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A case for cultural genocide: Taking a closer look at China's language policy in the TAR

Christina Newhall – Southern Oregon University

Amidst the chaotic and emotionally charged claims of brutality, imprisonment, and outright genocide in Tibet, lies a particularly insidious issue imbedded in China's education policy; the PRC's (People's Republic of China) newest language reform policy aims at unifying a nation through the Mandarin language. Its methodology is aggressive and has raised concerns regarding inequality and institutionalized racism. On the Tibetan educational front it has been met with resistance as Tibetans struggle between cultural identity and second-class citizenship within their own lands. The Dalai Lama has accused China of committing cultural genocide against Tibetans (Chaim 2010), but confusion regarding the scope of the term "cultural" genocide and conflicting reports of actual hardships or *intentional* harm done to Tibetans has left many scholars and UN officials grappling with semantics and definitions rather than recommending or taking action in support of Tibet. This paper explores the conflict of definitions and confusion of evidences, and attempts to focus on China's language policy and the assimilationist ideologies which drive it, as evidence for cultural genocide through language loss.

Genocide in Tibet? : A conflict of terms

Repeated claims that the Chinese government is conducting genocide in the TAR (Tibetan Autonomous Region) have been made by the Dalai Lama, as well as many concerned westerners. The Dalai Lama has also suggested that the wave of self-immolation protests by Tibetan Buddhist monks over the past decade is due to frustrations over the harsh immoral rule and cultural suppression imposed by the PRC. Some scholars however, claim that the term "genocide" is overly used and generally misunderstood. Barry Sautman (Hong Kong University) says of the accusation: "Hyperinflationary claims of genocide and colonialism are made to advance political agendas" (2006, 243). Helen Fein has claimed that genocide has become an

overused term in common day society: “The wave of misuse and rhetorical abuse of the term genocide is so debased by semantic stretch that its use stirs suspicion” (1994 par 3). The UN defines genocide, in Article II (1951), as:

In the present convention, genocide means any of the following acts committed with intent to destroy, in whole or in part, a national, ethical, racial or religious group, as such:

(a) Killing members of the group;

(b) Causing serious bodily or mental harm to members of the group;

(c) Deliberately inflicting on the group conditions of life calculated to bring about its physical destruction in whole or in part;

(d) Imposing measures intended to prevent births within the group;

(e) Forcibly transferring children of the group to another group.

This outline appears to be fairly straight forward in theory; however, challenges in delineating and defining what a “group” is, or determining *deliberate* action, can be much more complicated in practical determination. The considerations for making such determinations are further convoluted when the facts are skewed and information regarding actual conditions are unknown, as is often the case regarding social issues in Tibet. Disputes and accusations regarding occurrences of “unnatural” deaths vary significantly depending on source. Some claims by Western NGOs estimate mass killings number over 1 million (freetibet.org), though the estimated population of Tibet, according to National Bureau of Statistics of China, is only 3.03 million (2011), making the claim that 1 million people have been victims of genocide rather improbable. Some speculate that this population estimate is quite low, and the 3 million represents urban populations only. Statements and statistics remain unverified from both sides of this dispute (Barnett 2008).

The need for seemingly overly restrictive policies in the TAR has raised suspicion from many outside (western) onlookers. “Autonomous regions” were originally created and supported by the PRC to promote unity and local initiative with an overarching purpose of encouraging economic growth and stability (Karmel 1996). It appears however, in Tibet specifically, the intentions are quite the opposite. Rumors of Tibet being ruled under a state of Martial Law have circulated for years (University World News 2010). Indeed the “Tibetan Autonomous Region” appears to be autonomous in name only. One reason for this is perhaps due to Tibet remaining quite rebellious since the CCP (Chinese Communist Party) overtook the country in the 1950s,

and though many border regions have enjoyed a fair amount of independence in the post Mao period, Tibet seems to have become further strapped by restrictive policies.

Since the 1980s protestors of language policies and government rule in Tibet have been labeled "splittists" by the PRC and are dealt with as traitors. Wu Jinghu, a regional party secretary originally from the Sichuan region, has said of dissenters "…we should deal a relentless blow at the splittists, and must not be soft with them" (Karmel 1996, 487). How dissenters are dealt with by the PRC is again, a matter of debate. Figures and accounts from either side seem to share almost no middle ground. By some accounts, Tibet has several hundred prisons holding thousands of political prisoners. The Chinese government has made a statement claiming that the TAR has only 1 prison, which holds some 900 prisoners "… and all are guilty of criminal acts" (Blondeau, Buffetrille 2008, 87). The PRC's claim to the existence of only one prison in Tibet excludes the known presence of detention camps, reeducation through labor camps, juvenile detention centers, military prisons, police lock-ups, and People's Armed Police prisons (Blondeau, Buffetrille 2008). Clearly, political rhetoric, alarmist concerns, and facts are hard to separate regarding such topics. Difficulties in assessing the state of affairs in Tibet are at the heart of the inability to definitively assert a claim of genocide. A closer look at China's education policies, however, specifically regarding language, may bypass the need to sort out fact from rhetoric, and make a clear case for *cultural* genocide.

Language policy: A case of cultural genocide?

Cultural Genocide: [1]

Indigenous peoples have the collective and individual right not to be subjected to ethnocide and cultural genocide, including prevention of and redress for:

(a) Any action which has the aim or effect of depriving them of their integrity as distinct peoples, or of their cultural values or ethnic identities;

(b) Any action which has the aim or effect of dispossessing them of their lands, territories or resources;

[1] This version was a draft presented in 1994, and though it utilizes the term 'cultural genocide' it does not explicitly define it. The final draft adopted by the UN in September 2007 uses the term 'genocide' not 'cultural genocide' but otherwise retained the stipulations outlined here.

(c) Any form of population transfer which has the aim or effect of violating or undermining any of their rights;

(d) Any form of assimilation or integration by other cultures or ways of life imposed on them by legislative, administrative or other measures;

(e) Any form of propaganda directed against them.

Draft for Article 7 (1994) United Nations Declaration on the Rights of Indigenous Peoples

Language education policies as they exist in the Tibetan Autonomous Region, as enforced by the People's Republic of China appear to minimally be in breach of sections (a) in regard to ethnic and cultural identity, (b) in regard to access of resources such as a wage paying job and equal education, (d) in regard to an attempt to assimilate and integrate by the dominant Chinese culture, and implemented in policy, practice and education. Furthermore, the language policies appear to be in violation of the Chinese Constitution (1984) with regard to minority rights and preservation of language and right to equal education.

Language policy and illiteracy

The People's Republic of China has issued a statement of concern regarding literacy in its various regions. The PRC says it is concerned with the number of "illiterate" Chinese, especially within its autonomous regions (such as the TAR), and claims that nearly 400 million people in China cannot even speak to one another (theworldofchinese.com 2013). Online newspaper china.org.cn has claimed 90% of these illiterate communities reside in rural areas and "about half of those are in the western region" (2014). The paper goes on to report, "Recently, China worked out an action plan on educational development from 2003 to 2007 for the western region, aiming to wipe out almost all illiteracy among people between the ages of 15 and 50 in west China. There is still much work to be done to meet this goal" (2014). The PRC's policy aims at assimilating persons of various "dialects" in rural provinces to the majority language of Mandarin.

Most of the illiterate regions to which China has alluded are relatively small bands of indigenous peasants with distinct cultural features—including minority languages. There are approximately 56 ethnic minorities in China which speak around 80 different languages, and of these, 30 have written forms (Nelson 2005). What China refers to as "illiterate" is not a lack of language literacy, but rather a lack of *Mandarin* literacy among minority populations. The

ideology and efforts to “wipe out” illiteracy include an aggressive language policy intended to promote national identity.

The language policy being implemented in the TAR requires that all courses taught beyond primary school be in Mandarin, and furthermore, admission to University and Public Sector jobs requires a rigorous proficiency test in Mandarin. This means that Tibetan is only taught to children up to 6th grade. The deleterious consequences of this abrupt shift from Tibetan to Mandarin is evident in Tibetan children’s test scores which are significantly lower than Han Chinese scores whose native language is Mandarin. Clearly, since Mandarin is a second language to most Tibetan children, they are at an academic disadvantage. This issue has not been addressed in public schools; in fact, only an estimated 10% of Tibetan children enrolled in primary school will pass the Mandarin competency test and go on to middle-school (Johnson, Chhetri 2002). These policies give significant advantages to Han Chinese in academia and in the job market. These advantages lead to a financial and social success which Tibetans cannot seem to attain in their own homeland. This is no accident, it is *exclusive* by design and all but the most academically proficient—in Mandarin—will *not* advance. No less than 3 rigorous tests in Mandarin will take place from middle-school to University, and yet another for job placement (Johnson, Chhetri 2002). This process effectively filters out native speaking Tibetans from higher education and job placement.

Mandarin is quickly replacing Tibetan in all areas of government, as well as in social and public life (Inge 2013). Mandarin is the language used more and more often on public signs, advertisements and newspapers, leaving Tibetan speaking natives to be illiterate and alienated in their own land. These discriminating and restrictive practices and policies are what have led some to refer to Tibet as the “least autonomous region in China” (Karmel, 1996, 485).

The Tibetan language, Buddhism and culture

“Literacy is a ‘many meaninged thing’.”

Tove Skutnabb-Kangas (Rassool 1999, xi)

Though touted as a “bilingual” education system, the language policies as they exist in Tibet appear to be a system motivated to not only eradicate illiteracy, but to eradicate Tibetan. It has been suggested (Nelson 2005; Johnson, Chhetri 2002; Karmel 1996) that the language

policies implemented in China's minority regions are not as much about language education and literacy as they are about assimilation to the normative Chinese culture. Assimilation of minority groups to the majority supports an agenda of unification and national identity. This agenda explains the unusually heavy-handed enforcement of Mandarin in Tibet, as Tibetans have been perceived by the PRC to be particularly resistant to the acceptance of the notion that Tibet is rightfully a Chinese territory (Kizilos 2000). The separation of a people from their language and culture, and assimilation to the Chinese norm, has the advantage of spreading hegemonic ideologies through an increasingly homogeneous population.

Resistance to language policies in minority regions appears to be stronger among populations and language communities which have their own writing systems (Nelson 2005). This resistance may be due in part to a stronger link between cultural identity and language. It may be the case in these areas that language education in Mandarin Chinese is seen as a repression of minority language and culture instead of an advancement of "literacy" (Nelson 2005). Resistance is further encouraged by the lack of culturally appropriate curriculum, and a lack of historical representation of minority groups. Teachings incorporating topics important to minorities have been deemed unimportant or insignificant to the education model designers who promote nationalist ideologies and reside in faraway Beijing (Johnson, Chhetri 2002). Another cultural issue which lay at the heart of the Tibetan resistance is a difference in perception regarding the role religion plays in education.

Traditionally, Tibetan education was intimately bound to teachings of Buddhism. The Tibetan writing system is itself rooted in Buddhism and is an ancient form of Sanskrit historically thought to have been borrowed from India and fashioned explicitly for the purpose of inscribing the teachings of the Buddha. It has even been suggested (Inge 2001) that the very structure and inherent character of the Tibetan language reflects a Buddhist perspective of self. The notion that to study Buddhism to its fullest one must also study Tibetan has been implied by His Holiness the 14th Dalai Lama, who has stated: "When anyone wants to investigate Buddhist thought today, Tibetan language is the best means through which to do it" (dalailama.com 2014). The profound interwoven connection between culture, religion, identity and the Tibetan language—both spoken and written—cannot be overstated.

Chinese education is secular, and though it once incorporated ideals from Confucianism (which is not a religion), has always been secular (Johnson, Chhetri 2002). These kinds of

cultural incompatibilities, which Chinese education policies have failed to address, further the marginalization of Tibetans. An estimated 40%-60% of Tibetan children will not even attend primary school (Wangdu 2011). These staggering statistics are likely due to parents' disregard for the importance of secularist promotion of mathematics and economics which do not endorse or reflect Tibetan values or way of life. Bonnie Johnson, from the Department of Educational Policies at Penn State University, writes of minority parents in the TAR:

> Many minority parents believe that for their children, knowing about their language and religion is of greater importance than learning mathematics and science. This attitude often results in low school attendance rates (2002:145).

"Illiteracy" as it is regarded by the PRC seems to fall far from a Tibetan notion of the term. The Dalai Lama has responded to China's newest policy endorsement (which aims at achieving 98 percent Mandarin literacy by 2015) saying: "I would like to remind you that we have our own system of writing that is the most suitable language available today for expressing Buddhist ideas" (dalailama.com 2013).

The Tibetan language, which is part of the Sino-Tibetan language family, traces back to the 7th Century. Songtsen Gampo, Tibet's first emperor, united the people of Tibet and brought written language (Sanskrit) to the country, as well as a religion known as Buddhism. Tibet came under rule of the Phagmodur family in the 14th Century and maintained independence for nearly 400 years. Much of Tibet's history was scribed by literate Buddhist monks and scholars, which shaped the historical context and cultural significance of these writings (Kizilos 2000). The interwoven nature of Buddhism to Tibetan is so close that in much of Tibetan history and mythology, the Tibetan language is suggested to have been born out of Buddhism (Inge 2001). The layers of cultural significance which are alive in the language, and which represent so much with regard to tradition and religion, suggest that the language is not merely a tool for communicating, but is a spiritual staple and symbol of identity among many Tibetans. Tibetan journalist Yeshe Choesang states: "…to study Tibetan is to practice the soul of Buddhism….

Language is the depository of culture. If you lose that, you could lose everything" (2014, para 4).

The PRC alarmist concerns over illiteracy insinuate that Chinese citizens in minority regions are not able to communicate with one another, which is flatly untrue. In areas where minority languages are prominent, cultural practices and lifestyles proceed in the manner in which they have been accustomed for many (if not hundreds) of years—they just don't communicate in Mandarin. Many Tibetans have spoken out against the Chinese language education policies. Yeshe Chosang, of *The Tibet Post International*, has gotten right to the point regarding identity and language policy:

> In world history, language is maintained as a matter of national identity, language defines a culture. The current genocide of the Tibetan language by the Chinese government, through the removal of Tibetan language from schools replaced with Chinese, aims to make Chinese children out of Tibetan children (2014).

These strong words do not shy away from implying that Chinese policy seeks to assimilate Tibetans and unify China through minority language repression. Claims like these seem to beg the question: are aggressive assimilationist policies equivalent to "cultural genocide"?

Neo-colonialism, assimilation and cultural genocide

Assimilation [is]…the process whereby individuals or groups of differing ethnic heritage are absorbed into the dominant culture of a society. The process of assimilating involves taking on the traits of the dominant culture to such a degree that the assimilating group becomes socially indistinguishable from other members of the society. As such, assimilation is the most extreme form of acculturation.

-Encyclopedia Britannica (2014)

Accounts of colonization frequently accompany concerns regarding genocide. The term 'colonization' is contentious however, and is suggested to mean that a territory becomes occupied by an outside, or non-native group, whose intent is to establish control or influence over the native population. In the case of Tibet, this term could be considered inappropriate due to the continuity of land and territory. Arguments have been made that the relations between

China and Tibet are more a case of modernization which is arguably the inevitable future of any minority culture. Modernization is a process of social change, or progressive transition to industrialization. The term modernization suggests that a 'traditional' societal model is replaced by a modern, social model. Modernization generally occurs when an industrialized society comes in contact with a more traditional society and cultural diffusion ensues.

In the foreword of *Literacy for Sustainable Development in the Age of Information*, by Naz Rassool, Tove Skutnabb-Kangas submits that a "neo-colonization" is prevalent in the world today, and that the new face of colonization occurs less in the form of ruthless somatic domination, and more often in the form of education and language policy. She states: "Instead of the brutality of physical colonization, what we have now is recolonisation and neo-colonisation, where the means are increasingly cultural and linguistic" (1999, xiii). The notion that modernization is beneficial to "underdeveloped" countries or societies immediately implies a cultural hierarchy where "industrialized" is meant to imply "better-than." With this mindset, colonization and assimilation can appear as unfortunate, but necessary, evils which facilitate societal evolution. This mentality also encourages the idea that non-industrial cultures are deficient in relation to the norm (Rassool 1999). These are very dangerous notions to entertain; unfortunately, many of these ideas are so intrinsic to the values of industrialized peoples that reflection regarding their rationale is rarely practiced. Skutnabb-Kangas goes on to say (about modern language policies implemented on minority populations):

> A wrong educational language policy, organized against most scientific evidence about how education should be organized if it is to promote high levels of multilingualism, has been the order of the day in most countries. It has involved linguistic genocide for linguistic minorities and monolingual reductionism for linguistic majorities, coupled with inefficient foreign language teaching, and in both cases, blaming the victims for the results. Only elites have benefited (Rassool 1999, xiv).

What is striking about this comment is that, though it echoes the discriminating and insufficient language policies enforced by the PRC, this statement is nebulously leveled at western language policies which also frequently favor assimilationist tactics to promote nationalist ideals. In lieu of language polices and teaching methods which are guided by

pedagogy coupled with appropriate considerations for minority cultural values and the promotion of multilingualism, we see both in western policies and in Chinese policies, a practice of *subtractive* language learning which does not support or respect diversity. Subtractive language learning is frequently utilized to promote nationalism, and requires the minority language community to cease native language use and adopt, or assimilate to, the majority language and culture, effectively exterminating those distinguishing features of cultural group identity. The United States endorses a similar subtractive model with regard to immigrant language learning. In the case of Tibetans, the choice of whether to abandon one's native tongue and fully adopt Mandarin, or resist in an effort to maintain cultural identity, is the difference between earning a full education, job and future, or, remaining in poverty as a second-class citizen. Similar circumstances exist for immigrants in the US. Multiculturalism and multilingualism are not supported in subtractive language education.

Another facet of the language education controversy in Tibet is the apparent breach of China's own constitution. According to law as directed by the Chinese constitution (The Law of the People's Republic on Regional National Autonomy [1984] and the Constitution of the People's Republic of China): minorities have a right to use and preserve their native languages (Article 36, 37); the Regional National Autonomy Law provides that the curricula of local schools should reflect the interest of their constituencies and "ought to use textbooks in the relevant minority language and *the minority language should be used as the medium of instruction*" [emphasis added] (cited in Johnson, Chhetri 2002). The state of affairs within the Tibet Autonomous Region seems to fall far from these stipulations.

The BBC (bbc.co.uk) quoted a student participating in a 2010 protest in Tongren who claimed: "This reform is not only a threat to our mother tongue, but is in direct violation of the Chinese constitution, which is meant to protect our rights." The "reform" to which this student was referring is one proposed by the PRC which would see all educational institutions within the TAR begin the teaching of Mandarin in primary school and further reduce the presence of Tibetan in higher education (it is currently available as a special topics course in many Universities). *University World News* reported in 2010 that only 1.4% of students attending higher education in the TAR are Tibetan while Han Chinese represent over 50% of the student body. The paper also claims that while over 40% of Tibetans are unemployed, 70% of private sector jobs are occupied by Han Chinese living within the Tibetan region.

The grossly unequal conditions in education and employment, enforced and informed by language policies, are further exacerbated by the second-class standing of Tibetans whose culture is frequently referred to as “backward” and unsophisticated. The subtractive language policies in education coupled with the exclusive testing practices required for upward mobility which show preference of hiring Han Chinese over Tibetans in the TAR, suggest a case of institutionalized racism.

Conclusion

The extreme disadvantages faced by Tibetans in the Tibetan Autonomous Region is owed (in part) to educational models which employ practices of linguistic imperialism; this creates a social hierarchy informed by policies which encourage institutionalized racism. Though the term ‘colonialism’ as it relates to the Tibetan situation could be debated academically, the ideologies behind the language education policies in Tibet are undoubtedly colonialist. The loss of a language within a civilization is a devastating blow at the most intimate level of cultural identity, and a deliberate act to infiltrate, corrupt or eradicate this aspect of a culture is nothing less than cultural genocide.

Terms and definitions included under Cultural Genocide:

Ethnocide:
Intentional destruction of the culture of another people, not necessarily including destruction of actual lives.
Linguicide:
Forbidding the use of or other intentional destruction of the language of another people—a specific dimension of ethnocide.
Definitions by Israel W. Charny (as quoted from Genocide: Conceptual and Historical Dimensions, by Helen Fein 1994:90)

Colonialism:
Colonialism is a practice of domination, which involves the subjugation of one people to another. One of the difficulties in defining colonialism is that it is hard to distinguish it from *imperialism*. Frequently the two concepts are treated as synonyms. Like colonialism, imperialism also involves political and economic control over a dependent territory. The term colony comes from the Latin word *colonus*, meaning farmer. This root reminds us that the practice of colonialism usually involved the transfer of population to a new territory, where the arrivals lived as permanent settlers while maintaining political allegiance to their country of origin. Imperialism, on the other hand, comes from the Latin term *imperium*, meaning to command. Thus, the term imperialism draws attention to the way that one country exercises power over another, whether through settlement, sovereignty, or indirect mechanisms of control.
Taken from the Stanford Encyclopedia of Philosophy (First published May 9, 2006; substantive revision Apr 10, 2012)

Linguistic Imperialism:
A linguistic concept that involves the transfer of a dominant language to other people. The transfer is essentially a demonstration of power, traditionally military power but also, in the modern world, economic power--and aspects of the dominant culture are usually transferred along with language.
Robert Phillipson (1992) as cited in Wikipedia 2012

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Case Study: Yurok Language Reclamation Efforts

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The Indigenous group living in the remote region of the Northwestern California coastline and along the banks of the Klamath River remained almost completely untouched by dominant white society until the mid-nineteenth century. By 1848 the Yurok people felt the magnified effects of the California Gold Rush, the influx of settlers on their ancestral territories, and later the construction of the Hoopa Valley Boarding School (Hinton, 2001). These events subjected the native people to methods of assimilation and new diseases, which ultimately caused a chain reaction of cultural devastation resulting in language loss. At the time of first-settler contact there was an estimated 2,500 speakers of Yurok, but by the early 1990s that number had been significantly reduced (Garrett, 2011). The drastic reduction of intergenerational speakers led to an academic prediction that by the year 2010 Yurok would be classified as an extinct language (Cejnar, 2013). In response to such discourse, tribal government in collaboration with linguists from the University of California at Berkeley began a major reclamation effort which is on-going. This effort includes the implementation of the Master-Apprentice Program, community language courses, development of the Yurok Teacher Institute, Acquisition of Restored Native Speech (ACORNS) software for interactive language learning, the Yurok Language Project at University of California at Berkeley, and established Yurok language classes within the local public school curriculum (McQuillen, Gensaw, Lewis 2014). Through discussion and analysis of differing language revitalization methodologies and the successes of the Yurok Language Reclamation Program, this case study presents support on the cooperative efforts of indigenous people and linguists and their significant roles in preventing language loss.

In order to comprehend the ambitiousness of a full scale language reclamation effort it is necessary to have a brief understanding of the community's language history. The Yurok language is linguistically complex and differs drastically from other indigenous tongues of California. The language is a member of the Algic family which in turn is a sub-form of the

North American Algonquian language family (widely spoken in the central, plains, and eastern part of the United States). As a sub-form of Algonquian it is specific to just the northern Pacific Coast region. Only two California groups, geographically situated about 80 miles apart, speak Algic languages (Garrett, 2011). The Yurok language has a history of intense documentation "this began in the nineteenth century with vocabulary and sentences taken down by explorers, settlers, and US government ethnographers, but serious linguistic research began in 1901" Garrett (2011, p.2). A.L. Kroeber, T.T. Waterman, J.P. Harrington, R.H. Robins, and Edward Sapir provided anthropological and linguistic ethnographical documentation on Yurok grammar and language use. Despite this large scale documentation most of the audio recordings and field notes remained relatively inaccessible in government and private archives. Faced with the loss of Yurok speakers and a need to access documentation on their language, both the Yurok tribal members and the academic community at the University of California at Berkeley developed a co-dependent relationship. This collaboration provided access to crucial data and has ultimately played an essential role in the ongoing reclamation efforts (Garrett, 2011).

Perhaps the most important task when starting a language collaboration effort is to identify the goals of the communities involved with language work. The archives reveal that both the indigenous community and linguistic community established target objectives when working with the Yurok language. The compatibility of their target objectives has ensured a positive outcome. The Yurok tribe developed a mission statement and posted it on their education website. Their ultimate goals are addressed as the development and implementation of a program designed to restore their ancestral language and to generate living speakers of all levels of fluency (McQuillen, Gensaw, Lewis, 2014). The linguists who work extensively with the tribe and created of the Yurok Language Project identified, on their website, three major goals: documentation/ archiving, revitalization, and publications for the advancement of academic work (Garrett, 2014). Historical linguist Andrew Garrett, along with many of his colleagues and students, invest time and effort into meeting the indigenous community linguistic needs, and in turn the Yurok tribe is compliant in helping with the advancement of linguistic knowledge about their unique Algic language.

When an indigenous language is being spoken less by younger generations and the only fluent speakers are predominantly elderly the community has only a few options to use in retaining its language. The most effective option is to make use of a Master-Apprentice Program

methodology. In which each conversationally fluent elder is paired with an apprentice speaker for several hours a week to document, record, and learn language. In 1999 there were only fifteen individuals, all over the age of 70, who were conversationally fluent in Yurok. By developing and implementing a Master-apprentice program the Yurok tribe began to build a strong foundation of speakers, with differing levels of fluency from basic grammar knowledge, to intermediate, and eventually conversationally fluent. This specific methodology and language learning helped to enable and promote a wider scale reclamation effort for the Yurok tribe. By 2001 with help from linguists and the elders the tribe was reaping the benefits with the immergence of new language speakers clocking in numerous hours of language time each week. Hinton (2001) provides positive examples of young Yurok speakers coming out of the Master-Apprentice Program including Georgiana Meyers. Georgiana Meyers was paired with her grandmother and author of the late Georgiana Trull's Yurok Language Conversation Book, in which Myers rigorously strived to learn her language, and posed as a teaching assistant at Yurok language classes.

With the growth of new language speakers from the Master-apprentice program the Yurok tribe began increasing its language efforts. One way of doing this was by establishing community language classes at the three tribal offices in Klamath, Weitchpec, and Eureka/Humboldt. These classes are comprised of two hour sessions, offered weekly, and broken up into beginner, intermediate, and advanced. The curriculums for beginner courses include basic grammar and vocabulary through word sheets that are grouped by categories: such as animals, food, and cultural objects. Both the intermediate and advanced course curriculums are structured around community projects that include, for example, making videos in Yurok (McQuillen, Gensaw, Lewis, 2014).

However, it is important to note that without the work of linguists Andrew Garrett and Juliette Blevins most of the core language curriculum implemented within community learning classes would be unavailable to the Yurok tribe. In efforts to meet not only the tribal members' needs but also those of academic progression, a major collaboration project began in 2001 with the creation of the Yurok Language Digital Archive (Garrett, 2014). This 'corpus' was, and continues to be, a major undertaking of compiling documentation through transcribed phrases, audio recordings, songs, and advanced dictionaries and digitizing them for further linguistic analysis and use for indigenous community learning (Garrett, 2011). A database with this

interactive model has enabled the growth and advancement of the Yurok language reclamation efforts and the deeper understanding of Yurok language change. Work on this project helped establish and promote a written Yurok alphabet and a newly adopted Yurok alphabet. Garrett made it very clear that the purpose of the Yurok Language Project was to not only develop a working computerized archive, but also for the information to be transparent for anyone who wished to access it (Garrett, 2011). One way in which this is apparent is with regards to the archives system of audio recordings. For example, a tribal member may have had a great Auntie that was involved in the audio documentation efforts. The Yurok Language Project makes it possible for that individual to easily access the archive and choose to listen to Yurok spoken by that relative. The project can also be tailored to the scientific community as it has three options for displaying words, phrases, and written scripts of audio records. The options are default, hyphens, and linguistic (Garrett, 2014).

In addition to his linguistic efforts with documentation and publication, Garrett became a guest instructor at the Yurok Teacher Institute beginning in 2007. This institute was developed to accommodate a cohort of six. Individuals were selected based on Yurok language proficiency, volunteer language work, and academic merit. The ultimate goal of establishing this institute fit into the Yurok tribe's greater plan to increase the number of speakers of their language. Each institute's schedule included: curriculum on lesson building, development of classroom management skills, identifying differing methods of learning and teaching, and advanced grammar and conversation. Since 2007 the tribe has held six institutes, which have produced cohorts of individuals prepared to teach Yurok community settings also in academic settings (McQuillen, Gensaw, Lewis, 2014). This foundation allowed for the tribe to continue to expand their reclamation efforts through working with the government of California.

By 2009, after tireless lobbying, California assembly bill 544 passed allowing the Yurok tribe to certify its own language teachers, thereby providing the Yurok language speakers with credentials and allowing them to become instructors at public schools from kindergarten through twelfth grade. Presently, there are nine certified Yurok language instructors teaching in five public high schools either on or in close proximity to the Yurok Reservation (Cejnar, 2012). There are two elementary schools that have implemented Yurok language as their core curriculum. One of which, in Weitchpec, has just begun an immersion program. This great accomplishment not only allows for Yurok youth to gain access to their own language, but the

tribe also allows non-members, and all those who express interest in the Yurok language to take part in the Yurok Language reclamation effort.

The development of grade level specific curriculum and the creation of course materials for the Yurok language classes rely on the documented data within not only the Yurok Language Project, but also on software known as the Acquisition of Restored Native Speech (ACORNS). ACORNS went live in 2010. This project, developed by Dr. Dan Harvey at Southern Oregon University, was created in support of local northern California and Southern Oregon tribes language revitalization efforts. ACORNS was developed to allow language teachers, even those with little technical skills, the ability to generate media based language files to further diversify their instructional methods (Harvey, 2012).

The roles of the scientific and linguistic efforts in language reclamation have helped strengthen the classroom environment. Certified Yurok instructors, although considered conversationally fluent, where not raised as first speakers and thus their language abilities have room for growth. Being able to access new phrases and generate new vocabulary booklets has enabled student growth and improved the language skills of the teachers. As the number of certified teachers increase they continue to refine their teaching skills and seek out new methods of instruction. One such method that was implemented within Yurok language classrooms is the game “Where are Your Keys?” (WAYK) developed by Evan Gardner (Gardner, 2011). This method was introduced to the Klamath Early College of the Redwoods language course by James Gensaw Jr. one of the first individuals certified to teach Yurok in public schools. This effective game is ideal for indigenous languages, and has been used by tribal language programs across the country. It was designed to simulate language learning in an immersion setting through what the program calls “rotations.” The game uses a combination of memorization patterns and hand signals, and forces its participants to play through conversation without using their dominant language (Gardner, 2011). In March of 2013 Gensaw led WAYK’s developer Gardner, and intern David Edwards in rotations with the Yurok language. After which both Gardner and Edwards provided Gensaw with feedback on how to improve his WAYK techniques to increase language memory for students. By continuing to improve methods of instruction the tribal education program strengthens the Yurok language foundation. This is most evident within the public school classrooms, within the rising attendance of community courses, and within the

number of Yurok youth that take pride in learning and speaking their language (McQuillen, Gensaw, Lewis, 2014).

The Yurok language reclamation program is successful. Since 1999 the number of basic grammar Yurok speakers has increased to 600 individuals, the number of speakers with intermediate fluency are estimated to be 300 and the number of conversationally fluent community members and instructors is 35 (Onishi, 2014). The tribe continues to work collaboratively with linguists from University of California at Berkeley to document and record as many first speaker elders as possible. In doing so, this collaboration effort means that the creation and on-going development of a data-rich interactive archive that ensures the Yurok language will never go fully extinct. The linguistic community has also progressed towards accomplishing their goals with the development of the Yurok Language Project and digital archive along, with several publications such as the *Basic Yurok Grammar Handbook* and various scholarly articles. The results of the Yurok tribe's fifteen years of effort described in this case study provide documentation of the step-by-step process of language re-growth and an analysis on each program implemented by the Yurok tribe. It also illustrates the symbiotic relationship between both the Yuroks and linguists from University of California at Berkeley, and how through open channels of communication and how cooperative target objectives can produce positive results in fighting language loss.

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The Racial and Gender Policies of New Spain

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The Spanish obsession with the purity of bloodline emerged before the conquest of the Americas, but its system of measuring one's pureness crossed the Atlantic and laid the foundation for the formation of the caste system within New Spain. With the transplanting of Spanish culture to the Americas, Spain's objective was to build a new empire that directly reflected the religious, political, and social structures of Spain's society. By the seventeenth and eighteenth centuries, Colonial Mexico was a society centered on privileged white males. Women in New Spain dealt with the double effects of their gender and race, and although they sustained defined roles within the domestic, courtly and monastic aspects of colonial society their positions were often devalued or completely silenced. We can say that without a doubt the patriarchal and prejudicial social policies that governed Spanish culture subjected the population of colonial Mexico to a rigid hierarchy of class defined by gender and race, race referring to purity of blood.[2]

The roots of New Spain's social hierarchy, known as the "sistema de casta" or caste system, can be directly traced to the Spanish system known as "limpieza de sangre" or purity of blood. This system was originally implemented to judge Christian ancestry through documentation of bloodlines pure of Jewish or Islamic heritage.[3] We see similarities to this when looking at Spanish intermarriage with indigenous elites or African slaves, developing new defined races. Due to the creation of a multi-ethnic community within colonial Mexico we see the emergence of six cast orders: Europeans, Creoles, Mulattos, Mestizos, Indians, and Blacks.[4] The difference between the sistema de casta of the New World and the limpieza de sangre was

[2] Maria Elena Martinez, " The Black Blood of New Spain: Limpieza de Sangre, Racial Violence, and Gendered Power in Early Colonial Mexico," *The William and Mary Quarterly* 61, no. 3 (Summer 2004), 480
[3] Martinez, 483-87
[4] Ilarione da Bergamo, *Daily Life in Colonial Mexico: The Journey of Friar Ilarione da Bergamo, 1400-1900*, ed. Robert Ryal Miller (University of Oklahoma, 2011)

that instead of worrying about the possibility of Islamic or Jewish descent, the focus was more on the redemption of native and African peoples through religion and blood.[5]

The combination of the Spanish male dominated society, paired with the blatant separation between castes, governed all aspects of their society. Based on an individual's bloodline or gender, they were given specific roles within secular, domestic, or religious affairs. The Europeans sent from Spain took positions within the government and were held as the highest class. The Creoles, second to them, were those born of two pure Spanish parents, one in Europe and one in the New World. These two castes held the most prestigious positions within the government and courtly life in Colonial Mexico. Followed by the Mestizos, meaning mixed in Spanish, who were born of Spanish and Indigenous blood, and were essentially one half Spanish. The natives were near the bottom of the caste system, but were still considered far superior to the blacks. The Europeans saw the indigenous people as potential Catholics to be converted and allowed them to become part of the clergy, while the black were not.

In the writings of Ilarione da Bergamo, an Italian Capuchin Friar sent on a mission to collect alms, we see his awareness of the six-tier caste system, and how racial differences plagued the population. We also see his stance on the topic; his writings have a tone that reflects his acceptance of racial hierarchy. His initial descriptions of colonial life showed that he felt that enforcing the ideals of European societal life onto the indigenous cultures of the New World was a divine right. He comments on the lax moral codes of Mexico and describes scenes of public bathing, vulgar dancing, and sexual displays, derogatorily referring to the lower classes and in some cases even women as sluggards, drunkards, and thieves.[6]

There is evidence that the social hierarchy even played a significant role within one's wardrobe, and in defining the stigma of one's class, was in the style of one's clothing. The Friar describes women of the time to be especially beautiful, and mentions the ones within the higher castes adopted the Spanish style of dress. He continues in saying that the women of the lower castes who could not afford to dress in that style would wear what their social status permitted them. Going into detail he elaborates on how a wealthier woman of Indigenous caste would dress according to what was customary for an Indian woman to wear, but due to her wealth her dress

[5] Martinez, 487
[6] Bergamo, 115

would be more extravagant. Mulatto women would dress according to the custom of their caste, and so on.[7]

Ilarione describes the women of New Spain's character to be greater than of those in Italy, expressing their rhetorical talent. However, he makes it clear that he finds them ambitious and proud.[8] Reflected within his own interpretations of gender roles we see both a strong sense of classification by gender, and the prominence of racial stigmatism within New Spain's own society, specifically in this example among women. He mentions in a passage that the women of creole blood would rather marry someone of European blood, without giving pretense to the man's wealth, as opposed to their racial counterparts --Creole men--despite their wealth. He explains this was because the women of New Spain viewed the creoles as "lovers of Mulattos, for whom they have imbibed bad customs with their milk."[9] This is an interesting perspective because it shows that during the time spanning three centuries of Spanish colonization within Mexico, there grew a strong social and racial classification that governed the framework of society, so important that the purity of one's bloodline surpassed that of the importance of monetary gain.[10]

The Friar's writings pick apart the moral codes of the inhabitants of New Spain right down to their leisure activities and their living standards. He mentions three forms of "fiestas," or parties that were thrown and were specifically tied to castes within the social hierarchy of colonial Mexico. The first, of which he stresses as the most appropriate, was a festival that was held amongst the higher classes and aristocratic society members. During the festival the people indulge themselves in French style dancing. At one of these occasions no scandal would occur, and the atmosphere was pleasant, even in the eyes of a member of the Catholic faith. The second was known as the "Saraos," which was a combination of music, dancing and drinking. The third he describes as the most common among the lower castes and referred to as the "fandango," which by the Friar's description was the most vulgar and inappropriate.[11]

The Friar comments on the sexual promiscuity of the youth of the society, mentioning that many of the people that married were not virgins, that the number of illegitimate progeny was astounding, and that many women married having already given birth to children. He writes

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[7] Bergamo, 91-2
[8] Bergamo, 91
[9] Bergamo, 91
[10] Bergamo, 91-2
[11] Bergamo 116

about the conditions of the streets in New Spain, describing them in detail, mentioning the stench of the refuse that was upswept in the streets. These mixtures of refuse combined with the use of the common allies as a place to relieve ones bladder and bowels openly in public.[12]

When mentioning the details of occupations and amusements within colonial Mexican society he talks about an amphitheater where plays were performed and he mentions that the seating separated boxes for gentlemen and bleachers for commoners. The one thing he does mention that I found intriguing were three things that transcended race or gender, which were food, alcohol and tobacco.[13]

Friar Ilarione da Bergamo sheds light for us on a colonial society from a religious male, and foreigner point of view. Although his writings go into detail about the everyday life within Mexico, we see a limited perspective. His writings give us in depth knowledge on the Catholic religion's patriarchal ways, while he was traveling around enjoying food and drink, soaking up the local culture serving and collecting in the name of god, the women of the church remained cloistered in silence, some uneducated and in a sense married to Jesus.

Sor Juana Ines De la Cruz, on the other hand, was an intellectual women, a class defined Creole, born of natural birth[14] (one of illegitimate progeny that friar Ilarione mentioned) and raised by her mother, she somehow managed break free from gender norms and in an intelligent and cunning way advocate for the rights of women with regards to education in a colonial society. At an early age she moved past he common stereotype of being born out of wedlock and her wit made her an object of affection within courtly life of seventeenth century New Spain.

Women were essentially in that time given three options, to remain silent at home, to remain silent in the court and to remain silent in the church. Sor Juana felt unkindly to the idea of marriage and viewed joining the clergy as a way to have time to increase her scholarly learning. Once within the confines of her monastic path she began writing and expressing her all-be-it humble opinions of the scriptures, her writing is evidence of her knowledge for she makes reference to Greek mythology,[15] and subtle implications of her own life within her poems, and stories. Most men of this time, especially clergy, met Sor Juana with stark opposition. They

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[12] Bergamo, 87-9
[13] Bergamo, 116-23
[14] Bergamo, 116
[15] Ilan Stavans, Introduction, *Sor Juana Ines de la Cruz: Poems, Protest, and a Dream*(New York: Penguin, 1997)

persecuted her and wanted her to stop dealing within the secular affairs of colonial life, and to instead remain completely devoted to the faith, cloistered and silent.

One of the most outrageous displays of persecution was when she was sent a letter penned under the name Sor Fioleta de la Cruz, which was in actuality written by Fernandez de Santa Cruz. By writing a reprimanding letter, he was attacking Sor Juana at her most fragile part, her gender, the implications that she had stepped out of her gender bounds into a man's world was the most potent form of persecution. In her humble response she calls upon examples of biblical women such as the Queen of Sheba, Deborah, the mother of Samuel named Ann, Abigail, and Rahab.[16] Pointing a finger in the faces of the patriarchal society, she argued that women held major places amongst their communities, and even dealt with secular affairs, administering law, and making military decisions. She references her domestic studies within the kitchen, and her knowledge of how when an egg yolk is separated from the white and mixed with sugar it creates completely different consistency than if they were together. This shows that even as a woman whose goal was to become a scholar she had information of a woman's domestic chores.[17]

But perhaps my most favorite argument she makes and the one that holds the most weight with regards to the roles of women within the church, and the education of women, is when she talks about the Apostle Paul's writings on the education of women.

She laments on how the land she lived in would have been different if only the older women had been allowed to learn. Mentioning about how grammarians of her time applied the four basic rules of logic to interpret the meanings of scriptures verse-by-verse "let the women keep silent in the church," or the verse "let the women learn in silence." The translation of the latter acted in favor of women with regards to education, because it essentially was commanding that women learn, although in silence, it still encourages the education of women. She also brought into question the idea of the censoring of women who study and write in private, especially since it was publically known through interpreted scripture that women were not to publically preach.[18]

To me one of the strongest gender arguments she used was with the description of Christ. She mentioned how the Pharisees saw his good deeds of healing the blind and raising the dead

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[16] de la cruz, 45
[17] de la Cruz, 45
[18] de la Cruz, 59

and yet even though all his workings were things that everyone else loved him for, they were the very things they hated him for. So they publically humiliated him, gave him a purple robe and a crown of thorns, and crucified him. In a sense she could almost be referencing her plights towards education and her writings as comparative to that of the good deeds of Jesus, and that her persecution was being met by the "Pharisees" or rather male members of the catholic faith because they did not like the idea of being challenged by a woman.[19] Although after the response to the letter of Sor Fioleta de la Cruz, we see her reform herself and pass quietly to the end of her life; her plight to this day has won her the label as one of the first feminists.

Both primary sources provide differing perspectives on the gender and race policies that governed and were supported by the cloth and crown of New Spain. Both the Friar and Sor Juana's writings show the racial stigma that came along with the Spanish modeled sistema de casta, and the persecution of gender especially regarding women who challenged society. The influence of Spanish religious, political and social structures becomes transparent within the patriarchal and prejudicial ways that the New World was developing.

[19] de la Cruz, 31

Geographic variation in nuclear gene Abfi14 in the California red fir-noble fir species complex

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Abstract

The close evolutionary relationship between the California red fir (*Abies magnifica*) and noble fir (*A. procera*) has been identified by specific hybridization studies, their clinal variation in morphology, and their relative geographical location. The distribution and evolutionary history of these closely related species have intertwined for the centuries, causing a classification debate. In order to enlighten the classification discussion of the California red fir-noble fir species complex, a genetic investigation was prompted by the nuclear gene Abfi14. There are varying base pair lengths of the Abfi14 gene that correspond to different alleles within genotypes which can serve as an excellent marker for hybridization in the northern California and southern Oregon region because of the allele frequency differences between *A. magnifica* and *A. procera*. Allele lengths (base pairs) were measured by gel electrophoresis in order to determine the extent of introgression and geographic location of individuals within the species complex. Overall, the geographic allelic distribution of the species complex showed monomorphism of short allele lengths (146-195 bp) in the central Sierra Nevada region, polymorphism of short and long allele lengths (bp) within the hypothesized range of hybridization, and monomorphism of long allele lengths (196-245 bp) in the northern Oregon region with the exception of one sample of 146-170 bp; no geographic barrier of gene flow was identified.

Introduction

California red fir (*Abies magnifica*) and noble fir (*A. procera*) are closely related coniferous species, whose distribution, evolutionary history, and classification have long been debated (Mathiasen and Daugherty 2008). The close evolutionary relationship between these two species has been identified by their proximal geographical location (Parker 1963), clinal variation in morphology (Zavarin, et al. 1978), and hybridization studies (Silen et al. 1965;

Critchfield 1988; Oline 2008). Since the late 1800s, taxonomic classification has been debated because of geographic location, morphological similarities, and variation in molecular data within the *A. magnifica-A. procera* species complex. Furthermore, an examination of the research related to the classification of red fir-noble fir complex in northern California and southern Oregon demonstrates that much confusion about the distribution and variation of these true firs has existed and still exists today (Mathiasen and Daugherty 2008).

The variable descriptions of trees in the northern California and the southern Oregon region have been fueled by differing hypotheses of range demarcation between *A. magnifica* and *A. procera*. Based on morphology, Parker (1963) showed *A. procera* located as far south as 41˚ N in the Klamath Mountains of northwest California, whereas Zavarin et al. (1978) suggested that chemical analyses of limonene concentrations segregated red firs and noble firs into three zones: noble fir above latitude 44° N, introgression populations between California red fir and noble fir from latitude 40° to 44° N, and California red fir populations south of latitude 40° N. However, many botanists ascertain that there are both populations of *A. magnifica* and *A. procera* in the northern California and southern Oregon area, without any interbreeding or introgression (Mathiasen and Daugherty 2008). In contrast, The Oregon Flora Project does not document the presence of *A. magnifica* in southern Oregon at all, but recognizes and classifies trees with intermediate characteristics as *Abies procera x A. magnifica* (Oline 2008). Furthermore, Michael Kaufmann's (2013) range map of *A. procera*, *A. magnifica*, and *A. procera x A. magnifica*, shows *A. magnifica* south of the Cascade Mountains, hybridization of *A. procera* and *A. magnifica* in the Cascade Mountains and east Klamath-Siskiyou mountains, and *A. procera* north of the Cascade Mountains and in the west Klamath-Siskiyou mountains. Finally, Griffin and Critchfield (1976) maintain that a geographic barrier exists between the west and east Siskiyou mountains, with *A. procera* towards the west and *A. magnifica* towards the east.

Although *A. magnifica* in the central Sierra Nevada, California distinctly differ from *A. procera* in the Cascades of northern Oregon and Washington, there is a wide area in the Klamath-Siskiyou region in northern California and the Cascades in southern Oregon where these true firs have intermediate characteristics (Parker 1963; Oline 2008). Characteristics of the bark, needles, and bracts of the female cones are the primary morphological identifiers to distinguish red fir from noble fir (Mathiasen and Daugherty 2008). The bark of noble fir has

narrow vertical ridges, is grey to light brown, and is much thinner and softer than red fir bark; the bark of red fir has deep furrows with rounded ridges and is dark to reddish brown. Furthermore, noble fir needles are grooved on their upper surface, while red fir needles are not grooved, but are more quadrate. The typical form of the noble fir cone is shown with exserted bracts which extend outside of the cone scales to almost sheath the entire cone; red fir cones have no visible cone bracts since they are completely hidden inside the cone scales (Mathiasen and Daugherty 2008).

Considering both species, there is clinal variation of bark and needle characteristics in southern Oregon and northern California, and a much more complicated morphological distribution of cone bracts within the red fir-noble fir species complex (Oline 2008). Bark and needle characteristics seem to change, from exhibiting features of red fir to those of noble fir, very gradually as you move from south to north in this region, making a demarcation between the species very unclear. Furthermore, there are exserted cone bracts in the southern Sierra Nevada, completely hidden bracts in the central Sierra Nevada, and a gradual clinal increase in bract length in northern California and southern Oregon until cones are fully sheathed by bracts in central Oregon (Oline 2008). As described above, Zavarin et al. (1978) examined the monoterpene composition within the two species and found that chemical analysis showed clinal variation in the Mount Shasta region, whereas the southern Sierran trees were chemically more similar to nearby trees in the central Sierra Nevada than to either *A. magnifica* in northern California or *A. procera* in Oregon.

Complicating the picture of morphology is Oline's (2008) genetic data for trees with intermediate characteristics. Tree populations with the intermediate bract length, extending only to partially cover the cone scales, such as those in southern Sierra Nevada, and the northern California and the southern Oregon region, have been described as *Abies magnifica* var. *shastensis*. In *Abies magnifica* var. *magnifica* the bracts are not visible, while in *A. procera* they extend to cover the scales and fully sheath the cone (Oline 2008).

Furthermore, molecular data has provided some insight into the relationship and history of the *A. magnifica-A. procera* species complex. A molecular investigation by Oline (2008) was prompted by the existence of two divergent sequences of the highly conserved *rbcL* gene reported for *A. magnifica*. *rbcL* is a haploid chloroplast gene, which is inherited paternally in A. magnifica and A. procera. In the red fir-noble fir species complex, there are two different alleles of the *rbcL*

gene that have been observed. The two types are called the M-type and the P-type, and are specifically defined by different DNA sequences. Populations of pure noble fir in Washington and southern Oregon have exclusively the P-type allele, whereas populations of true red fir from central California have only the M-type allele. Since the *rbcL* gene is haploid, an individual tree can only have a genotype of M or P. Oline's (2008) investigation showed that the two different haplotypes have a straightforward pattern of distribution throughout the species complex, with monomorphism of the M haplotype in the Sierra Nevada and the Klamath–Siskiyous and polymorphism in the Cascades (fig. 1). Furthermore, since this region of polymorphism in northern California and southern Oregon is also the region of clinal morphological variation, especially in bark, cone, and needle characteristics, hybridization between *A. procera* and *A. magnifica* in the area is supported (Oline 2008).

With such varying morphological data and taxonomic confusion, we attempt to provide insight to the classification debate within the *A. magnifica-A. procera* species complex with further genetic analysis. This genetic investigation was prompted by the nuclear gene Abfi14, which is a known spot in the *Abies* genome with considerable variability, and is not a gene that codes for any protein (Saito et al. 2005). There are varying base pair lengths of the Abfi14 gene that correspond to different alleles within genotypes. This can serve as an excellent marker for hybridization in the northern California and southern Oregon region because of the allele frequency differences between *A. magnifica* and *A. procera* (Saito et al. 2005). The goals of this investigation are to *(i)* test for introgression and hybridization of *A. magnifica* and *A. procera* in northern California and southern Oregon which would result in populations with genetic contribution from both species, and *(ii)* determine whether there is a geographic barrier separating breeds of *A. procera* from hybrids-as hypothesized by Kauffmann's (2013) and Griffin's et al. (1976) range maps-between the trees in the west and east Siskiyou Mountains, resulting in the west and east Siskiyous being significantly different with different allele size (bp) frequencies, and in the west Siskiyou trees being significantly similar to pure *A. procera* lines.

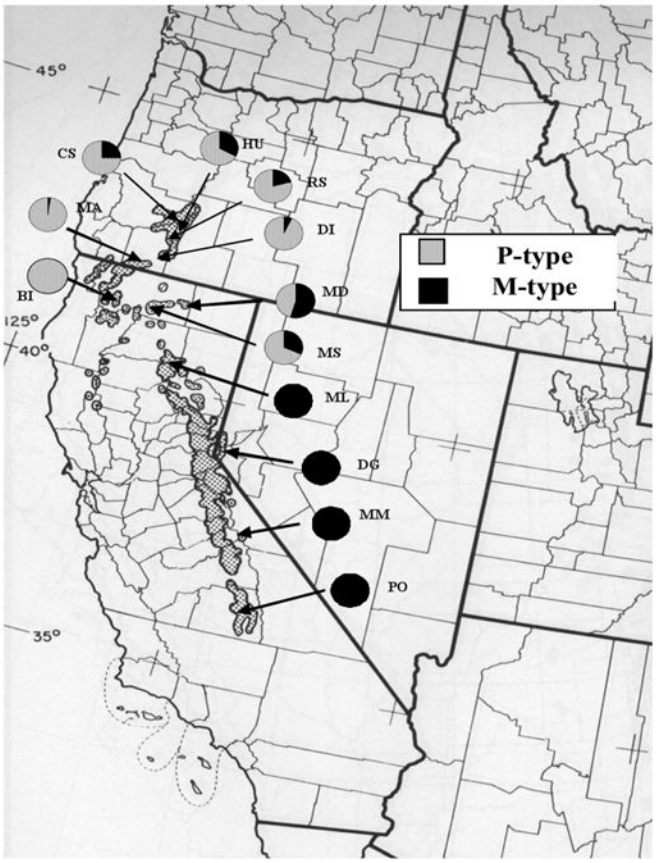

Figure 1. Summary map of existing data on the distribution of the M and P alleles across the range of red fir. Each circle is a pie chart showing the frequencies of the P and M alleles at that site (Oline 2008).

Methods

Most needle samples were collected during 2013 from locations of hypothesized red fir-noble fir overlap in the northern California and southern Oregon region (table 1; fig. 2). The *A. procera* needle samples were taken from northern Oregon above latitude 44˚, beyond the maximum hypothesized range of red fir-noble fir overlap. The *A. magnifica* samples were taken from central California below latitude 39˚and the minimum hypothesized range of red fir-noble fir overlap. In the southern Oregon and northern California region, bark, needle, and cone characteristics were used as identification for which needles to sample. At specific populations, trees were selected approximately 15 meters apart. DNA from needle samples was used to determine the allele size (bp) frequencies of the Abfi14 gene of sample populations. DNA

extraction and purification of fresh needle samples was done with the DNeasy Plant Mini Kit (Qiagen Inc., Valencia, California) according to the manufacturer's instructions.

PCR for the Abfi14 gene locus was performed using the Abfi14F (5'-ACATCAACCACTTCATGTTGC-3') and Abfi14R (5'-ATCTCACAATACCCCAAAAGG-3') primers of Saito et al. (2005) under similar conditions. For the PCR reaction, 1X of Buffer, 2.5 mM of MgCl2, 0.1 mM of dNTPs, 0.5 µM of primer Abfi14F, 0.5 µM of primer Abfi14R, and 1.5 Units per 30 µl reaction for a total reaction volume of 30 µl. The thermal cycling conditions were ran for 2 minutes at 94˚C, 30 seconds at 94˚C, 1 minute at 57˚C, 1 minute at 72˚C, repeated for a total of 35 cycles. After the 35 cycles were completed, the PCR reactions were held for 5 minutes at 72˚C, then indefinitely at 4˚C.

The real PCR products and molecular weight size standards were loaded into a gel electrophoresis with 1.7% solution of agarose in the gel. At a power supply of ~130 volts, the gel was allowed to run for ~25 minutes. A UV transilluminator was used to fluoresce the DNA segments and take a picture. Calibration was performed using the molecular weight size standards by fitting a curve to the migration distance (mm) versus LOG band size (bp) of the size standards. The band sizes (bp) of our alleles of interest were determined by measuring the distance of each band travelled and plugging that value into eq. 1:

10 ^ ((migration distance – y-intercept)/slope) (1)

Once allele sizes (bp) were determined for all of the samples, frequencies for each allele size range (bp) for every sampling site was calculated (table 1, fig. 3). Population frequencies were statistically analyzed using the $\chi 2$ test to discover whether there is any significant difference in allelic frequencies between populations as defined in table 2. The $\chi 2$ test was used to compare the populations of northern California and southern Oregon with each other and with the true populations of *A. procera* and *A. magnifica* in order to determine whether hybridization and/or a geographic barrier between the east and west Siskiyou Mountains have occurred. Putative hybrid populations (DI, CO, MA, SS, and BG) were compared to each parental species to quantify their genetic contributions; specific regional populations were tested against neighboring sample sites to determine the extent of gene flow and the hybrid zone between the species (table 1, fig. 2, table 2).

In order to test whether the west Siskiyous (BG) are separated from the east Siskiyous (MA and SS)by a geographic barrier and that pure noble fir grows in the west Siskiyous, the similarity of

the west Siskiyous to the Mary's Peak, Oregon (MP) site and to the east Siskiyous were analyzed (table 1, fig. 2, table 2).

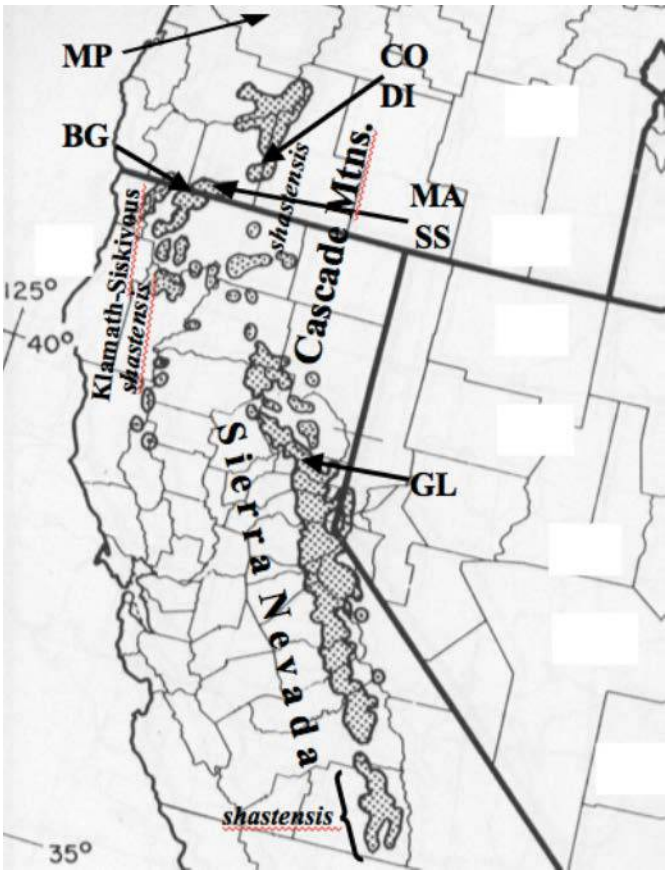

Figure 2. Map of sampling sites during 2013. Fresh needles were obtained from each sampling populations in a grid-like system with approximately 15 meters between trees that were sampled.

Results

Table 1. Sampling sites and locations, sample sizes, and observed numbers within the allele size ranges (bp).

				Genotype			
				Allele size range (bp)			
Site	Latitude (°N)	Longitude (° W)	*n*	146-170	171-195	196-220	221-245
Northern Oregon region							
Mary's Peak, Oregon (MP)	44.113	123.581	15	1	0	7	7
West Siskiyous region							
Bigelow Lakes, Oregon (BG)	41.699	123.4	12	1	3	4	4
Cascades region							
Dead Indian, Oregon (DI)	42.226	122.326	26	7	13	1	5
County Line, Oregon (CO)	42.286	122.286	32	10	6	12	4
East Siskiyous region							
Mt. Ashland, Oregon (MA)	42.059	122.693	28	12	5	8	3
South Side Mt. Ashland, Oregon (SS)	42.06	122.719	28	16	3	5	4
Sierra Nevada region							
Gold Lake, California (GL)	39.675	120.643	12	10	2	0	0

Note: A list of collection sites with their location, abbreviation, coordinates, sample size, and observed numbers of the four allele size ranges (bp) for Abfi14 gene. Sites are grouped into northern Oregon, west Siskiyous, Cascades, east Siskiyous, and Sierra Nevada regions, and two letter codes in parentheses are used to indicate sites in table 2, Fig. 2 and Fig. 3. Allele size ranges were chosen to show the considerable variability of the Abfi14 gene.

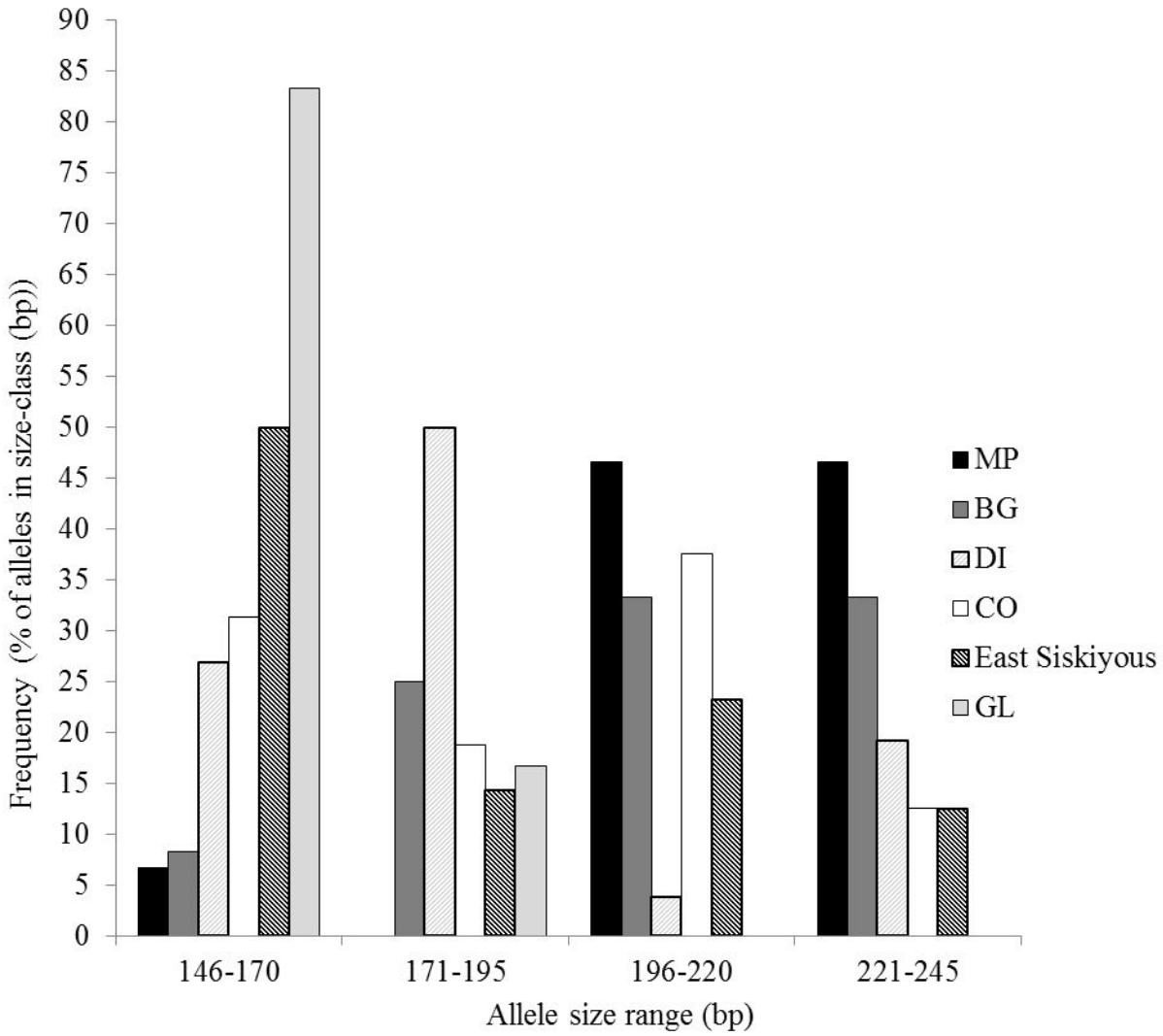

Figure 3. Frequency histogram of Abfi14 alleles in size-classes (bp) for each sampling site. See table 2 for meanings of sample site abbreviations.

Table 2. Summary of χ2 test results of sample populations. Presented are the compared populations, total χ2 value, degrees of freedom, critical value, and meaning or significance of each result. Results presented with 95% confidence interval. See table 1 for meanings of sample site abbreviations.

Sites	χ^2 Sum	Degrees of Freedom	Critical Value	Significance
Cascades region				
DI, CO	12.0353	3	7.82	Different
Cascades and Sierra Nevada regions				
DI, GL	10.9201	3	7.82	Different
CO, GL	11.2292	3	7.82	Different
Cascades and northern Oregon regions				
DI, MP	20.8855	3	7.82	Different
CO, MP	10.7558	3	7.82	Different
East Siskiyous region				
MA, SS	1.91	3	7.82	Similar
East Siskiyous and Sierra Nevada regions				
MA, SS, GL	13.3349	6	12.59	Different
East Siskiyous and northern Oregon regions				
MA, SS, MP	20.0676	6	12.59	Different

Table 2, continued

West Siskiyous and east Siskiyous regions				
BG, MA, SS	9.6453	6	12.59	Similar
West Siskiyous and Sierra Nevada regions				
BG, GL	15.5636	3	7.82	Different
West Siskiyous and northern Oregon regions				
BG, MP	4.3568	3	7.82	Similar

There is a pattern of geographical differentiation in the distribution of Abfi14 alleles (table 1; fig. 3). As shown in table 1 and figure 3, the allele lengths (bp) of the Abfi14 gene at Gold Lake, California, representing pure *A. magnifica*, is primarily of short length (146-195 bp). In comparison, the allele lengths at Mary's Peak, Oregon, representing true *A. procera*, are mostly of longer lengths (196-245 bp), with the exception of one sample of 146-170 bp. The populations in the southern Oregon and the northern California region (DI, CO, BG, MA, and SS) were polymorphic being genotyped with both short (146-195 bp) and long (196-245 bp) alleles (table 1). The east Siskiyou region (MA and SS) and the Dead Indian, Oregon site had a higher frequency of short alleles (64.2% and 76.9%, respectively) than long alleles, whereas County Line, Oregon had an equal frequency of short and long alleles and the west Siskiyou region had a higher frequency of long alleles (66.6%) than short alleles (fig. 3). Furthermore, fig. 3 shows a bimodal trend, with *A. magnifica* (GL) peaking at the shorter lengths (146-195 bp) and *A. procera* peaking at the longer lengths (196-220 bp). The overall pattern of the long and short alleles of sampling sites from the northern California and southern Oregon region is of intermediate frequency of *A. procera* and *A. magnifica* (fig. 3).

Statistical analysis using the $\chi 2$ test shows that much variation exists in the southern Oregon and northern California region, represented by the significantly different populations in the area (table 2). Furthermore, when comparing the two sites within the Cascades region (DI and CO), they are significantly different from each other (table 2). Notably, the east Siskiyou region (MA and SS), east and west Siskiyou regions (MA, SS, and BG), and west Siskiyou and northern Oregon regions (BG and MP) are statistically similar (table 2). Excluding the statistical similarity between west Siskiyou and *A. procera* (BG and MP), all other populations within the southern Oregon and northern California region are significantly different from the true *A. procera* and *A. magnifica* populations (table 2).

Discussion

One objective of this study was to investigate whether introgression and hybridization between *A. magnifica* and *A. procera* have occurred in northern California and southern Oregon. The varying base pair lengths of alleles for the nuclear gene Abfi14 correspond to the considerable variability of genotypes for the *A. magnifica-A. procera* species complex found in this region (Saito et al. 2005). Overall, the geographic distribution of Abfi14 allele lengths from table 1 and fig. 3 shows monomorphism of short allele lengths (146-195 bp) in the central Sierra Nevada region, polymorphism of short and long allele lengths (bp) within the hypothesized range of hybridization, and monomorphism of long allele lengths (196-245 bp) in the northern Oregon region with the exception of one sample of 146-170 bp. Furthermore, excluding the statistical similarity between the west Siskiyou Mountains and *A. procera*, populations within the hypothesized range of hybridization are significantly different from both *A. magnifica* and *A. procera*. The statistical differences represent genetic contribution from both species because the samples are not more similar to one species than the other (table 2). As this region of polymorphism in southern Oregon and northern California is also the region of clinal morphological variation, especially in cone bract length, and bark and needle characteristics (Oline 2008), this supports a broad zone of introgression and hybridization between *A. magnifica* and *A. procera* in the region (table 1, fig. 3).

Furthermore, in considering the degree and pattern of polymorphism of these populations (table 1, fig. 3), there does not appear to be a cryptic geographic pattern as hypothesized by Kauffmann's (2013) and Griffin's et al. (1976) range maps. Although the west Siskiyou

Mountains are statistically similar to *A. procera*, they are not statistically different from the east Siskiyou Mountains, which is not consistent with the hypotheses of Kauffmann's (2013) and Griffin's et al. (1976) range maps (table 2). However, statistical analysis shows that much variation exists in the southern Oregon and the northern California region as represented by the significantly different populations in the region (table 2). In addition, there is a change in allele frequencies of the Abfi14 gene from west to east, with a greater frequency of long alleles (bp) in the west and short alleles (bp) in the east (fig. 3). Finally, there was an identification of a short allele in the hypothesized true Noble fir population, representing a larger hybridization zone than originally hypothesized (table 1).

The pattern of polymorphism within the northern California and southern Oregon populations is consistent with Zavarin's et al. (1978) and The Oregon Floral Project's (Oline 2008) range maps of the geographical distribution of the *A. magnifica-A. procera* species complex. Zavarin et al. (1978) suggested that chemical analyses of limonene/monoterpene concentrations showed introgression populations and clinal variation in the southern Oregon and the northern California region, which is similar to the data of allele frequencies showing genetic contribution from both *A. procera* and *A. magnifica* (table 1, fig. 3). Furthermore, The Oregon Floral Project (Oline 2008) does not even recognize the presence of *A. magnifica* in southern Oregon and northern California, a parallel observation of our genetic data (table 1, fig. 3). However, our data is only partially consistent with Oline's (2008) molecular data for the haploid *rbcL* gene. Oline's (2008) investigation showed monomorphism of the M haplotype in the Sierra Nevada and the Klamath-Siskiyous and polymorphism of the M and P haplotypes in the Cascades (fig. 1), whereas this investigation showed polymorphism of long and short alleles for the Abfi14 gene in both the Klamath-Siskiyous and the Cascades (table 1, fig. 3). This could be the result of some genes of the *A. magnifica-A. procera* species complex hybridizing in the Klamath-Siskiyous, while others do not. Finally, our results are inconsistent with the hypothesis that A. procera extends as far south as latitude 41˚ N in the Klamath Mountains as predicted by Parker (1963); the allele frequencies show introgression between *A. magnifica* and *A. procera* in the Klamath-Siskiyou mountains above 41˚N (fig. 3).

Furthermore, there are several interesting questions raised by these data. Considering the short and long allele frequencies of the Abfi14 gene, there is a higher frequency of short alleles (bp) among the east Siskiyou Mountains and the Dead Indian, Oregon site, while the County Line,

Oregon site had an equal frequency of long and short alleles, and the west Siskiyou region had a higher frequency of long alleles (bp) than short alleles (bp) (table 1, fig. 3). Thus, there is a pattern of changing allele frequencies from west to east, with a higher frequency of long alleles (bp) in the west and short alleles (bp) in the east (table 1, fig. 3). Though our sampling sites were small and the resolution of the gel electrophoresis procedure was not very high, this raises the possibility that populations in this region, with great historical, geographical, and climate complexity, have different fitness levels based on the genetic contribution of *A. magnifica* and *A. procera*. Therefore, it is possible that individuals in the west Siskiyou region have higher fitness levels when there is greater genetic contribution from *A. procera*, as represented by allele frequencies and the statistical similarity between the west Siskiyou Mountains and *A. procera* (table 1, table 2). Furthermore, while individuals in the east Siskiyou Mountains and the Dead Indian, Oregon site may have higher fitness with a greater genetic contribution from *A. magnifica*, as represented by the higher frequencies of short allele lengths (bp) (table 1, fig. 3). Further studies could compare the geographic and climate history of *A. magnifica* and *A. procera* to determine whether there is a relationship between the species' history and the frequencies of allele lengths (bp) of the Abfi14 gene found in the northern California and southern Oregon hybrid zone.

Also, the chance identification of a sample of short allele length (146-170 bp) from the northern Oregon region may indicate that the zone of introgression may be broader than hypothesized, suggesting that these two species cannot be studied independently and that a broad survey of both *A. magnifica* and *A. procera* may be needed to understand the intricacy of the species complex. This is similar to Oline's (2008) identification of the M haplotype in a single *A. procera* far north of the hypothesized zone of hybridization in southwestern Washington. This presents convincing evidence that introgression has allowed genes from *A. magnifica* to penetrate widely throughout *A. procera*, suggesting that hybridization is widespread and has a long history of occurrence. However, the geographical sampling for this experiment was narrow from north to south and east to west. To alleviate this problem, greater samples further north and south, in addition to larger sample sizes and multiple sampling sites in the southern Oregon and the northern California region, could improve the molecular picture of hybridization of the *A. magnifica-A. procera* species complex by allowing for the measurement of a north to south, east to west transect.

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