 2000; A. Romney, Moore, & Brazill, 1998). Ultimately, output from

CA expresses correspondence of categorical factors as proximity in Euclidian space. We rescaled and converted all counts of reported knowledge for each category to scores between 1 and 5. These scores – 1 being low and 5 being high –were therefore determined for each knowledge category for every interview.

Table 4 Categories and sub-categories of knowledge of the dataset with examples.

Factor	Categories	Examples
Uses	building	windows, doors, siding, roof shingles
	cultural	grave boards, grave frames, henna additive
	gardening	bean stakes, husk mulch, fencing
	medicinal	flower tea, honey
	husbandry	feed, bedding
	heat	firewood, charcoal
	food	scored and roasted, stewed with lamb, sweet sauté
Unique Reports	ecology	*Lodos* wind signals the harvest, bears love branches
	language	*mayasil* for chestnut tea, *erekeme* for volunteer sapling
	horticulture	if piled within husks, nuts continue to mature
	cuisine	boils together with peanut, adds to baklava
	physiology	*kara aşı* variety does not split when roasted
	medicinal	chestnut flower tea is good for hemmerhoids
	insight	*İtal*, meaning import, explains variety name *İtalyan*
	culture	trees are inherited through the woman's side
	building	bedrails, roof shingles
Traits	direct	size, tough sharp spines
	indirect	honey properties, chestnut-fed animal's meat properties
Cultural Reports	legends	before the common era (CE), people ate chestnut with honey
	practices	grave board, henna additive, gleaning of husks
	sayings	*'kestane kebap acele cevap'* ('reply quick as a roasted chestnut!')
	poems	love poems, riddle-poems
	insights	chestnut collectors don't sing because they are racing the others
	stories	early love letters signed with *kestane kebap acele cevap* (see above)
	language	unique regional terms for chestnut related items and activities
Typologies	horticultural	grafted varieties
	timing	the nuts that fall earliest, i.e. *akkın*
	past/present	grafted varieties that are now gone versus the ones now present
	geographic	nuts and their known qualities from a distinct region i.e. *Sinop*
	size	big (*iri*) small (*ufak*)
	bioform	naturalized trees known for physiological characteristics

As a logistical matter, there was a strong regional factor in our protocol implementation. We travelled as one mixed-gender research team to the Eastern Black Sea Region. Our gender-unaddressed protocol was conducted exclusively in the central and eastern Black Sea region while our men-only and women-only protocol was conducted in the western Black Sea, Marmara and Aegean regions. To determine whether, and to what extent, this affected our results, two-way ANOVA was performed in order to determine the effect of gender while accounting for the effect of region. To perform ANOVA, we derived and tested two continuous dependent variables for each interview: 1.) a total of all scores mentioned above and 2.) a Simpson's Diversity Index value (SDI) using total number of knowledge reports per abovementioned category. The SDI, common in studies of biological diversity, accounts for richness and diversity of the variable. Lower SDI value indicates higher diversity.

RESULTS

In all, 142 interviews (N=142) were conducted. Of these, 48 were conducted with our gender-unaddressed protocol (N=48), while 48 men-only (N=48) and 46 women-only (N=46) interviews were also conducted. Table 5 shows the total number of reports by knowledge category and protocols. In addition to expansive lists of uses, their necessary plant parts, valued traits, and cultural reports (Table 4), several protocol-specific knowledge bodies became apparent only after collection and data compilation. These categories included unique reports, cultural reports and multiple typologies of chestnut materials. Unique reports were those reports which were made by just one interviewee. An example of a unique report is a woman's claim that chestnut husks from European hybrid varieties were not preferred because when applied as a mulch to gardens, they decayed too slowly, and remained spiny for much too long. Unique reports were noted and categorized as pertaining to ecology, language, horticulture, cuisine,

physiology, medicinal value, culture, building, and general insight. A special form of unique report emerged which we labelled ‘insight’. These were explanations offered by participants to explain a biophysical or social phenomenon that arose in discussion.

Table 5 The relative contribution of reports by interview protocol. Number of participants per protocol indicated next to protocol heading.

Factor	Unaddressed (N=48)	Women (N=48)	Men (N=48)
Uses	526	214	512
Unique Reports	29	93	28
Traits	231	154	190
Cultural Reports	28	41	27
Typologies	58	66	57

Cultural reports included legends, practices, sayings, poems, insights, personal stories and unique regional terms to do with chestnut. Many of these were also unique reports, though personal stories, because they are by definition unique, were not credited with being unique reports. An example of a personal story is when a women recounted when her husband was away with military service, they communicated by letters, and always signed them off with the phrase “reply as fast as a chestnut roasts!” (*Kestane kebap acele cevap*!) An example of a legend was shared by a woman in İzmir province in which Allah once said that “I’ll give chestnut such a taste that you’ll collect it spines and all.” (*ben bir tat veririm ki gürün (diken) içinde toplatırın demiş*). Another example of a cultural report was a poem-riddle. “Hey what am I, what am I?/ I am the man with the fur coat/ The one that fate threw / The one cooked in hot embers” (*Hey ne idim, ne idim/ Samur kürklü bey idim/ Felek beni taşladı/ Kızgın külde haşladı*). Many such reports were also unique reports.

To most participants, our question: “what kinds of chestnut are there?” (“*kestane’nin ne çeşit var?”*), meant ‘what varieties of grafted cultivars are there?’ However, due to our

persistence in asking this question several ways, many other important typologies were articulated including early ripening versus later ripening nuts, cultivars that were used in the past versus those used today, and unique types of wood and nut named by their province of origin. Past versus present day typologies were exclusively shared in women-only interviews and tended to relate to horticultural varieties that were once favored but which were abandoned for more commercially viable ones. Also included in the dataset was the distinction between direct or indirect reported plant part traits. Indirect traits are not traits of the utilized plant part, but were instead noted as unmistakable traits of derived products. The unique qualities of chestnut honey compared to other honeys: its astringency, its viscosity and its tendency to not crystallize, are examples of this.

We rejected our null hypothesis that there was no significant qualitative or quantitative difference in the knowledge reported under our three protocols. Results of correspondence analysis (Figure 9) show the distinct nature of knowledge reported by women in our women-only protocol. Regardless of frequent mixed-gender scenarios which occurred under our gender-unaddressed protocol, reported knowledge from this protocol is much closer to that derived from our men-only protocol. It is also worth noting that women-only reported knowledge is more like gender-unaddressed than it is men-only, when considering its position along the vertical axis. CA reveals approximate equidistance between distinct knowledge bodies reported by site, indicating that there is no obvious effect of region on reported knowledge.

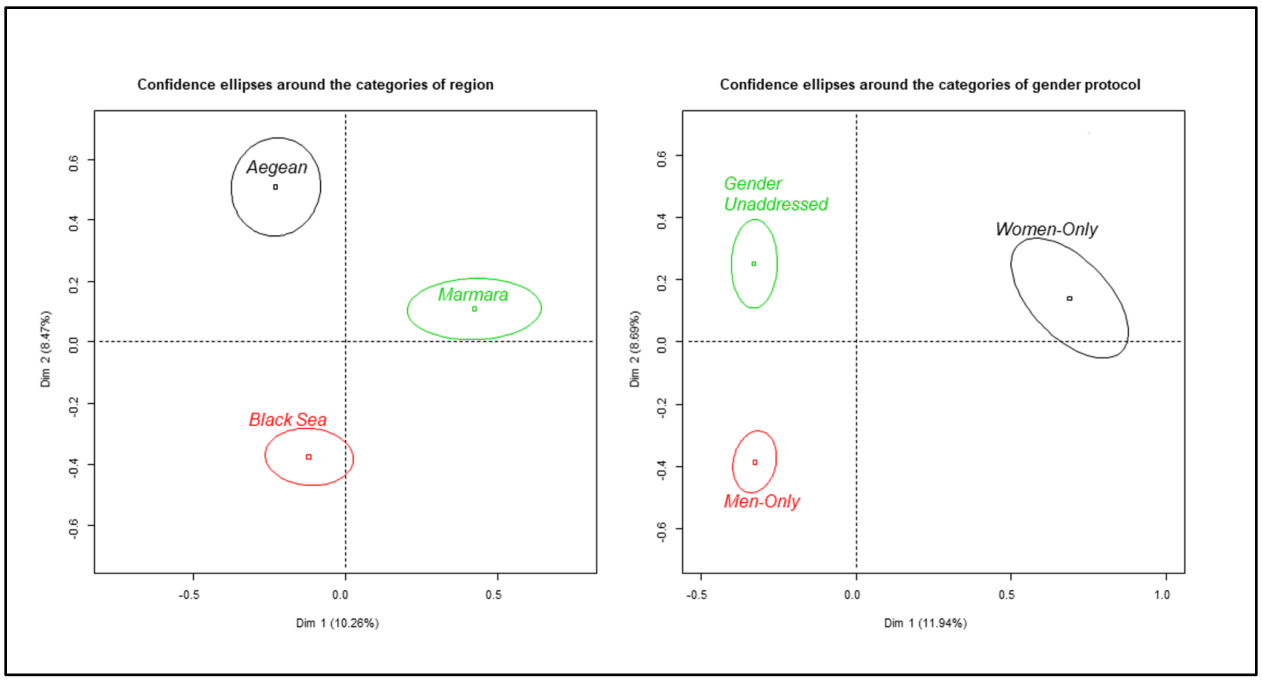

Figure 9 Results of Multiple Correspondence Analysis (MCA) of all interview knowledge scores of all categories and region (left) and interview protocols (right). Data is represented by a confidence ellipse encompassing 95% of data points.

ANOVA results (Table 6 and 7) substantiate the results of CA in terms of knowledge diversity but not in terms of total knowledge score. Region was observed to be a significant factor in the variation of knowledge score and knowledge diversity. Gender was observed to be a highly significant factor in the variation of knowledge diversity, but not in knowledge total, between groups. Tukey post-hoc test fails to verify any significant effect of region on reported knowledge diversity (Figure 10), but a significant effect of region was verified on total knowledge score. However, further consideration of this variation in total knowledge scores shows that the regional difference was most significant between the Marmara and Aegean regions. In these two regions, the same protocol was applied. Therefore, it was observed that the significant regional difference documented in total knowledge scores could be attributed to differing amounts of knowledge reported in these two regions, but could not be attributed to divergent protocol.

Table 6 Results of Two-Way analysis of variance of total knowledge scores by gender accounting for the effect of region. Significance indicated as < 0.001 '**'

Factor	DF	Sum of Sq	F- Value	Pr(>F)
Gender	2	5.5	0.569	0.56744
Region	2	47.7	4.939	0.00851 **
Gender: Region	2	5.9	0.609	0.54547
Residuals	135	652.0		

Table 7 Results of Two-Way analysis of variance of knowledge diversity by gender accounting for the effect of region. Significance indicated as <0 '***', 0.01 '*'.

Factor	DF	Sum of Sq	F- Value	Pr(>F)
Gender	2	0.5200	13.177	5.92e-06 ***
Region	2	0.1766	4.474	0.0131 *
Gender: Region	2	0.0846	2.143	0.1213
Residuals	135	2.6640		

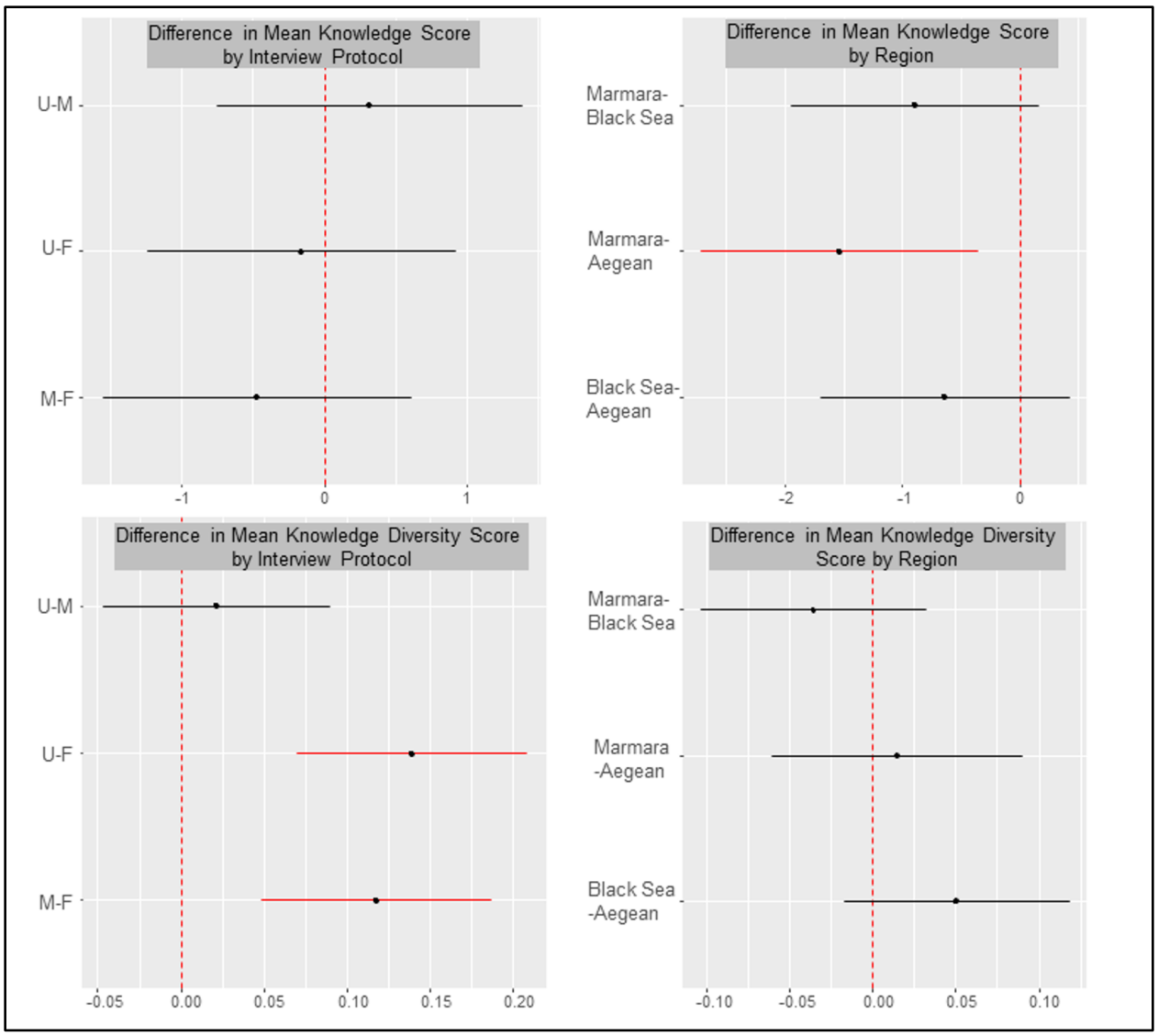

Figure 10 Results of a Tukey post-hoc test on analysis of variance (ANOVA) of total interview knowledge score and interview knowledge diversity by different interview protocols (U = gender unaddressed, W = women-only, M = men-only) and different regions. Confidence bands represent 95% of true difference between pairs. Significant differences do not cross the zero value and are highlighted in red.

As described above, knowledge diversity was calculated as the SDI of knowledge reported in individual interviews. There is a significant difference between the knowledge diversity reported by women-only and that reported by men-only and gender-unaddressed groups (Figure 10). We suggest this difference is due to several factors. First, the much larger confidence ellipse around the representation of women's knowledge when compared to the

men's and that of the gender-unaddressed group suggests that the knowledge structure reported by women was less uniform (Figure 9). Men-only and gender-unaddressed groups shared a much more standardized and bounded knowledge structure. Women's average SDI value (lower means more diversity) was 0.30 compared to 0.432 and 0.441 for men-only and gender-unaddressed respectively.

Further insight is achieved by considering the breakdown of reported knowledge. In following the order of categories as laid out in Table 4, fewer uses per interview were reported under the women-only protocol compared to the men-only and gender-unaddressed protocol. The most reported use sub-category by men-only and gender-unaddressed interviewees was building, while for women-only interviewees it was food (Figure 11a). Order aside, all three protocol reported food, building and gardening as the top three use-categories. However, for women, the next most prominent use-category is home heat. The differences in cultural uses is illustrative of the diversity consistently found in women-only reporting. Men-only reported cultural uses more than three times more than women-only, yet all of these reports referred to the same use, the *mezar tahtasi*, or the grave boards that accompany burials. Women-only reported *mezar tahtasi* in addition to many other cultural uses. For example, one woman reported that chestnut flower tea is added to henna-dye for wedding ceremonial bodily decoration. The most popular cultural use reported by women-only was facilitating the gleaning of discarded and conveniently-placed chestnut husks by those local community members in need of soil conditioner or fertilizer.

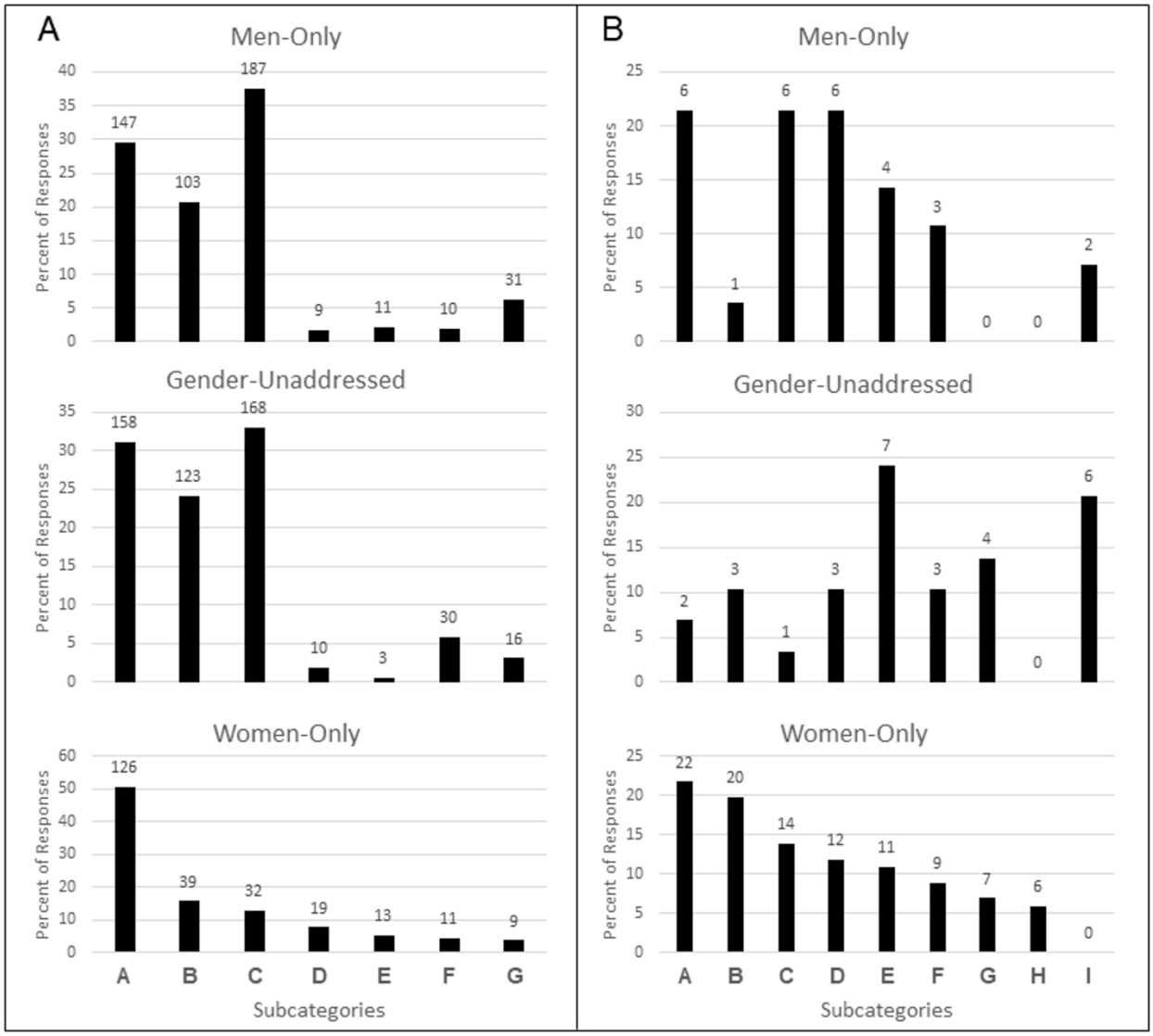

Figure 11a) Breakdown of use sub-categories by interview protocol. The number of reports for each category are located above the sub-category bar. Sub-categories are signified by the following: A-Food, B-Gardening, C-Building, D-Heat, E-Medicinal, F-Husbandry, G-Cultural; **b)** Breakdown of unique knowledge subcategories by interview protocol. The number of reports for each category are located above the sub-category bar. Sub-categories are signified by the following: A-Physiological, B-Cultural, C-Language, D-Horticultural, E-Insight, F-Culinary, G-Ecological, H-Medicinal, I-Building

Discussion of unique reports must be prefaced by stating that women-only interviews generated more of them. Unique physiological, linguistic (see Okan et al. 2017) and horticultural reports were prominent for both men-only and women-only interviews. Women-only unique reports, however, were roughly 18% cultural (Figure 11b). Another prominent category for

women-only unique reports, when compared to the men-only, are ecological and medicinal. The category of cultural reports, not to be confused with unique cultural reports, is another category where women-only interviews were more likely to contribute and to be more diverse. A significant majority of gender-unaddressed and men-only cultural reports were either practices or language related to burial. By comparison, women-only cultural reports enjoyed much more even distribution between the sub-categories of stories, legends, poems, sayings and practices, while also including the burial uses for chestnut.

Women-only interviews generated significantly less reported traits than the others, but were more likely than other interview protocols to supply indirect traits, and again, these were more diverse than those provided by the other protocol. In the case of the gender-unaddressed interviews, 75% of indirect trait reports were traits of chestnut honey, a very prized, income-generating product in Turkey. Twenty percent of women-only reported indirect traits related to the health benefits of chestnut-inflorescence tea. Other women-only indirect trait reports included the embittering properties of chestnut leaves to meat when used as a fodder for sheep, as well as the special benefits to tomato plants and mushroom growth from application of chestnut husk compost.

Finally, women reported more plentiful and evenly distributed typologies of chestnut materials. Horticultural categorization was reported prominently by all interview types and was taken to mean both locally-utilized, grafted cultivars as well as undomesticated local types. Both men-only and gender-unaddressed chestnut kind reports consisted of 86% and 85% horticultural typologies, respectively. Women-only interviews were much more likely to begin discussion of typologies of chestnut materials in regard to the labor schedule. In this regard, early versus later harvest was an especially important quality. A very important distinction was made for the

earliest self-dropping nuts, referred to variably as "*akkın*" or "*akkıtan*." These earliest nuts were seen to initiate the season, were rather unimportant commercially, and were noted for special cooking needs. This typology went unreported in the other interview types.

Only in women-only interviews were undesirable qualities of more recently introduced, chestnut blight resistant, European-Asian hybrid cultivars discussed. Firstly, women commonly referred to them as "*ital*", meaning literally foreign imports. Men exclusively referred to these varieties as "*İtalyan*" or "*İtalya*" meaning Italian or Italy respectively. Further, from women's reporting we learned that the General Directorate of Forestry, the agency which regulates use of forest space, supplies the newer varieties for a fee. Women found notable challenges in dealing with the husks of these varieties. Firstly, they reportedly did not naturally release nuts after ripening, and instead had to be knocked down with a stake. Upon having been knocked down, they remained recalcitrant and one woman reported selling the nuts still attached to the husks because of the bother. Further, another woman reported that the husks from these varieties were troublesome when applied to gardens as a mulch, a very common practice, because they would not decompose and lose their sharp spines.

DISCUSSION

Gaps in knowledge by gender have received a good deal of attention from numerous dimensions of contemporary society, but political science has wrestled with the issue most extensively. Historically, it has routinely appeared that women know less than men about politics (Gidengil, Blais, Nevitte, & Nadeau, 2003; Verba, Burns, & Schlozman, 1997). To explain this difference, numerous studies have attempted to locate the cause in women's comprehension levels, access to information and level of interest in political knowledge (Delli Carpini & Keeter, 1996; Luskin, 1990; Popescu & Toka, 2009). However, the most influential factors have turned

out to be features of research methods. The most recognized and demonstrated factor in the gender gap in political knowledge is a deeply qualitative one: men are more likely to guess than women and women are more likely than men to answer, “I don’t know” (Mondak et al. 2004; Lizotte and Sidman 2009). What may be more pressing for ethnobiology, however is the insight that operating definitions of knowledge have been shown to play a strong role in results. Categories of political knowledge known to be more valuable to women are consistently under-represented in survey instruments compared to those more valuable to men (Karp and Banducci 2002; Stolle and Gidengil 2010; Dolan 2011).

In the field of ethnobiology the gender gap in knowledge has been understood to be contingent, not on information volume, but on divergent habitat familiarities of men and women (R. A. Voeks, 2007). Thus, Pfeiffer and Butz (2005) maintain that it is imperative to carefully select phenomena of interest for study, as plant use categories as well as their respective habitat types may have consequential effects on efforts to learn women’s and men’s relative knowledge. Many of these prominent asymmetries are argued to be firmly established. Women, for instance, are generally understood to possess more knowledge of food, medicinal plants and other biological resources found in disturbed landscapes nearer to the residence, while men are commonly understood to have more abundant knowledge of undisturbed forested habitats (Begossi et al. 2000; Voeks 2007; Dovie et al. 2008; Torres-avilez et al. 2016).

However, little about the gender differences in knowledge associated with various research approaches has been investigated. It strikes us that an important project for ethnobiologists is to take inventory of, and to further develop, robust methodologies for engaging women’s knowledge. One such factor is the gender dynamics that arrive along with the research team. Pfeiffer and Butz generate a thorough list of potentially disadvantageous dynamics that can

arise without consideration of this factor. This includes aggravation of cultural restrictions that pertain to cross-gender interactions, women's general shyness with male researchers, and the gender-sensitivity of certain plant-related information (Pfeiffer & Butz, 2005). Kothari (2003) identified a correlation in the ethnobotanical literature from South America between extreme interest in healing traditions associated with male-dominated shamanism, and the invisibility of more day to day plant-healing associated with women. She contributed to developing a community-performed research agenda which illuminated women's rich plant medicinal. We consider the present work to be a useful contribution to this emerging literature. Our special contribution is to illuminate how muting may occur when certain perspectives are rendered inadmissible as a result of research methods.

One of the most obvious characteristics of our results is the evidence of muting of women's perspectives in scenarios where the gender composition of the research activity was not controlled for. In our control protocol, many interview events involved only female participants, and yet the presence of the male researcher seems to have 'precluded' the emergence of knowledge models that were so prominent in the women-only interview events (Colfer, 1983/2017). A reemphasis on the similarities between men-only and gender-unaddressed knowledge is in order. The men-only and women-only interview events were conducted with cohabitating men and women, kin and married couples. Yet there was striking similarity, not between these interview results, but between that of men-only knowledge reported in western Turkey and gender-unaddressed knowledge reported in faraway northern and eastern Turkey. The structure of women's knowledge by our accounting was especially distinct and provides more evidence on the shortcomings of a cultural consensus model of community plant knowledge.

Interestingly, not all characteristics of women-only reported knowledge were equally muted. This belies a question about which manner of knowledge was muted by male presence and why? The most salient features of women-only reported knowledge, when compared to that of the other two protocols, were its diversity, its greater uniqueness, its considerable cultural content, and the tendency to categorize chestnuts by their demands on labor at different times of the year. This might suggest that in some mixed gender scenarios, some categories and styles of knowledge were more admissible than others.

It is our observation that the refrain which men of the household used to warn researchers against expecting much knowledge from their women kin, can be paraphrased to mean something much more precisely as, "sure you may speak with her, but she may not know how to serve up the kind of knowledge an outsider is likely after." This interpretation may explain why, in many instances, women participants agreed to such a formulation. We take it that what was being discussed here was more of a skill, on the part of participants, to infer and triangulate the interests and preferences of the interviewers. A case in point is the divergence, by protocol, in the expressed views of the new European-Asian chestnut blight resistant hybrids. It is certain that the male researchers among us were assumed to have an affiliation with and/or connectedness with the General Directorate of Forestry, the entity overseeing the import and dissemination of these cultivars. Male-only discussion of these goings-on was especially careful. The characteristics of the varieties were not discussed in detail, details of the dissemination programs were mentioned only sparingly, and value judgements on these varieties were withheld. In the divergent milieu of the women-only interviews this assumption about researcher affiliations was, seemingly, more readily relaxed. It is also possible that women felt more willing to seize the moment and speak through researchers to the General Directorate of Forestry. Women openly

discussed program history and mechanics. They offered raw perspectives on the pros and cons of such varieties and communicated their disfavor for the varieties overall. Ultimately, a strong differential in levels of formality characterized these divergent protocols, where male presence triggered more reticent presentation of knowledge.

Understanding variation in knowledge by gender may be the best first step for ethnobiology to embrace intersectionality. McCall claims that the most laudable achievement of women's and feminist studies may be opening the academy and society for the expansive concept of intersectionality. She goes on to argue that a top priority for ensuring impact of intersectionality theory is the need to develop methods to study it (McCall, 2005). Two core features of ethnobiology make it a suitable candidate to carry on the work of intersectionality. First, ethnobiology has historically maintained a focus on people's cognition of environment (Hunn, 2007; Martin, 2004). This granular interest represents a unique milieu for the investigation of intersectionality, which might not only lead to concrete methodologies, but has the potential to loop back and enrich intersectionality theory. Second, as Hunn articulates, the phenomena of interest for ethnobiology are usually threatened. They must always be engaged "while there is still time" (Hunn, 2007:9). This is now infinitely true for the knowledge of women, ethnic minorities, the poor and all groups who have been somewhat "invisible" (Kothari, 2003) and "muted" (S. Ardener, 1975) for most of the discipline's history. This recognized and central urgency may be an asset in the rapid amplification of intersectionality by ethnobiology.

CONCLUSIONS

This research program was conducted at a critical time for both the population health of *Castanea sativa* in Turkey and rural livelihood viability throughout Turkey. There are three pathogenic outbreaks which severely compromise chestnut tree health in Turkey: ink disease

caused by the oomycete *Phytophthora cambivora*, chestnut blight caused by the fungus *Cryphonectria parasitica*, and most recently, major damage is occurring with the arrival of the gall wasp, *Dryocosmus kuriphilus*. All three of these pathogens were introduced into Turkey by trade in wood and/or nursery products. Further, Turkey's modern economic trajectory has spurred mass out-migration from rural areas to cities within Turkey and in Europe. Thus, many villages, even villages named "Chestnut Grove" (*Kestanelik*) report significantly decreased chestnut related livelihood practices along with significantly decreased nut harvests.

This context is then congruent with much of the rural developing world where ethnobotanical knowledge is most plentiful, most diverse and most quickly disappearing due to numerous causes. This study has demonstrated that an "extra effort" to engage women can help prevent their knowledge from being muted. It has demonstrated that knowledge may be defined and shared very differently depending on the interview environment, a feature which includes the gender composition of the research team, but which also includes the researcher's approach to defining knowledge. Ethnobotanical insights of individuals of various religions, occupations, statuses, income levels, geographic origins, and genders can all be potentially muted in the process of research. Thus, it is imperative that ethnobotanical methods strive to account for the contours of social variation in the research context. There is no small risk that inadvertent devaluation of knowledge by research practitioners can contribute to certain ecological knowledge remaining inadmissible for the long term. This may be true in the context of future research visits, and in the home community, long after the researcher departs.

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CHAPTER FOUR[3]

While There is Still Time:
Folk Biological Value and Chestnut Conservation Prioritization in Turkey

ABSTRACT
This paper investigates folk value for the chestnut tree across Turkey, where the species is threatened by multiple exotic pathogens. We define folk biological value as the constellation of values for the biological world that are vital to cultural cohesion and survival. The survival of biological and cultural diversity are interdependent. Meaningful biological conservation therefore requires research methods that can perceive and support cultural, folk, values. In the tradition of cultural significance studies, we develop and test a methodology to identify and illuminate the most salient folk values for the threatened chestnut species held by the Turkish public. Drawing on protocols from agricultural economics, ethnobiology and participatory plant breeding, this novel methodology investigates value for the sweet chestnut along the value chain. We conducted 165 group interviews with 14 chestnut value chain groups – defined by like livelihoods – and conducted multi-site ethnographic research with 3 chestnut-utilizing communities across Turkey. Our results show that the divergent cultural histories of the Black Sea region and western Turkey have given rise to distinct zones of chestnut folk value. Crosscutting this geographic divide, we show how knowledge-value patterns transform in step with the flow of the value chain, and how folk value characterizes value to individual well-being. Our findings suggest that folk values such as aesthetic and mnemonic value permeate the entirety of the value chain and motivate conservation at village sites where trees are maintained. This research furthers the capacity of ethnobiology to serve communities in the throes of urgent biological conservation, who are transitioning from ecological protection to prioritization.

Keywords: *value chain research, folk valuation, aesthetic anthropology, Castanea sativa*

[3] Co-authors on this manuscript include Taner Okan, Çoşkun Köse, Elif Aksoy, and Nesibe Köse

INTRODUCTION

In an era of correlated biological and cultural loss (Barnosky et al., 2011; Ceballos et al., 2015; Loh & Harmon, 2014; Rapport & Maffi, 2010), there is emerging conviction that biological and cultural diversity are necessary for survival. In fact, ethnobotany has called itself to the challenge of becoming the "science of survival" (Aiona et al., 2007). This mandates adherence to biocultural conservation methods that can achieve multiple goals. First, such methods must be able to identify, understand and support values for the biosphere that are vital to cultural cohesion and survival, what we define as folk value. Second, such methods must elicit local valuation and prioritization of biological resources in particular cultural communities in the throes of urgent biological conservation. Doing so requires capacity to account for the more conventionally understood value of these resources to individual well-being, namely nourishment, happiness and prosperity, as well as the comingling of these forms of value and more collective, folk biological value. Finally, these methods must be able to work rapidly to respond to inherent urgency. As ethnobiologist Eugene Hunn declares, biocultural conservation in our era must engage "peoples in their tight environmental embrace while there is still time" (2007:9). In this study we develop and test a methodology to identify and illuminate the most salient folk values for the chestnut species in Turkey, where the species is threatened by numerous exotic pathogens. These include ink disease caused by the oomycetes *Phytophthora cambivora* (Petri) Buisman and *Phytophthora cinnamomi* Rands (Erdem, 1951), the chestnut blight caused by the fungus, *Cryphonectria parasitica* (Murill) Barr (Akdogan & Erkman, 1968), and most recently, the gall wasp, *Dryocosmus kuriphilus,* Yasumatsu (Cetin et al., 2014).

To begin with, discerning the relationship between biological and cultural survival is a highly complex task. Vagaries defy efforts to determine to what extent a people's survival is

contingent on the health, occurrence and/or accessibility of some feature of the biosphere, like a species (Platten & Henfrey, 2017). First, a species is by no means a monolith. Of one and the same species, certain populations, tendencies, traits, and types are the object of differentiated esteem. Second, in an increasingly urban humanity, characterized by the concentrating influence of nation-states, cultures and peoples are increasingly difficult to identify and locate. Yet, even in urban diaspora, under cultural assimilation and in transitional, disparate and heterogenous geographic arrangements, peoples maintain enduring and complex value for particular, often remote, lifeforms and biological communities (Vandebroek & Balick, 2012).

Certain species-culture associations present an important model in that they have existential value for particular peoples. These have been described as cultural keystone species (Garibaldi & Turner, 2004). In certain extreme cases, the confluence of spiritual, aesthetic, cultural, and economic value for a species is of such magnitude that existence for a people is inconceivable without it. An example is that of the Nilotic Nuer and Dinka peoples of southern Sudan, for whom the lives, ideas and bodies of cattle permeate the livelihoods, material culture, kinship organization, language and imagination of the entire community (Coote, 1992; Ryle, 1982). Yet the existential level of value for cultural keystone species is rarely so clear. As Platten and Henry assert, the value of cultural keystone species is difficult to distinguish outside of their natural "complexes of interconnected material and subjective factors" (2017:496). To understand the complexes they describe, it is necessary to account for the enormous importance of collective identity, group cohesion and cultural survival in the maintenance of biocultural associations.

The conceptualization and measurement of cultural significance and use-value are the main ways ethnobiologists have investigated collective, cultural value**.** To Claude Levi-Strauss, life forms were significant to indigenous peoples for being of "use or interest"…where "use

concerns practical and ‘interest’, theoretical, matters” (1966:2). Subsequent efforts tended to single out for investigation the observable and individual-level phenomenon of use, while neglecting the more abstract qualitative notion of cultural, or even practical, interest (Hunn, 1982). Numerous works have arisen to approach use with quantitative rigor. These include the Cultural Significance Index (CSI), also known as the Index of Cultural Significance (ICS), (see Pieroni 2001; Garibaldi and Turner 2004; Garibay-Orijel et al. 2007) and the Use-Value Index (UVI) (see Prance et al. 1987, Phillips and Gentry 1993). These approaches attempt to elicit and quantify the local importance of certain species by analyzing the body of data resulting from multiple ethnobotanical interview or questionnaires. Some combination of factors such as frequency of mentions, quality of properties, and frequency of uses is synthesized quantitatively to reveal local cultural significance.

While CSI and UVI research has generated very meaningful documentation and innovative methodology, for the purposes of identifying conservation priorities, it suffers from two significant shortcomings. First, they are indirect by necessity. Why use an indirect methodology when one might just ask people what the most important species are? One answer is that traditional peoples routinely decline invitations to discuss their environment that way. As Turner describes,

> *when one knowledgeable elder of the Nicola Valley in Thompson territory was asked, "Which plants would you say were the most important in the old days?", she replied, "I'd pick them all-they're all important. I wouldn't know which ones to pick."* (1988:274)

Consequently, CSI’s and UVI’s were designed, in large part, to bypass the resistance of indigenous and traditional peoples to rank elements of their environment by importance (N. J. Turner, 1988). Due to this circuitous approach, they represent a questionable way to assign

conservation importance to certain elements of the local ecology while consigning others to disappearance in the face of looming ecological threats.

A second shortcoming of CSI's and UVI's is that their function was not to produce coherent conservation priorities. Instead, 'cognitive ethnobiology' (Hunn, 2007:4) approaches strove to better understand the adaptive role of human cognition. In other words, the intent of the CSI has tended to be illuminating the role of human perception and cognition of environment in individual survival and, consequently, human evolution (Martin, 2004). Specific interests tended to be linguistic features such as lexical retention and classification (Garibay-Orijel et al., 2007; N. J. Turner, 1988). There are two primary reasons these studies are not suitable for determining the cultural value of local biological resources. First, the Darwinian concept of adaptation at the core of this approach hinges on an individual having fitness sufficient to complete its life-cycle. As a framework for estimating value then, it makes sense that this focus elicited very meaningful consensus among individuals about the survival value of certain plants, animals, etc.. CSI's and similar ethnobiological investigation have discovered breathtaking depth and breadth of indigenous knowledge of individuals (Harold C Conklin, 1954). However, so far few approaches have been discerning in values for cultural survival. Second, much like the reported shortcomings of contingent valuation in environmental economics (Diamond & Hausman, 1994), investigations targeted on cognition, when they investigate value at all, deal squarely with the inexactitude and abstraction of hypothetical value.

In the process of implementing a CSI, Stoffle et al. (1990) managed to overcome these two challenges. They achieved this in concert with the leadership of their Paiute and Shoshone research communities in Nevada. In the face of inevitably destructive development activities, the participating Paiute and Shoshone communities saw the need to articulate features of the local

environment that were priorities for conservation. The authors argue that this inclination hinged on the Paiute self-determined transition from a "cultural-resource protection position to one of resource prioritization" (Stoffle et al., 1990:420). The authors came to understand this autochthonous shift only after untethering their own concepts of significance from a Western scientific fixation on individual survival and acknowledging the deeper motive of group, or cultural, survival. The author's use of a CSI was thus meant to inform extremely consequential decisions about what to conserve and what to let die based on the locally determined importance of habitat and species to cultural survival. In doing so they delivered the long-lost word, significance, back to its more traditional meaning, something synonymous with value: value for a people.

We follow on this path of directly investigating folk biological value – the constellation of values for the living world that are vital to cultural cohesion and survival – to more fully illuminate the motivations for biological conservation and prioritization. We also document our effort to identify and study folk value for a single species, the European chestnut, *Castanea sativa*, in Turkey, where this locally treasured tree is threatened by multiple exotic pathogens and pests. In our novel methodology, we bring together protocols from value chain studies in agricultural economics, ethnobiology and participatory plant breeding. First, to trace value for sweet chestnut in a systematic, coherent, way, we followed the value chain. Then, to ascertain value, we combined ethnobotanical and participatory plant breeding methods, taking the characteristics of trait reporting to signify value, just as the characteristics of use reports signify significance to CSI's and UVI's. To develop a rich explanatory resource for the variation we observed, we conducted multi-site ethnography in sites across Turkey. This methodological innovation is necessary to advancing ethnobiology's capacity to perceive and understand

variations in folk value within a specific cultural keystone species. Because it is more direct and perceptive of cohesive cultural values, we argue that folk valuation surpasses the ability of CSI and Use Value Indices to characterize local cultural resource conservation priorities in the face of urgent loss. Critically, we do so without communicating any rank or order among these priorities. The resulting methodology represents an important instrument for an ethnobiology overtly concerned with serving communities contending with urgent biocultural conservation.

MATERIALS AND METHODS

Our research was conducted over a two-year period between June of 2015 and July 2017. Our primary objective was to plot a research program to evaluate variation in ethnobotanical knowledge across a comprehensible flow of value, the value chain. Typically, economic value is explored across geography using value chain (Kaplinsky & Morris, 2002) and filière analysis (Bernstein, 1996). The purpose of such work has pivoted on the study of market forces, whether for purely economic study of transaction and price dynamics, or with a more activist intent to understand and mitigate oppressive forces. The purpose of the present study was fundamentally different in that our definition of value was more than economic, more than utilitarian and more than cognitive. Bernstein similarly adapted filière and value chain analysis by treating the approach as an instrument which could be separated from its purely economic analysis. While Bernstein's chosen form of analysis was political economic, the present study applies ethnographic and ethnobotanical analysis.

It was necessary to make two further adaptations to the value chain model. First, value chain and filière analysis tend to single out a particular commodity and follow that commodity as it 'moves' through various stages. However, ethnobotany has largely studied cultural interactions with multiple local plants. For this reason, we turned to participatory plant breeding (Farnworth

& Jiggins, 2003) and evaluation (Nyende & Delve, 2004) as a resource for methodologies that study variations in value for a single species. In these fields, smallholder feedback is sought and used to characterize the breeding process at various stages. Generally, the goal is to improve the chances that a newly bred variety will be adopted by the participants and similar users. The key to this approach is to document preferences within variation in types of the same species through the study of traits. Although we borrowed the study of knowledge of traits, we applied our findings differently. Specifically, we take counts of reported traits to signify what counts of uses per plant signify in classic ethnobotanical survey, which is significance and/or value (Ankli, Sitcher, & Heinrich, 1999; Frei, Baltisberger, Sticher, & Heinrich, 1998; Vandebroek, 2010).

Second, almost since its inception, it has been understood that ethnobotany thrives when contextual understanding is high (H.C. Conklin, 1954; Hays, 1974). Yet, the extensive, disorienting travel required by a value chain approach, in combination with the rapid styles inherent to a trait preference cataloguing, necessitated an holistic and cohesive perspective offered through ethnography. Multi-site ethnography has been developed to meet such a challenge. Multi-site ethnography can be understood as a methodology which brings together thick, or highly detailed contextual description, in research that requires snowballing – soliciting and following the suggestions of participants wherever they lead– when such an approach requires travelling considerable geographic distances (Hannerz, 2003; Scheper-Hughes, 2004).

Fieldwork

Research consisted of two, distinct fieldwork stages: value chain interviews and ethnographic field work. Value chain interviews began in the village, the sites where chestnut trees and chestnut groves were physically maintained. In collaboration with the Turkish National General Directorate of Forestry, we identified ten provinces that represented the geographic

distribution of the chestnut species in Turkey (Figure 12). These were Şile, Zonguldak, Sinop, Artvin, Rize, Trabzon, Çanakkale, Aydin, İzmir, and Bursa. In each province, we identified up to three villages known for actively participating in chestnut-related livelihood activities of collecting, growing, and/or beekeeping. Collectors, growers and beekeepers were the first three value chain groups consulted after which these households contributed to our snowball approach to identifying value chain groups further downstream.

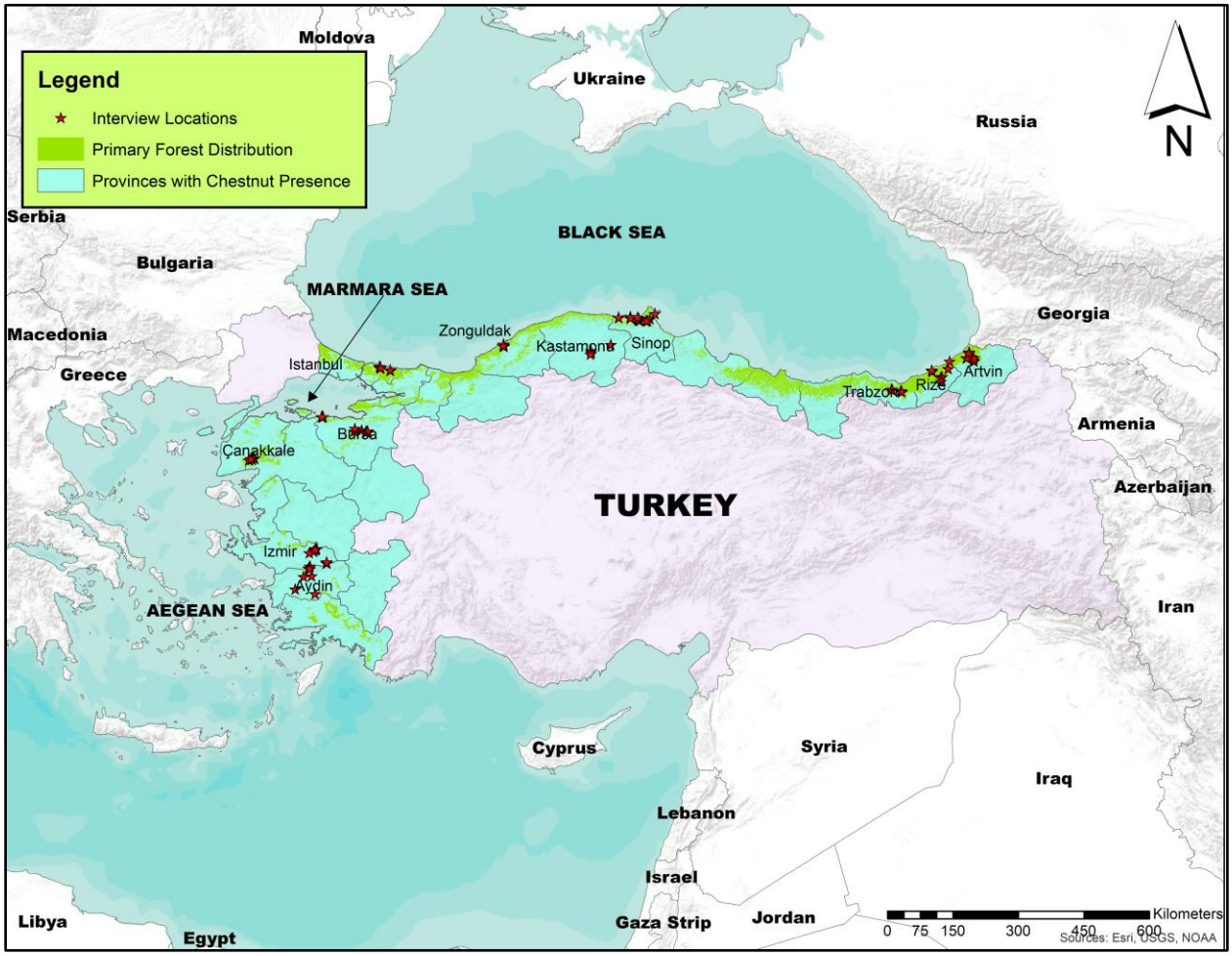

Figure 12 Turkey and research context. Distribution of chestnut projected using Maxent from our occurrence observations and data from NASA Earthdata, USGS Earth Explorer and the International Soil Reference and Information Centre. Provinces with chestnut presence were officially determined by the Turkish National Directorate of Forestry. Official provinces where research was conducted are labelled.

When we arrived at each village, we requested the assistance of the locally elected village representative, known as the *muhtar*, to identify households known to engage in chestnut collecting, growing and/or making chestnut honey (Miles & Huberman, 1984). Interviews were conducted in groups. We restricted group interview participation to household members. After offering informed consent, participants were invited to conduct semi-structured interviews that aimed to illicit exhaustive reports on traits through the following order of questions: 1) will you name any and all types of chestnut materials you known? 2) will you name any and all uses for the chestnut materials you have listed? 3) will you name the part of the chestnut plant required for each use? 4) will you name any and all traits important for the use you have mentioned? 5) will you name any and all traits you use to distinguish between the types of chestnut materials you reported in the first question? Interview questions 1 and 2 were not directly incorporated into analysis, but instead served, respectively, as necessary steps to illicit responses in interview questions 3, which we took to represent diversity of plant part value; 4, which we took to signify value; and 5, which we took to signify the specificity and complexity of value. In order to account for gendered differences in knowledge, in five of the ten provinces: Şile, Bursa, Çanakkale, İzmir and Aydın, we conducted gender-segregated interviews protocol, with female and male researchers facilitating the respective interview events.

Village participants were asked to identify particular value chain groups to whom they supplied chestnut materials ‘downstream’ in the value chain. These recommendations determined the participants for our later, downstream, interviews. Downstream value chain groups included migrant chestnut harvesters, professional grafters, nut wholesalers, timber mill operators, all-purpose carpenters, boat builders, basket makers, instrument makers, ornate carpenters, and a distinct ethnic minority known as *Tahtacı*, or Wood People. *Tahtacı*, an

historically semi-nomadic ethnic group, were reported to hold premier value for forests and orchards, these being intrinsically tied to their identity as Wood People. As part of our goal of exploring values beyond utility and interest, we included a specific Tahtacı village as a value chain group in our study. In each of these groups, once individuals offered informed consent, groups would participate in precisely the same interview exercise described above. In these group interviews, which were more prone to occur in public settings, groups tended to consist of male members of different households.

The second stage, the multisite ethnography, consisted of two efforts. First, in consultation with village participants, three village communities hosted an extended ethnographic fieldwork by Wall –who is competent in Turkish – during a period of time that was crucial to the chestnut livelihood. The first ethnographic fieldwork took place during the 2016 nut collection period in the village of Abdulkadirköy, Sinop. The second took place during the 2016 harvest period in the chestnut-growing Aegean villages of Eğrikavak and Kemerköy in the provinces of Aydin and Izmir respectively. The third excursion took place during the chestnut flowering and honey collection period in the Eastern Black sea area known as Camlıhemşin, Rize. At each village site, the researcher stayed a period of two to three weeks. In addition to writing detailed description of daily events and interactions, Wall participated extensively in labor. Because the lead researcher was male, local restrictions in gender interactions were very much in place, yet labor participation allowed for substantial relaxation of these norms. Fortunately, conversations with women were abided in many such cases. Second, all researchers took extensive detailed notes before, after and during the research exercises conducted with villagers and value chain groups all over the country. These compiled observations proved very important in interpreting the subtleties of contextual variation which we encountered.

Data Analysis

To determine whether there was variance in results between value chain groups, we generated metrics for interview results. Each metric represents a distinct feature of reported knowledge. The first was total traits reported per interview, which we took to signify value for the chestnut species, much as frequency of reported uses for species signifies significance in CSI's. The second was the percentage of traits reported that were specific to one reported type of chestnut material. We took this metric to signify the complexity and specificity of value for the species. The third was the diversity of traits reported by plant part. We calculated this using the Simpson's Diversity Index (SDI). This metric of plant part diversity we took to signify the richness and evenness of value for the whole plant organism. With each of these values we performed one-way analysis of variance (ANOVA) to determine whether there were significant differences between our 14 value chain groups. We then plotted the group means for each of these metrics using a heatmap with heatmap.2 function in R.

Ethnographic data amounted to an extensive body of holistic observations and descriptions. This included summarized conversations and extensive accounts of social context. This knowledge base was consulted at all steps of data interpretation. It illuminated contextual influence on the variation we observed in quantitative data. Ethnographic documentation was consulted routinely as an invaluable resource for providing coherence to disparate reports at the village, regional and national level.

RESULTS

Study Context

In the Black Sea region of Turkey, the European chestnut, *Castanea sativa*, inhabits high-precipitation, state-managed forest in northern facing slopes adjacent to the coast of the Black Sea. The distribution in this region extends from the Caucasus in the east, to the border of Bulgaria in the west. This entire area is locally known as the Black Sea region. In western Turkey, the chestnut naturally occurs in high-precipitation, lower and middle elevation terrain all around the Marmara Sea, otherwise known as the Marmara region. Farther west, in more arid areas of western Turkey, the species is found at higher elevations, from the more temperate Çanakkale peninsula in the northwest to the Kazdağları mountains in the more Mediterranean southwest. In the southwest, in the region known as the Aegean region, the tree is dependent on human management which includes grafting, irrigation, pruning, sanitization and occasional fertilization. In the northwest it is generally found in mixed managed forests interplanted with conifers.

Styles of human engagement with the species vary substantially by location. To the east of the Black Sea Region, chestnut thrives in expansive state-managed forests, where it is harvested as a prized timber. Here, many villages are named *Kestanelik*, which translates very roughly as Chestnut-ness. In its most concrete form, *kestanelik* means chestnut-dominated grove. The term can also mean chestnut time, or time spent working in chestnut groves or time spent enjoying chestnut with family. Within villager-managed landscapes, which are often dedicated to tea production, *kestanelik* are relegated to steep slopes and other inhospitable geography, where its primary use is a treasured forage for bees. Secondary uses for *kestanelik* include nut collection, various wood and timber applications, fodder and bedding for livestock and herbal

remedies derived from the male flowers. In the central and western Black Sea region, the highland geography is much less mountainous and *kestanelik*, which similarly tend to be located on state-managed land, are more aggressively managed through sanitization and pruning by villagers to maximize nut collection. Here, utilization of wood by villagers rivals the use of the nut and appears invaluable to all manner of construction applications.

In western Turkey, which encompasses the Marmara and Aegean regions, chestnut is typically managed on a tree by tree basis, with the majority of trees being grafted. In terrain around the Marmara Sea, two general approaches can be found. In the south, the province of Bursa is famously known for grafted orchard production dating back to the Ottoman period. In western Marmara, chestnut trees inhabit disparate highland locations where they are managed by the Turkish National Directorate of Forestry (OGM), in mixed stands. Grafting is revered but prohibited by OGM on these lands and can only be practiced illegally. In rare cases where trees are established on private land, grafting is practiced.

In the Aegean provinces, grafted chestnut orchards are established on privately owned and state-leased land at higher elevations, usually above 800 meters. The climate requires irrigation for chestnut trees, especially in the early life stages of the plant. The dry climate seemingly provides some relief from the severity of the chestnut blight fungus and chestnut production has recently become a very major part of life in many villages. In many Aegean sites, sales of chestnuts to wholesalers buying on behalf of sweet manufacturers and city chestnut roasting consortiums are the most significant contribution to local income. It is important to note that this production pattern is congruent with livelihood patterns in the surrounding area. Southwest Turkey is one of Turkey's most highly productive agricultural zones, with tree crops playing a particularly prominent role.

Interview Results

We conducted 165 group interviews that represented 14 different value chain groups. At least one group interview was conducted per value chain group (Table 8). The composition of this dataset reflects the disparate chestnut-utilizing community in Turkey. For instance, there are many times more collectors and growers of chestnut than there are firms selling chestnut candy. It is also informative in terms of plant parts used. While villagers such as collectors, growers, and honey collectors noted uses for flowers and burrs of chestnut, these individual parts did not make it into a value chain. Instead, they were kept for household use, and most commonly, offered to relatives, neighbors and guests. We documented one reported case of selling flowers at the local bazaar, but could not find other actors who did the same. Therefore, downstream from villages, value chain groups either utilize the nut or the wood of the chestnut tree. Though observations within the entire value chain are possible, the sample sizes of each value chain group were not high enough to describe or analyze variation within each value chain group.

Table 8 Value chain groups interviewed and number of group interviews per group.

Value Chain Group	Number of Interviews (Black Sea/ Western Turkey)	Value Chain Group	Number of Interviews (Black Sea/ Western Turkey)
Grower	54 (0/54)	Tahtacı	2 (0/2)
Honey Collector	38 (5/33)	Basket Maker	2 (2/0)
Collector	36 (25/9)	Boat Builder	2 (2/0)
General Carpenter	8 (7/1)	Grafting Specialist	2 (0/2)
Nut Wholesaler	8 (4/4)	Laborer-Harvester	2 (0/2)
Lumber Miller	5 (5/0)	Ornate Carpenter	1 (1/0)
Sweet Manufacturer	4 (1/3)	Instrument Maker	1 (1/0)

The Overarching Regional Values of the Black Sea Region and Western Turkey

Our only interview with ornate carpenters illustrates the influence of regional and cultural history on present day value for the chestnut species. Our participating group was the staff of an ornate carpentry trade school program in Kastamonu City (Figure 12). There, we learned that chestnut was simply not utilized and not known about by these craftsmen and craftswomen. When we pointed out that this interview was being conducted around a simple chestnut table, the master craftsmen declared loudly, "from this whole place you've found the one item made from chestnut, this table!" (*Bütün bu yerden sadece bir tane kestaneden yapdığı şey bulubilirsin, bu masa!*). He did not know or seem interested in where it came from. In this instance, chestnut suitable terrain along the Black Sea coast was not far geographically, but it was very far culturally. Ottoman high-steppe frontier towns, such as Kastamonu, were sites of Ottoman power projection over regions under less firm control, such as the Black Sea region. Populations of the town of Kastamonu maintained restricted paternalist interaction with the cultures of nearby Black Sea peoples, many of whom would have been Christian Greeks, Armenians, and Georgians (Parry, 1976). The trade of ornate carpentry was strongly associated with Ottoman aesthetics, and this long-maintained practice did not adopt the use of chestnut in this site. Characteristic of Ottoman style many other prized woods, such as walnut and mulberry, were used. The cultural differentiation indicated by styles of plant use proved to be a prominent feature in our findings.

The two, distinct cultural-historical zones where chestnut utilization and value did emerge from our research were the Black Sea region and western Turkey. These regions experienced vastly divergent cultural histories which deeply characterize the lives of inhabitants today, including their value for the chestnut tree. According to trait reporting, participants in the

Black Sea region reported considerably more traits of wood than any other plant part (Figure 13). Participants from western Turkey, by contrast, report considerably more traits for the nut. This divergence in regional plant part value is reflected in the composition of value chain groups encountered in the two regions. The forest-dependent practices of nut collectors, basket makers, lumber millers, instrument makers and boat builders in our sample population were all found in the Black Sea region. The nut-based livelihood activities of chestnut growers, grafting specialists, sweet manufacturers and laborer-harvesters were all found in western Turkey. While physical geographic features are certainly a factor in this regional divergence, comprehensive historical and ethnographic observations put this divergence into appropriate context.

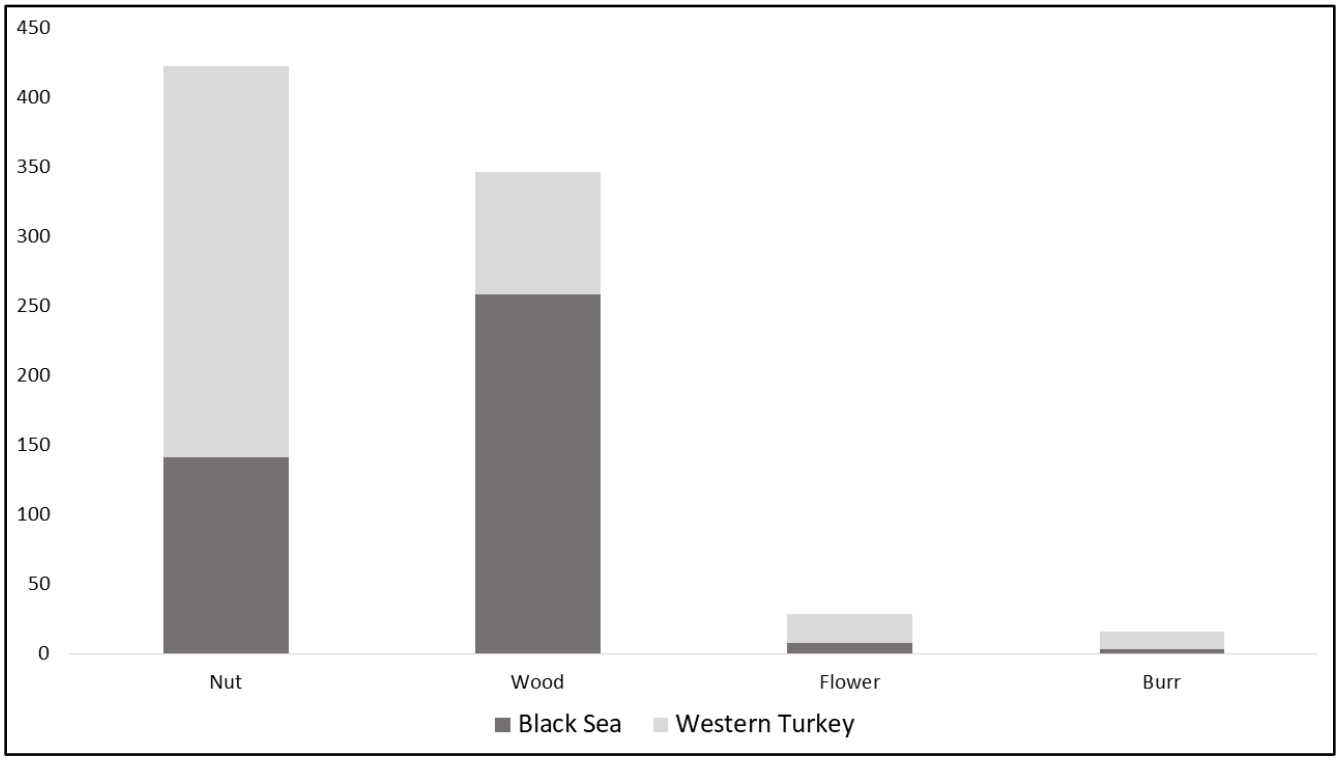

Figure 13 Total traits reported by plant part and region

Black Sea Region

The Black Sea region, and its mountainous topography, is contiguous with the lesser Caucasus which extend through southern Georgia, northern Armenia and northern Azerbaijan.

This proximity to the Caucasus is integral to the region's legendary ethnic diversity, much of it characterized by Caucasian groups such as Georgian, Laz, and Hemşin, all of whom are represented in our research participant pool. A contiguous band of highland topography runs parallel to the Black Sea coast from east to west. Along much of this range, only narrow stretches of land between sea and mountains are arable and easily navigable. This wall of mountains is recognized as a major historical determinant for peoples of the Black Sea region prior to and during the Byzantine and Ottoman historical period (King, 2005). For much of the classical period, the region and its inhabitants could be colonized and governed exclusively from the sea. This fact led to conquest and settlement by seafaring peoples such as the Greek Pontics and the Genoese. Today, Turks readily acknowledge the uniqueness of coastal Black Sea culture. Commonly cited differences include languages, ethnicities, accents, dress, cuisine and traditions.

This heterogenous context has given rise to a surprisingly consistent chestnut utilization culture. The association of Black Sea peoples and the chestnut tree has been common regional knowledge for many centuries (Xenophon 370 BC). The Caucasus and eastern Turkey are in the center of genetic diversity for the chestnut species and are the site of the earliest known management of the tree (Conedera et al., 2004; Claudia Mattioni et al., 2008). From Şile, just north and east of Istanbul, all the way east to Artvin on the border of Georgia, chestnut is by and large not grafted and not thrashed out of the tree. There, grafting was disparaged by most of our interviewees. It was blamed for killing trees. It is avowed unanimously across this entire area that trees are not planted, but instead allowed to grow where they sprout. If any management is described, the managed unit is not the tree, it is the *kestanelik*. Management practices including prescribed fire, grazing, and other methods of sanitizing and clearing *kestanelik* were all observed and/or reported in this region.

Chestnut collection, chestnut-honey harvest, and basket making in the Black Sea region are best understood as environmentally enjoyable, culturally indicative, and leisurely livelihood activities. For nut collection, considerable time, nearly all day for two to three weeks is spent with family and friends out of doors in chestnut groves. Often a stump fire, for heat and for valuable charcoal, is kept near a shelter where tea and regular picnics are prepared. Wandering alone, or perhaps in pairs, and collecting the naturally dropped chestnuts in quiet *kestanelik* was the normal collection routine. Working beehives in highland terrain in the spring is similarly enjoyed. Basket-makers likewise described the act of rambling to acquire young chestnut stems as a pleasurable hobby.

Black Sea nut collection does feed into a thriving wholesale market. These nuts are in demand as far west as Istanbul and as far to the east as Gaziantep, Batman and Erzurum, according to wholesaler reports. Known as *kuzu kestane*, or 'lamb chestnut', these nuts are savored for their distinctly rich taste and especially easy peeling properties. The primary market for this product is the bazaar system which supplies individual shoppers with products for the home. It is not a product favored by the more commercial sectors of street-roasters and sweet manufacturers which we will discuss later. However, we did observe their sale at particular high-end grocery outlets in the affluent suburbs of Istanbul.

Timber is another distinct use (Figure 14). Boat builders, lumber millers, and carpenters are engaged in full time livelihoods which intensively use chestnut lumber. Chestnut is the only wood of choice for most boat builders due to its incomparable set of properties including water resistance, solidity, rot resistance, light weight, and its extreme tolerance of bending and twisting required in forming ship hulls. The premier provenance of chestnut lumber for boat builders is the eastern Black Sea provinces of Artvin and Borçka. Wood verified to come from these areas

exhibit heightened degrees of the forementioned qualities. Lumber millers and carpenters all reported traits specific to chestnut timber, especially its weather and rot resistance. A special category of reporting dealt with numerous details to describe the high-tannin sap which must be rinsed out of the milled wood over an extended period. This sap was known as bitter water (*acı su*) and carpenters could hold forth with great detail about this compound. It was known to corrode plain steel nails, and so shipbuilders used only galvanized. *Acı su* was prized and manipulated by carpenters in their more decorative pieces. Its dark and organic patterns made each piece special (*özel*). In any case, the compound had to be dealt with by multiple rinsing and air drying cycles of any cut lumber. If not, any given cut of lumber could become stained permanently.

Figure 14 Clockwise from top left: **a**) an Aegean region Eğrikavak man in his highland garden home at harvest time. Framing timbers in this home are chestnut; **b**) Man in Laz village in eastern Black Sea waving from his chestnut home; **c**) commercial lumber mill employee in Eastern Black Sea using a chestnut basket to transport wood shavings; **d**) Commercial in-husk chestnut harvest scene from Kemerköy in İzmir.

Western Turkey

Physical and human geography of chestnut-value in western Turkey is divided between three distinct regions that maintain chestnut trees: southern Marmara (Bursa), western Marmara (Çanakkale) and the Aegean (İzmir and Aydin) (Figure 12). In the case of western Turkey, the common chestnut culture we observed is best explained as an interregional dynamic driven by recent historical, ecological and economic trends triggered by disease invasion and market demand. However, two cultural and historical features are notable: the historical Ottoman association of Bursa with chestnut production and the present favorability of chestnut cultivation for the historically semi-nomadic Yörük and Tahtacı cultural groups.

The southern Marmara city of Bursa is commonly understood as the epicenter of chestnut culture and consumption in contemporary Turkey. Bursa is also an epicenter of Ottoman history, having served as the administrative capital of the Ottoman empire between 1335-1363, and as a legendary Islamic spiritual center thereafter. Under Ottoman rule, chestnut production was concentrated in Bursa and this historical association is fused in popular consciousness such that chestnut products, especially candied chestnuts (*kestane şekeri)*, feature prominently in the tourism industry in Bursa. The association is meaningful not just to tourists, but to local identity. When we asked one chestnut sweet firm owner, why his conference room was decorated so extensively with Ottoman era antique culinary equipment, he replied that this décor made him reflect on these questions: “where did we come from and to where are we passing?” (*Nereden geldik? Nereye keçeceğiz?*) To him, his highly commercial and industrial livelihood was seamlessly connected to local history.

In the Aegean region, all but one village we worked with identified to some degree as Yörük. Yörük, meaning roughly 'those who walk', have been variably known as Turkmen or

Turcoman. The title refers to a category of Turks who maintain some distinct cultural attributes associated with the original Turkish culture that arrived in Anatolia ca 1200. Chief among these attributes is nomadism. In many cases, there is little to definitively distinguish a Yörük way of life in modern Turkey from others. However, many communities understand themselves as distinct and conduct a way of life that demonstrates this. In the Aegean province we encountered several permutations of this distinction, but what generally held is that households in these communities maintained two homes, one in the lowlands and one in the highlands (Figure 13a). Homes in the highlands were associated with chestnut production.

In a most traditional variation, the Tahtacı village community of Yeniköy resided five or more months in their highland area near the Madran mountains. Participants here openly stated that the point of chestnut cultivation was to allow them to spend time in the mountains. "Because, we get to be near Madran", (*Çünkü biz Madran'ın yanında olduğumuze göre*) as one woman cried. This community, like another Yörük community in Yılanlı, İzmir, had transitioned their land holdings to chestnut cultivation from apple and grape production, very recently. In addition to the income inherent to such activities, the persistence of formal access to these lands is contingent on them remaining productive. In other words, the government allows access as long as the land is being maintained in tree-cover. It was a very common claim from these participants that if chestnut cultivation could not sustain disease pressure, they would readily switch to a different tree crop.

Despite pronounced historical and cultural differences, communities we interviewed in southern Marmara, western Marmara, and the Aegean exhibited similar patterns of association with the chestnut tree, namely whenever feasible, the individual tree is cultivated, it is maintained in orchards, and it is grafted with varieties known to produce nuts favored by candy

companies or roasters. Harvest season is an intense commercial labor and marketing period, where paid migrant laborers undertake harvest activities according to gender. We observed that these laborers came from villages where tree crop harvesting practices were well known, but where the harvest period occurred at a different time. Many laborers came from regions where pine-nut collection and sale was the chief agricultural income. Men climb and thrash chestnuts out of the trees, still in the husk while women collect them and haul them to the tractor-trailer. This harvest is purchased rapidly by wholesalers who sort and store the product themselves. As one grower and wholesaler stated, the "harvest period is an unbelievable commotion" (*Hasat zaman inanilmaz bir haraket!*).

In and around Bursa, pest and disease pressure have caused chestnut production levels to decline so precipitously that the province produces very little in comparison with other regions (TNGDF, 2013). However, the sweet manufacturing industry has not moved. Dozens of these companies mount purchasing operations throughout the country, acquiring thousands of tons of chestnuts at the farm and village gate. It is even reported that they deploy their own harvesting crews, paying cash to tree owners for nuts that are still on the tree. Candy makers have strong preferences for nuts that perform well in mechanical shellers, have shinier brighter coloration, are absorptive in syrup solution while remaining whole, and are round. It behooves grafting specialists and wholesalers to arrange predictable supplies of such nuts and this is done through a well-known grafted cultivar known variably as *sarı aşı, ışıklar,* or *şekerçi* (meaning, respectively yellow graft, from the town of Işıklar, and the one for candy).

Roasters (*kebapcı*) from cities across Turkey and Lebanon represent the other major buying block. They also demand specific traits. First and foremost, due to labor efficiency and sales maximization considerations, they exclusively prefer large chestnuts. They are also keen to

buy nuts with considerable sheen and good color on the shells. Peeling must also be manageable by hand. There are graft types known to meet these demands, such as *kara aşı*, or black graft.

In western Marmara, our research site of Çanakkale is unique in western Turkey in that the sparse highland terrain with precipitation and temperatures suitable for chestnut trees is in restrictive state forest. Villagers here are engaged in chestnut collection and honey collection in a manner very much resembling that found in the Black Sea region. However, here, grafts for chestnut are highly desired, even to the point of disparaging non-grafted trees and the nuts they produce. As a local refrain indicates, "grafted are smart and wild are insane" (*aşıllı akıllı, yaban deli*), many locals strive to access grafts and to establish grafted chestnuts, even if only a few, on their limited landholdings. What prevents them from doing so everywhere is OGM policy in combination with the remoteness of chestnut suitable highlands from their village settlements. The tension appears to be longstanding, as foresters showed us numerous trees on state land that had been grafted in rebellious acts decades ago.

Inter-Regional Variation in Value

Having taken stock of the distinctive settings for chestnut culture in the Black Sea region and western Turkey, variations in knowledge along an interregional value chain can be investigated to better understand crosscutting patterns of valuing the chestnut species. We observed significant differences between value chain group mean total, specificity and diversity of reported traits (Table 9). When all group means are accounted for, each group has a unique combination of values for total, specificity and diversity. Plotting the relative difference between all of these reveals several clear patterns (Figure 15). These patterns suggest a significant relationship between the structure of knowledge and the flow of value.

Table 9 Results of analysis of variation of knowledge total, diversity and specificity by value chain group

Factor	df	Sum of Sq	F- Value	Pr(>F)
Total	13	1135	87.28	12.43 <2e-16 ***
Diversity	13	16.53	10.18	3.79e-15 ***
Specificity	13	2. 893	6.70	4.96e-10 ***

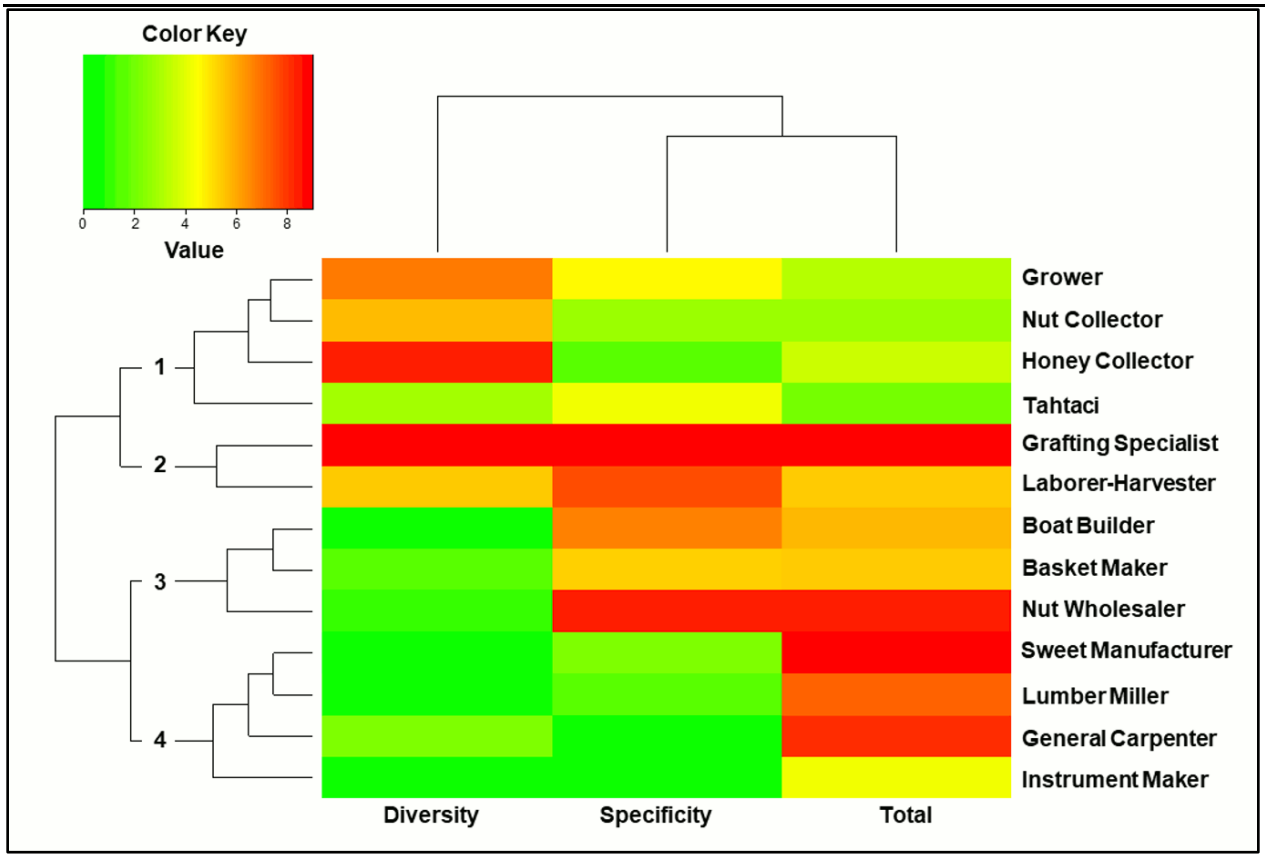

Figure 15 Heatmap and clusters of means of value chain group reported trait total, diversity and specificity

A prominent and informative feature of the heatmap output is the order of value chain groups indicated on the right. This order was set in response to the cluster calculation, which are represented to the left as 1,2,3 and 4. Accounting for the means of all three metrics for each value chain group, difference between groups was plotted as distance in Euclidean space. This distance is reflected in the order of the value chain groups. Greater distance in the order

signifies greater difference. For example, by this analysis, growers' responses were more similar to nut collectors' than they were to honey collectors'. It is noteworthy that the generated order, a reflection of difference in participant knowledge, closely follows the flow of the value chain. Cluster 1, including growers, nut collectors, honey collectors and Tahtacı are all village inhabitants whose chestnut related livelihoods take place strictly in villages and surrounding landscapes. Those in Cluster 2, grafting specialists and laborer-harvesters, are also village inhabitants who travel from their home village to other villages to conduct their livelihoods, which are linked to the specific livelihood of chestnut growing. Positioned within Cluster 3, basket makers and nut wholesalers are also village residents. Boat builders conduct their livelihoods outside the village, in nearby commercial centers, but may live in either village districts or commercial centers. Those in Cluster 4, sweet manufacturers, lumber millers, carpenters and instrument makers all live in and conduct their livelihoods in commercial centers.

In the order represented, the traits reported by clusters are 1) mid to high diversity, low to mid specificity and low total; 2) high to mid diversity, specificity and total; 3) low diversity, mid to high specificity and total; and 4) low diversity and specificity, mid to high total. This gradual transition of knowledge structure occurs in step with the flow of the value chain. At the sites of maintenance, the village landscapes where trees are worked with directly, we see fewer, less specific traits reported for more plant parts. Those who, in the course of their livelihoods, directly interact with and perform services for the communities at the sites of maintenance report diverse, specific and numerous traits of the tree. Those who live in agrarian districts but do not interact with villagers at the sites of maintenance in the course of performing their chestnut-dependent livelihood activities, tend to report specific and numerous traits of a single plant part. Finally, those who live and work in commercial centers report numerous traits of single plant

parts, without specifying many associations between the traits and kinds of chestnut materials that they know.

This congruence between value flow and reported knowledge suggests the following about knowledge-value patterns. Market value, the most commonly understood form of value, is embodied in a distinct pattern of knowledge illustrated in the fourth cluster. Knowledge-value patterns are much more likely to travel from this position and be adopted 'upstream' than the other way around. The villagers of Çanakkale are a prime example. Though most begrudgingly admitted that they did no commercial growing and exclusively collected mountain chestnut (*dağ kestane*), which candy manufacturers and commercial roasters would not buy, they still reported favorability for traits preferred by candy manufacturers and commercial roasters, namely large size and shiny shells. This influential knowledge-value pattern holds very material implications as can be readily seen in the prominence of the commercially desirable yellow graft cultivar (*sarı aşı*) in newly established chestnut plots in the Aegean region.

At the sites of maintenance, regardless of ethnic or cultural composition and whether the maintained unit is the *kestanelik* or the individual tree, a common knowledge-value pattern dominates which appears to be the inverse of market value. High diversity of valued plant parts and richness of detailed preferences speaks to the deep value of multifunctionality in the context of village livelihoods. Villager participants were cognizant of the influence of market value on their local value. One prominent typology that emerged from responses to our questions regarding 'kinds of chestnut materials' was abandoned varieties vs. available varieties. Abandoned varieties were always brought up in a spirit of nostalgia, particularly for the tasty variety known as black graft (*kara aşı*). When recounting the ravages of chestnut blight, one

woman opined, “maybe we chose the wrong variety when we chose yellow graft,”(*Yani belki yanlış seçtik*).

The case of grafting specialists is emblematic of the comingling between knowledge-value patterns. Because grafting chestnuts was known to be practiced by Greeks ca. the first century B.C. (Virgil, 2011), and considering the strong pairing of chestnut cultivation and nursery skills we observed in Bursa, it is apparent that chestnut cultivation in western Turkey has utilized grafting and careful horticulture for quite some time. Grafting specialists act as the emissaries of market influence. For landowners, their grafting skills as well as their up-to-date horticultural knowledge is in high demand. In this process, it would seem that their extensive knowledge is characterized by their need to converse and relay information in any and all environments to be found along the value chain.

DISCUSSION

The knowledge-value patterns we observed can be visualized as falling into a plane with four quadrants, each representing distinct sets of priorities for conservation of traits, cultivars and geographically distinct populations. In this visualization, the horizontal axis could represent the cultural and historical divergence of the Black Sea region and western Turkey and the vertical axis the spectrum between market value and local maintenance value. For example, the market value of timber for a Black Sea industry like boat building emphasizes no multifunctionality from trees, but instead necessitates straight, sizable chestnut timber with appropriate qualities. Villagers in the Black Sea, on the other hand, require hardy, self-propagating trees that compete well in native, mixed forest and exhibit vigorous flowering for honey bees, substantial nut mast, and appropriate timber, branching and leaf qualities. In western Turkey, there is premium market value on the nut traits we have described. Nevertheless, villagers have extensive multifunctional

demands on the species which resemble the Black Sea villagers in all aspects. However, this complex of demands is placed on an entirely different genotype that has adapted to the different geographic and anthropogenic conditions in western Turkey. Additionally, the silvicultural habits in western Turkey are entirely different, driven almost completely by grafting. For a conservation endeavor to account for these variable sets of priorities in these variable contexts will necessitate substantial collaboration between villagers, foresters, plant breeders and disparate value chain members.

Our findings show how folk value is directed at very specific, biological features such as specific trees, specific morphological features and specific sets of morphological features characteristic of a particular species. Variations in this value materialize in the form of variations in conservation behavior. This behavior appears very differently in different places, such as in cities, where it may materialize as shopping inclinations at markets, as compared to villages, where it may take the form of planting, uprooting and maintaining. Our study shows that the core matter for ethnobiology, what Hunn articulated as a "tight environmental embrace" (2007:9), is maintained more and more by disparate networks of people, including urbanites (Vandebroek & Balick, 2012). The most cohesive values – the aesthetic, mnemonic and spiritual ones – are the ones that permeate the entirety.

Throughout Turkey, we observed aesthetics to be a prominent form of value for the species. Aesthetics, in its broadest and original sense, has to do with appreciation, especially appreciation by the senses. Anthropology has approached aesthetics as a deeply motivated dimension for humans that may or may not be associated with art. For example, Jeremy Cootes describes the deep passion and detail of cattle-dependent Nilotic people for the color, design and shininess of their cattle's hides (1992). Terminology with which Nilotic peoples describe and

praise the appearance of cattle, able to capture combinations of specific colors, proportions of the colors, spots and more, is voluminous and sophisticated. As the ethnographer Ryles noted, "when discussing the colour pattern of an animal– as they do for hours – the Dinka sound more like art critics than stockbreeders." (Ryle, 1982:92) This vocabulary and the visual concepts embodied within it, are readily applied in Nilotic perception, description and representation. Dance, emotional descriptors, poetry and many more cultural elements all cite these terms born of visual appreciation of cattle.

Our findings align with Cootes' where the extensive, motivating body of knowledge related to cattle appears to be entirely separate from concerns for individual utility. The most motivating value for chestnut conservation at and away from sites of maintenance are aesthetic and mnemonic value. This appreciation is not just of the specific qualities of chestnut materials, but also the unique and revered space of the *kestanelik*. These are all perceived and portrayed in striking detail, and their special properties characterize time, memory and place. As with Nilotic people and cattle, the chestnut species is a sensory cornucopia which has infiltrated the lived experience of countless persons in Anatolia. Chestnuts and other *çerez*, or natural dried fruit and nut snacks, are essential fixtures of passing time socially. A common refrain goes, '*dedem mısır patlattı, nenem kestane kavurdu* 'my grandpa popped popcorn and my grandma roasted chestnuts.' Almost any regular citizen of Turkey would draw rich reference from this saying. It speaks to being cared for and safe. It may very well suggest a rustic home in one's ancestral village. Seasonality is implied as chestnuts are available in the fall and winter and are ideally roasted on woodstoves, which have been lit to keep warm. On top of all this, and in the midst of popping corn, what is the value of chestnuts smelling heavenly, peeling effortlessly, biting through as smooth as butter, and with a slightly sweet and salty aftertaste?

This study highlights the need for further research in a number of dimensions. First, ethnographic concepts of value and value-flow would rightly identify the need to study hyper-local circulation of less trafficked materials as well as the circulation of species-related cultural content. In the case of our study, women were the primary collectors and purveyors of chestnut flowers and chestnut husks. Though flowers never travelled far, and though there was only one report of their being sold for money, their medicinal and religious value ensured that they fed into a deeply important local economy of hospitality and kinship reciprocity. Chestnut husks were similar in this regard. Though our study covered a large geographic area, studies focused on more local folk biological value and its role in local cultural solidarity are certainly warranted. Similarly, as our previous work details, there is a tremendous amount of cultural content bound to the chestnut species in Turkey (Wall, Bas, Köse, & Okan, 2018). This included personal stories, legends, sayings, riddles and more. In addition to following the flow of physical materials such as plant parts, there is tremendous opportunity to learn more about folk biological value by studying the exchange and circulation of such cultural material.

This brings us to the stark issue of intersectionality, which challenges ours and similar studies. Having stressed the importance of cultural content and smaller geographic frames, it behooves us to state our findings that these are strongly gendered factors, as women were much more likely to report cultural content, and much more geographically restricted in their socialization (Wall et al., 2018). In the present study, we discovered that the conventional value chain model we implemented, when followed beyond the village, put us on a path to encountering mainly men. Intersectionality is a word for the fact that social oppression and suppression are provisioned according to intersecting identity attributes such as gender, class, race, ethnicity, and religion (Crenshaw, 1991). Just as the public market space for redeeming

value is often dominated by men, it is also likely dominated by whichever ethnicity, class, etc. happen to be most dominating. Working in smaller geographic areas and paying attention to cultural content are promising ways of perceiving and engaging conventionally muted social groups. It is important for all research to identify and explore many more approaches to mitigating such muting potential in research.

Finally, our work shows the importance of studying idiosyncratic ethnobiological knowledge (Vandebroek, 2010). Conventional approaches to plant knowledge studies occur at the sites of maintenance, and synthesize consensus of knowledge in that community (Müller et al., 2015; A. K. Romney, Weller, & Batchelder, 1986). Aberrant knowledge, typically unique to an individual, has often been wrongfully ignored (Vandebroek, 2010). As with the highly rich, diverse and specific knowledge structure of grafting specialists, our study shows that what may be completely idiosyncratic in a discrete geographic community may be common to a discrete but geographically disparate community. The knowledge and action of such communities may be essential to adaptive interconnectivity between local communities at sites of biological maintenance.

CONCLUSION

This study outlines a method to start the urgently needed work of engaging folk value for the biosphere in a period of accelerating biological loss. Agrarian, traditional and indigenous communities at the sites of maintenance are more likely to be integral components of the environment for their most valued species than their disparate urban, sub-urban and migrant counterparts. However, interconnectivity of value-knowledge complexes allows for augmentation of the tight environmental embrace of even the most remote members of a cultural group. This is the power of folk value. Our work shows that preeminent influence of

individually-oriented market value can compromise the more enduring ecological maintenance driven by folk value. Aesthetic, sentimental, mnemonic, and cosmological value can all be indispensable motivations and encouragement of conservation. Therefore, folk value should be at the forefront of ethnobiological research as culture after culture transitions from environmental protection to resource prioritization in order to survive. Indigenous and traditional peoples have historically rightfully objected to ranking and prioritization of parts of the biosphere. However, works such as this one show that urgency of cultural survival fosters the conditions for ethnobiology to serve in a culturally appropriate phase change when and if communities are ready.

CONCLUSIONS

The contributions of this study can be understood in the following two ways. First, there are distinct findings and methodological innovations that are relevant to any and all efforts in Turkey to conserve the chestnut species in the face of compounding disease pressure. Second, this study presents proof of concept for several methodologies and theories relevant to conservation biology, ethnobiology and other disciplines that directly investigate biocultural associations in the Anthropocene. In Turkey and beyond, this study offers insights for culturally informed conservation practice in the present era of rapidly evaporating biological diversity, often referred to as the Sixth Mass Extinction.

Local Significance of the Research

Findings presented in this dissertation are relevant to on-going efforts in Turkey to conserve chestnut resources. These efforts include the work undertaken by the General Directorate of Forestry (OGM). Their approach is routinely tailored to the needs of each province. For instance, new leasing practices in the Aegean region between growers and regional OGM ensure the establishment of significant new area for chestnut trees in the region. In Bursa, regional OGM actively distribute a wide variety of cultivars, including blight resistant European-Asian hybrid varieties. In the Black Sea region, especially under the Kastamonu regional directorate, numerous chestnut seedlings are nursery-cultivated and established in plantings across the Black Sea region. The Ministry of Food, Agriculture and Livestock, specifically the Aegean Agricultural Research Institute (AARI), manages chestnut materials in seed and tissue banks as well as research orchards. This same institute has carried out important, unpublished, studies to document genetic diversity for the species.

Independent university research is also making diverse and important contributions to conservation efforts. Dr. Umit Serdar, and collaborators at On Dokuz Mayis University in Samsun in the central Black Sea region, are disseminating knowledge, practices and materials necessary for intensifying chestnut cultivation. Dr. Omer Erincik at Adnan Menderes University is running advanced trials for the application of hypovirulence as a biological control in the southwestern provinces of Aydin and Izmir. Dr. Engin Ertan, also of Adnan Menderes University, continues to catalogue extant phenotypic diversity of the species, both of cultivars and natural volunteers, in much of western Turkey. Finally, the Food and Agricultural Organization has been a proactive and persistent force for establishing cooperative disease control endeavors for chestnut populations in Turkey. In well-constructed collaborations with the Ministry of Forestry and Water Management and numerous local academic partners, FAO has completed trials and trainings in biological control of the chestnut blight (2014) and the gall wasp (2017).

There is another level of conservation. This consists of the active measures of collectors, honey-collectors and growers all across Turkey to maintain chestnut presence and vigor. Chapter one casts these practices as niche construction, and by doing so, sheds light on the important role of disease mitigation in historic agricultural ecologies and cultural landscapes. Planting, coppicing, grafting, pruning, pollarding, burning, stripping, sanitizing, applying fungicides: these practices and many more might all be applied in each individual plot we visited and analyzed, and thousands more like them. More, these acts are being applied strategically, often singly, on a tree by tree basis.

For these and any similar efforts, several findings found herein are especially relevant. First, chapter one runs contemporary plant genetic resource accession and management through a

rigorous update according to history, ethics, and the ethnographic record. The status of *Castanea sativa* as a plant genetic resource species is a striking fit with this argumentation when Turkey is considered. No Turkish accessions appear among the thousands registered in the Genesys network, the "global gateway to genetic resources." Nor are they found in the smaller European Cooperative Program for Plant Genetic Resource Conservation database. The causes of this absence cannot be stated definitively. However, the likely causes are historical and political. The Turkish Republic and its predecessor, the Ottoman Empire have historically maintained suspicious and highly competitive relations with their counterparts in western Europe. This has had a major chilling effect on scientific collaboration and specifically plant collection. Today, in Turkey, despite many active international scientific collaborations, there remains notable rigidity in plant sharing agreements.

In any case, it is clear that the unique traits of Turkish chestnut germplasm are not represented in globally accessible resources. They are not being conserved in the world's most efficient and reliable facilities. Thus, those who care about chestnut in Turkey, their preferences and distinctly valued traits, are not given voice in the global repositories. It must be re-stated that, though they are not publicly available, an undetermined number of cultivars and genotypes are curated at the Aegean Agricultural Research Institute in southwest Turkey.

Additionally, the perception of *C. sativa* in Turkey is strongly binary between agriculture and forestry. The one known official repository for *C. sativa* germplasm in Turkey is located in the Mediterranean climate of Izmir (AARI). As chapter 4 indicates, chestnut livelihoods and germplasm in Aegean are deeply characterized by commercial production and this context certainly influences the materials in the AARI. Additionally, it is unlikely that Black Sea germplasm would successfully thrive in grow-outs in this Mediterranean climate. Thus, Black

Sea materials are managed predominantly by the Ministry of Forestry according to their distinct institutional priorities, namely, for stocking logging forests. This system may or may not have the potential to maintain the easy peeling and wonderful tasting traits of Black Sea chestnuts. With the premium GDP value of the tree in this region being its performance as competitive timber, there is likely no intent to do so. However these nut traits are highly desired by tradesman, high end grocers and average citizens throughout Turkey, and they even have enthusiastic admirers in the *C. sativa* research community in Italy.

For the above-mentioned bureaucratic conservation dimension, it is especially timely to understand the divergent value dimensions for chestnut trees in the Black Sea region and western Turkey, respectively. Rural abandonment is now recognized as a substantial ecological threat in much of the world (Plieninger, Hui, Gaertner, & Huntsinger, 2014). In Turkey, it is common knowledge that rural abandonment is a chronic sign of the times. This is particularly true of the Black Sea region, which is famous in Turkey for its massive out-migration to Europe and the cities of Turkey. It has been posited that the advent of chestnut blight explains this extensive out-migration (FAO, 2009). All of this recognition, however, has stirred little change in OGM policies designed to protect forests. This is due to entrenched attitudes that oppose local livelihood involvement in forests. Our findings in chapter two suggest that, along with epidemiological and environmental factors, local culture and local involvement is a strong determinant in tree health. Both in Black Sea and Aegean contexts, in the case of the highly prized chestnut population, attitudes which understand anthropogenic influence as wholly damaging must be reconsidered. Chapter four strongly supports this position from the angle of cultural value in the Black Sea region. Local people who are offered a dignified way to access

their prized ecological resources for non-commercial purposes may be, however marginally, less apt to leave and less apt to send their children away as economic migrants.

This work also presents significant methodological contributions with particular relevance to the Turkish context. First and foremost, Chapter 3 demonstrates that knowledge can be defined so rigidly in common parlance, that women's knowledge can be severely muted in research efforts. This points to the practice of knowledge muting for other marginalized groups as well. This is not unique to Turkey, yet methodologically our efforts to engage women were successful because of a carefully designed and locally suitable approach. Our first step was to organize as a mixed-gender team capable of dividing by gender and performing equivalent protocol. Our next step was to approach male heads of household first, through trusted figures like the *muhtar* or local foresters. This allowed the head of household to exercise his right and obligation to protect, by verifying the nature of the visitors and our work. Among us were a married couple and a woman with child. While this cannot be replicated by all research teams, it was a clear asset. Our request for our women researchers to visit with the women at home was often a very welcome request, as it followed local proclivities to separate genders. In short, our protocol of separating genders for research purposes involved several essential stages prior to the separation of genders. In Turkey, such an approach has the potential to enhance research quality for efforts to engage women and other marginalized groups.

Similarly, Chapter 2 demonstrates a unique methodological approach to investigate a biophysical phenomenon – in our case, disease mitigation – in concert with local cultural perspectives. While perhaps more common in agricultural research, where land access is usually formalized, our interest in visiting particular areas of state land along with their informal users acted to build trust and trigger memory. It was also beneficial to conduct a biophysical research

exercise of blight severity evaluation. This approach achieved three important goals. First, it gave a very appreciated signal to the research participant that we respected their access to these areas. Second, it communicated that we were not theorizing or idealizing ecological space as detached from local livelihoods. Third, as the performance of scientific technique in such village spaces is rare, it demonstrated that we were applying valuable labor towards something they cared about. In our case the multi-disciplinary field protocol led to especially forthcoming ethnobotanical interviews. Walks in the woods or orchards also allowed for very essential verification of and supplementation to interviewee reports. In Turkey and similar contexts, where rural livelihoods that interface with forests have been stigmatized to a certain degree, our research approach was successful in decreasing suspicion and timidity of interviewees.

Finally, our value chain approach, which inherently acknowledged the lesser-known village-level, wood and non-commercial value of the species, was successful in grappling with physical and human geographic heterogeneity. Similar to its worth as a forest and agricultural species, folk value for the species straddles dimensions of culture, governance, history, spiritualism, memories and aesthetics. As such, a strictly economic approach would have significant shortcomings. Particularly, such a lens would fail to show the significant value for the species in the Black Sea region. The value chain findings were very well rounded out by ethnographic observation. Discussion of chestnut in any context, even the bureaucratic, was seen as rather quirky until we touched on the importance people invested in being in a warm home with family on cold evenings when chestnuts were roasting. This idea could open the door to discussions of the love of Black Sea village-scapes, with chestnut framed and sided homes and chestnut bee-boxes positioned nearby. It could trigger a nostalgic discussion of Black Sea fisherman and the glory of being in the Aegean garden-home in the summer, where, even as the

lowlands were simmering, a blanket was always required to sleep comfortably. The sheer predictability of behavior when such concepts were conjured demonstrated to our research team that these were deep motives for conservation of chestnut populations for villagers, commercial vendors and bureaucrats alike.

In summary, our findings lead to a number of specific recommendations for all abovementioned efforts to conserve chestnut resources. First, people of the Black Sea region and people of western Turkey value and manage the chestnut species very differently. A national program to implement conservation would be wise to consider these differences and develop divergent approaches. Specifically, livelihood-centered approaches should recognize that a premier value of chestnut trees in the Black Sea is low-maintenance and vigorous self-propagation in a variety of conditions. This proved to be true in recent efforts by the FAO to implement biological control of chestnut blight. According to many participants in these efforts with whom we spoke, efforts were more manageable and results more successful in the Aegean provinces. This was likely due to the ease of garnering local participation and cooperation to care for and monitor a handful of trees. As a village *muhtar* in Rize declared when asked how many trees he collected from, "I don't know, a hundred thousand maybe." (S*anırım bin yüz*.) A handful of trees receiving a treatment in the Black Sea region may spark curiosity, but it will not dovetail with livelihood interest.

In the Black Sea region, where livelihood interest in chestnut is overwhelmingly non-commercial, other more aesthetic values may be more motivating. A policy approach which allows villagers to establish and maintain *kestanelik* (chestnut groves) may prove more alluring. *Kestanelik* are everywhere in the Black Sea region, but it is generally prohibited to graze animals in them, prescribe fire or otherwise remove unwanted vegetation. This has rendered many

kestanelik inhospitable, unattractive places for locals. Where once families hauled out picnics and maintained two-week vigils in the forest, sleeping out of doors, now thick and obnoxious rhododendron, thorny shrubs and ticks prevail. Chestnut trees in these places do not prevail. Places where local livelihood vigor insists on maintenance of these spaces should become model sites in the Black Sea region. We believe it will prove very successful conservation policy to encourage livelihood activities in communities like those found in Zonguldak, Ayancik and Erfelek, where *kestanelik* are actively maintained, with local attitudes that border on ownership. It is our view that such encouragement can represent a government-side approach to developing the non-local formal connectedness that proved so important to local disease mitigation. In Chapter two, we found that such connectedness was essential to chestnut population health in sites across Turkey.

Kestanelik, or chestnut groves, can also support trial of germplasm. It would be constructive to do so in collaboration with local *muhtars*. With the OGM nursery production system behind it, germplasm trials might explore several objectives for sweet chestnut in the Black Sea region. First, germplasm trials could be established to assess local blight and gall wasp tolerant germplasm. We have observed significant variation in chestnut blight severity across the Black Sea region. We have also observed significant variation in chestnut blight severity within individual plots. Our methodology could be replicated to identify candidate germplasm to trial for gall wasp and blight tolerance. In light of our findings we would recommend a second, focused selection program at a smallholder-oriented program, like that found at Ümit Serdar's lab at On Dokuz Mayis University in Samsun, which could further select on such germplasm for other locally valued qualities for timber and nuts.

In western Turkey, efforts to establish biological control of chestnut blight and gall wasp presently show significant promise. The genetic diversity of the chestnut blight causing fungus is especially low in the southwest (Omer Erincik personal communications). This genetic diversity is likely to increase over time. Due to sexual reproduction of the fungus in specific locations, this is already occurring (Daldal, Erincik and Wall, forthcoming). This change would signify much worse conditions for biological control of chestnut blight. This high genetic diversity is already present in regions like Bursa and in the Black Sea region. Regarding gall wasp, biological control also declines in efficacy over time (Paparella, Ferracini, Portaluri, Manzo, & Alma, 2016).

On both of these fronts, a long-term strategy should involve local germplasm evaluations for chestnut blight and gall wasp tolerance in concert with focused local breeding programs. Chestnut blight tolerance is most reliably sourced in eastern Asian materials. European-Asian hybrids with blight tolerance are already numerous and several such cultivars are widely available in Turkey, formally and informally. These have not been properly evaluated for fit according to local preferences. The most prevalent such variety, *Marigoule*, is not highly regarded. Many sweet manufacturers do not approve of the fruit qualities. Villagers bemoan the short stature and minimal timber volume. Women dislike the properties of its husks, which do not decompose quickly enough for garden application. Thus, more work should be done to introduce traits of significant local value to these varieties. Regarding gall wasp tolerance, significant promise has been identified in Greek materials in research orchards maintained by the Center for National Research Institute of Biology, Agroecology and Forestry (IBAF) campus in Porano, Italy (personal observation of curator Dr. Fiorella Villani). Turkish materials with genetic similarity to the Greek materials should be identified and evaluated.

Significance of the Research in Turkey and Beyond

This work makes several methodological and theoretical contributions to disciplines which have historically promoted and shaped conservation practice. These include the ethnosciences, conservation biology, environmental ethics, and coupled human and natural systems research. Chapter one presents an approach to bringing common sense moral reasoning to bear on a scientifically specialized and technocratic conservation programs that tend to revolve around unstated morality. Plant Genetic Resource conservation is not at all alone within the much larger institutional world of natural resource conservation. This confluence of endeavors, institutions, public, private, for-profit agencies, and social movements is ever hybridizing, specializing, and contesting for influence on the biosphere. There are many reasons why maintaining opaque morality becomes the norm in such professions. First, projecting certainty is especially important in the acquisitions of funding and the exercise of power. If moral considerations are presented, it is best to present them as foregone conclusions. Second, if moral considerations are considered foregone and even irrelevant, labor at all levels of the organization tends to be more focused and productive. Yet this crystallization may lead to disharmony between the motivating principles of the professional endeavor and the more common sense public value for the endeavor. Plant Genetic Resource conservation, by its own understanding, is beholden to a rather large public, namely all of humanity. By evaluating the behavior of the PGR conservation according to ethics and relevant social science, chapter one shows a preliminary approach to working out this disharmony.

Chapter two develops and shows the efficacy of an approach to investigate contemporary cultural agency in association with maintenance of historically anthropogenic landscapes in a period of ecological distress. Specifically, this chapter develops an approach to study cultural

resilience in a context of rapid landscape-level adaptation in practices that amount to niche construction. Chapter three develops and tests a model of research to engage knowledge that strategically accounts for the ever-operating interlocking matrix of oppression. As such, it embraces assertions of feminist scholars who see women's studies as a strategic first step towards accounting for the ubiquitous oppression of other social categories including those of race, ethnicity, religious practice, and class status. Specifically, by running a control group, this chapter presents a method of verifying a "muting" effect that can bias the results of research. The control group results verified the efficacy of the effort to engage knowledge which was otherwise muted.

Finally, chapter four demonstrates an approach to studying value through the adaptation of established ethnobotanical techniques to study knowledge. In contexts where a resource is under threat, appropriate prioritization requires the detailed study of value. This section shows that by establishing a comprehensive ethnographic understanding of the value chain, and engaging knowledge at different positions, the influence of value on knowledge can be characterized and important priorities for urgent conservation can be identified. Chapter four offers a timely instrument to help curate and damage control in conditions of population and species erosion.

This work makes several theoretical contributions to the abovementioned disciplines. Chapter one demonstrates the need for overt moral reasoning in conservation frameworks. If conservation is to be upheld and performed exclusively by licensed official institutions, it could be said that moral reasoning can be simply codified in law and processed accordingly. However, in this era of profound institutional environmental setbacks, it is now well known that resilient and durable strategies for conservation require a compelling public case. This is equally true in

democratic and autocratic societies. Compelling reasoning is the distinct purview of ethics. Economics, and reasoning thereof, is but one member of this larger category. Chapter four makes the important point that the ontological turn in the social sciences, though it has materialized almost entirely in highly inaccessible social science discourse, may have robust ethical underpinnings. The deeper recognition of other sovereign realities that this ontological turn allows may be adopted whole cloth by ethnoscience and their studies of indigenous perception of environment. Under the conditions of the Anthropocene, this indigenous perception must be engaged in moments of prioritization by engaging value. PGR conservation is put forward as a lucid example of this prioritization.

Chapter two presents a case where it was necessary to combine cultural resilience and human niche construction theories. Neither of these theories alone could evaluate a case where historically anthropogenic landscapes were threatened due the arrival of multiple exotic pests and pathogens for the biocultural keystone species of those landscapes. Because human niche construction theories have focused on developing explanatory power for landscape dynamics over long periods of time, there was a missing opportunity to understand human niche construction in urgent moments of transition. A case in point is human niche construction theory's conceptualization of learning. While cultural learning is highly cited in these theories as essential to *Homo sapiens*' exceptional intergenerational niche construction ability, it is not studied. By considering livelihood practices and landscape maintenance as cultural, we made it possible to leverage cultural resilience theory in our research context. With the established cultural resilience focus on memory, learning and connectedness, we demonstrate how the human niche construction we observed was strongly characterized by local cultural resilience.

Observations reported in chapters three and four cast reported knowledge as a medium which is deeply characterized by sociality. While not a new supposition, this observation has significant implications for cross-cultural research. This work supports growing recognition that social marginalization occurs through complex triangulation of intersectional identity attributes between individuals and groups. The research environment is absolutely no exception. Our evidence of muting suggests that such muting may characterize knowledge reported in any environment where marginalization is occurring. Marginalization may always be occurring. In addition, chapter three suggests that performance might be a necessarily understood feature of epistemology. Cross-cultural and intersectional fieldwork should come to acknowledge that cognition is communicated differently depending on the sociality of the moment, and interpret reports accordingly. In our study community, for instance, it was often explicitly stated by men that their women kin would not know anything about chestnuts. Our women-only research protocol elicited unique, diverse and culturally rich reporting which was unmistakably knowledge. Knowledge was thus defined locally as a male mastered performance for visiting researchers, which was entirely distinct from the hospitable conversation and entertainment shared by women with women.

Chapter four, likewise, calls into question operating ontologies of knowledge for cross-cultural research. Many of the social sciences have traditionally settled on a consensus model of knowledge which views knowledge as essentially homogenous, but held at differing volumes by different people in a community. Our observations along the knowledge-rich, and geographically disparate, value chain challenges such a model. Knowledge of the single species, sweet chestnut, was significantly different depending on which 'position' in the value chain a participant inhabited. The value chain shows how value, understood as a category broad enough to include

utility, interest, aesthetics, and sentiments can cause new, self-contained, consensuses to form in-situ. The value chain shows how value spurs idiosyncrasy in knowledge. Thus, interpreting knowledge generated by social research requires acknowledging the influence of value and its locally prominent attributes on that knowledge. As the final section will illustrate, this has terrific implications for conservation prioritization.

Final Note: The Importance of Folk Value in the Anthropocene

The Anthropocene and its corollary, the sixth mass extinction of species, once acknowledged, freight in other, more tectonic, acknowledgments. First, they require an acknowledgment that social processes and human attributes preserve the biosphere to the extent that it is preserved. In this understanding, wilderness, biological diversity, ecosystem sustainability, and other objects of conservation exist where, and to the extent that, human behavior allows. As an immediate proof, it is certainly a social reality that prevents the detonation of atomic bombs all over the world

The second implicit acknowledgement is that unconscious and conscious selection comingle to perform winnowing process. The Norwegian wharf rat, the starling and kudzu due not owe their prevalence to conscious selection. On the other hand, examples of conscious selection are countless. Crowns-of-thorns starfish-killing robots patrol the Great Barrier Reef. Barred owls are shot by rangers in the Northwest United States to provide relief for the spotted owl. In the vast majority of cases, human-caused extinctions are most easily understood as unconscious acts. The elimination of numerous species caused by the decreased area of the Amazon forest is a collection of unconscious or unintended acts. Yet, how unconscious would the act of harvesting the horn of the last black rhinoceros be? Clearly, extinctions in our era point to a grey area in terms of conscious and unconscious.

The third implicit acknowledgment is that value will determine the proportionality of unconscious to conscious acts of species deletion. Value exists at distinct but interacting levels. From a meta perspective, in our era the valuation inherent to the globalized economy is the most powerful organizing principle. Carbon emissions, circulation of invasive pathogens, ecological fragmentation: such biologically deleterious phenomenon, often referred to as externalities, are generated by countless acts occurring in the pursuit of value. Pursuit of value at the global level relies on the routine establishment and maintenance of certain species and populations, while simultaneously eliciting ambivalence towards and deletion of others. Within sovereign nations, values may be expressed in the face of globalized market dynamics which may or may or not register such value. Threats to certain known rivers, certain species, certain populations are noted or not noted, responded to or not responded to with available means. The world over, heterogeneous fields of value that hover below the national level are routinely muted.

The final implicit acknowledgement is that such value is not being lost by everyone equally. There is hierarchy inherent to the Anthropocene and to this great curation. The truth of this is borne out by a particular and commonly cited ethical observation. The cultural groups least responsible for global climate change, i.e. indigenous and traditional peoples, presently experience some of its earliest, most direct and most brutal effects. Extinction and other forms of biological erosion are integral parts of this injustice. This work advocates for conscious and moral exploration of the great curation through the case of one treasured, and threatened, species in one particular country. This case shows that there is voluminous undocumented care and value for the biosphere far below the national level. Such dimensions motivate maintenance even in the face of extremely torrential global forces. To understand and give voice to this rooted, diverse and durable value may prove ethically sound in two ways. First, it may liberate long muted, but

highly motivating, value for the biosphere. Second, these distinct and indigenous priorities may provide invaluable insight into conserving the optimal biological value in our great curation.

APPENDIX A— Ethnobotanical Interview Themes and Worksheet English

Site Number _____

Household Number _____

1. *Which varieties of chestnut do you use? What are the names?*

2. *What best describes your landuse for chestnut nuts, leaves, wood, etc? (Arazi Kullanımı Kodları: 1=Evin yanında ve tapulu; 2= Eve yakın tapusuz, 3=Evden uzakta tapulu; 4= devlet ormanı geleneksel hakkıyla; 5-devlet ormanı geleneksel hakka sahip olmaksızın; 6=hazine arazisi; 7 Özel ağaçlandırma, 8=işçi olarak para için; 9=işçi olarak kestane için; 10=Başaklama hakkı; 11=Akrabaların arazisi)*

3. *Where did this variety come from?*

4. How many of this variety do you use/collect from? If unknown, about how many kilos of chestnuts do you collect annually?

5. How do you use the chestnut (the nuts, the leaves, the wood, the flowers, the husks (kozak)

6. What variety is best for each use?

Site Number _____
Household Number _____

Variety A)Name B)Landuse Category C)Where from D) # tres/killos **USES**	1	2	3	4	5	6	7	8
A B C D	Quality							
A B C D	Quality							
A B C D	Quality							
A B C D	Quality							
A B C D	Quality							

Arazi Kullanımı Kodları: 1=Evin yanında ve tapulu; 2= Eve yakın tapusuz, 3=Evden uzakta tapulu; 4= devlet ormanı geleneksel hakkıyla; 5-devlet ormanı geleneksel hakka sahip olmaksızın; 6=hazine arazisi; 7 Özel ağaçlandırma, 8=işçi olarak para için; 9=işçi olarak kestane için; 10=Başaklama hakkı; 11=Akrabaların arazisi

APPENDIX B— Ethnobotanical Interview Themes and Worksheet Turkish

Yöre Numarası _____

Hanehalkı Numarası _____

1. *Kestanenin hangi çeşitlerini biliyorsunuz?*
2. *Kestanenin hangi çeşitlerini yetiştiriyorsunuz /kullanıyorsunuz?*
3. *Bu çeşitleri nereden ve nasıl elde ettiniz?*
4. Her bir çeşit için tahmini kaç ağaçtan yararlanıyor sunuz?
5. Sahip olduğunuz ve yararlandığınız kestane çeşitlerinin kullanım yerleri nerelerdir?

	Faydalanma Biçimi						
Çeşit Adı	*Gıda*	*Tıbbi*	*El Sanatları*	*Ahşap*	*Aşılama*	*Üretme*	*Diğer*

6. Yukarıda bahsettiğiniz çeşitlerden ürün elde etme kalitesini *sıfırdan beşe kadar puanlar mısınız?*

Çeşit Adı	Faydalanma Biçimi	Ürün Elde Etme Kalitesi						*Bu çeşite hangi özelliklerinden dolayı bu puanı verdiniz?*
		0	1	2	3	4	5	

7. Bu faydalanma biçimlerinden ne *kadar sıklıkla yararlanıyorsunuz?*

( ) Haftada bir
( ) Ayda bir
( ) Yılda bir defa
( ) Diğer

8. Yararlandığınız çeşitlerin toplandığı arazileri aşağıdaki listeye göre işaretleyiniz?

Çeşit Adı	Nereden Topluyorsunuz												
	1	2	3	4	4	5	6	7	8	9	10	11	12

Yöre Numarası ____________________
Hanehalkı Numarası ____________________

Çeşit A)Adı B)AK C)Nereden D) # Ağaç **Kullanımlar**	1 Ne kadar sıklıkla	2	3	4	5	6	7	8
A B C D	0 1 2 3 4 5 Kısımlar ve Özellikler	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
A B C D	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
A B C D	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
A B C D	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
A B C D	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5

Arazi Kullanımı Kodları: 1=Evin yanında ve tapulu; 2= Eve yakın tapusuz, 3=Evden uzakta tapulu; 4= devlet ormanı geleneksel hakkıyla; 5-devlet ormanı geleneksel hakka sahip olmaksızın; 6=hazine arazisi; 7 Özel ağaçlandırma, 8=işçi olarak para için; 9=işçi olarak kestane için; 10=Başaklama hakkı; 11=Akrabaların arazisi

APPENDIX C— Tree Health Evaluation Form

Yöre Numarası _____ GPS Coordınates_____ Direction (0-360)_____
Hanehalk Numarası _____ Collector _____ Vegetation _____

Tree Number	Location (Forward m)	Location (L/R m)	Dbh	Height	Crown	Shoots (1-5, >5)	grafted (y/n)	Severity			
								a	b	c	d
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											

A) Trunk; B) Lowest quarter of crown; C) Second Quarter of the Crown ; D)Upper Half of Crown
1) <10% damage, 2) 10-25% damage, 3)25-50% damage; 4)51-80% damage; 5) >80% damages

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