

The History of Social Perceptions of *Eucalyptus Globulus* in the East San Francisco Bay Area

Patrick R. Hennessy

ABSTRACT

The presence of *Eucalyptus globulus* in the East San Francisco Bay Area has adversely affected the East Bay's native environment and has increased the region's fire hazard potential. Though residents' perceptions of eucalyptus trees differ based on what type of stakeholder that person is, these perceptions have been the driving force of action and policy in the history of the trees in this region. In this study, I identified and analyzed historical and contemporary perceptions of East Bay residents of eucalyptus trees. While eucalyptus' earliest days in the East Bay were met by nearly unchallenged positivity and excitement, residents grew more anxious about the trees' presence in the 20th century. Most current residents sampled felt that eucalyptus trees are a fire hazard to the East Bay, and that they played a large role in the 1991 Oakland-Berkeley fire. Respondents had varying opinions on the tree's aesthetic value and potential use as a resource, but there was a general consensus that eucalyptus trees will be a part of the East Bay landscape indefinitely. Land management policy that is understood and shaped by the people it is affecting enhances its effectiveness and level of embracement from that community. Thus, East Bay residents and land managers must continue to be aware of the species' presence in the region, and adopt land management policies that are cognizant of the trees' continued existence.

KEYWORDS

1991 Oakland-Berkeley Fire, social construction of nature, invasive species, land management policy, urban fire hazards

INTRODUCTION

Since European settlers came to East San Francisco Bay Area (East Bay) invasive plant species like eucalyptus trees have had profound, lasting impacts on the region. Although there are over 700 species in the eucalyptus genus, the Tasmanian Blue Gum (*Eucalyptus globulus*) is the most widespread of all eucalyptus species in the East Bay (Paine and Hanlin 2010). Following Anglo settlement starting in the late 18th century, expansive grasslands dotted with native oaks and California bay trees were replaced by European grasses, and affluent landowners began to transform the landscape by planting non-native pines, cypress and eucalyptus (Nowak 1993). Eucalyptus was first brought to California 1853, for use as ornamental trees (Groenendaal 1983). By 1880, *E. globulus* was planted for lumber, firewood, medicinal products, tannin, oil, windbreaks, and as street and park trees (Groenendaal 1983). When the local timber and forestry economy evolved, fewer eucalyptus trees were harvested, leaving this invasive species to grow at will (Ritter and Yost 2009). *E. globulus* has become an indelible presence in the region's landscape, requiring East Bay residents to cope with management problems associated with *E. globulus* like its toxicity to native plants, heavy water intake and high flammability.

E. globulus has had many adverse affects on the East Bay's environment, including the suppression of native vegetation and increasing the region's fire hazard potential. Eucalyptus trees have a large amount of leaf litter that contains flammable oils (Blackburn and Petr 1979). Native vegetation growth amidst eucalyptus trees is very low, as the extensive ground cover of the eucalyptus' leaf litter blocks sunlight and overwhelms seedlings (Ritter and Yost 2009). Additionally, eucalyptus trees release toxins to the surrounding soil that are poisonous to other plants, further inhibiting native plants' ability to live near eucalyptus groves (Russell and McBride 2003, Ritter and Yost 2009). Because eucalyptus trees are usually the only kind of vegetation that is not affected by the released toxins, eucalyptus trees are often found clumped together in groves (Ritter and Yost 2009). As eucalyptus groves grow, the amount of water they take in and the rate at which the water table drops increases, preventing native species from tapping into the water table's resources (Rodríguez-Suárez et al. 2011). As a result of the

increased danger *E. globulus* poses to the East Bay, local land management policy must recognize *E. globulus*' presence for it to be as thorough and effective as possible.

Due to its negative effects on native vegetation and heavy threat of fire to the urban profile of the East Bay, effective land management policies must address the prevalence of *E. globulus* to ensure the safety of the environment and human life and property. Land management strategies that regulate the vegetative cover and use of local lands often look to either control, contain or eradicate invasive species (Zavaleta et al. 2001). One type of mitigation technique is prescribed burning, where land managers use controlled burns to reduce fuel loads and to maintain ecological harmony in an ecosystem accustomed to fire (Stephens and Ruth 2005). Prescribed burnings of eucalyptus forests in their native Australia significantly reduced the incidence and extent of unplanned fires, and lessened the available fuel source if fires were to occur (Boer et al. 2009). However, since the eucalyptus groves are located within the urban San Francisco Bay Area, if burning techniques are used they must be highly restricted and must minimize air pollution (Agee et al. 1973). Different kinds of urban tree removal are practiced throughout the world, and a study conducted in Australia found that requests for urban tree removal peaked after incidences of fires (Gilbert and Brack 2007). Removal of eucalyptus trees in the Bay Area does occur, and it may be an effective means of ecological restoration (Laćan et al. 2010). One such method is goat grazing, but this is possible only in small areas because it is extremely expensive (Svihra 1992). In short, even if residents decide removing eucalyptus trees is in their best interest, there are no "easy" means of removing them in the East Bay.

Residents' perceptions of eucalyptus trees differ based on what type of "stakeholder" that person is in the community. However, those perceptions are apt to change as a result of social trends, changes in occupation or important events in time (Zavaleta et al. 2011). Many studies have shown that invasive species have complex and profound impacts on their new homes, and these impacts lead to many different viewpoints from different types of stakeholders (García-Llorente et al. 2008, Zavaleta et al. 2011). For example, a study conducted in South Africa found many residents were concerned with the large water intake of eucalyptus trees that decreased natural stream flow (Forsyth 2004). Still, the same study found that many local beekeepers were

concerned about cutting down eucalyptus trees if it meant losing an important pollen source (Forsyth 2004). Changes in perceptions and opinion may occur rapidly due to significant events, like the 1991 Oakland-Berkeley fire, which killed 25 people, destroyed 1,500 acres of land and was exacerbated by the presence of eucalyptus trees in the Oakland and Berkeley hills (Pagni 1991, Svihra 1992). But while studies on residents' perceptions of eucalyptus trees have been conducted before in South Africa and Portugal, no such studies have documented historical and contemporary perceptions of eucalyptus trees in the East Bay.

Because *E. globulus* plays such a prominent role in the East Bay's landscape and present complex land management challenges, it is important to know what people think of the trees in their neighborhoods. I expected to find a downward trend in appreciation and affinity for eucalyptus trees over time, having evolved from enthusiasm, to skepticism, and finally to concern about *E. globulus*' continued presence. I expected current East Bay residents to have a strong understanding of basic factual knowledge of eucalyptus trees, including the fact that they are not native to this region. However, I expected to find a wider range in perceptions on more potentially controversial questions, including thoughts on aesthetics, use as a resource, and the future of *E. globulus* in the region.

METHODS

To better understand contemporary East Bay residents' perceptions of eucalyptus trees, I formulated a simple survey instrument and distributed it online. My survey had three sections: basic demographics, questions on factual knowledge of eucalyptus trees, and questions on the opinions and perceptions held by respondents. In my first section, I asked participants a range of multiple-choice demographic questions, including questions on their ethnicity, age, annual income, and educational background, among others. My second section, on basic factual knowledge of the trees, asked True/False questions including whether eucalyptus trees were native to the East Bay, how long people thought the trees had been in the East Bay, and basic physical and ecological traits of the trees. Survey participants were given the opportunity to respond with "Unsure/Don't Know", in

addition to simply “True” or “False”. In the third section, focused on more opinionated questions, I used Likert scales to examine respondents’ perceptions of eucalyptus trees’ associative fire hazards, aesthetic values, use as a resource and finally on the perceived future of eucalyptus in the Bay Area. Respondents were given a range of five possible responses, from “Completely Disagree” at one end, “Completely Agree” at the other, and “Neutral” in the middle. I sent my survey via email to 325 people, and received responses from 122 people.

After receiving responses from a large enough cohort, I analyzing my data using basic coding schemes. For example, I transformed responses to opinionated Likert scale questions from ordinal data to categorical data following similar studies, so I could use basic mathematics to analyze responses (Bardsley and Edwards-Jones 2007; García-Llorente et al. 2008). For example, a response of “Completely Disagree” was given a score of “1”, whereas a response of “Completely Agree” was given a score of “5”. “Neutral” was given a score of “3”, and so on. After transforming this data, I used R, a statistical software program, to find the average score of any given question, which I could then interpret as an overall trend. For example, an overall average of 3.54 was interpreted as “Agree”. I also used R to generate histograms of responses for opinionated and demographic questions, so I could visualize and present the range of responses better.

RESULTS

Demographics

Respondents tended to be older and Caucasian, with a high level of income, a high educational background, and many years spent living in the East Bay (Table 1). Additionally, 35% of my respondents had lived in the East Bay for over 40 years, while 20% had lived in the East Bay for 31-40 years, 20% had lived in the East Bay for 21-40 years, and the remaining 25% had lived in the East Bay for 20 years or less. This meant that 75% of my survey respondents were living in the East Bay when the 1991 Oakland-Berkeley fire occurred.

Table 1. Demographics of survey respondents.

Age		Education	
18-35 years old	22%	Some College or Less	5%
36-50 years old	6.5%	Associate's Degree	2.5%
51-65 years old	33%	Bachelor's Degree	33%
66-80 years old	43%	Master's Degree	45%
80+ years old	5%	Ph.D. or Professional Degree	14.5%
Annual Income		Ethnicity	
Less than \$25,000	11.5%	Caucasian/White	88%
\$25,000-\$50,000	20.5%	Asian	7.5%
\$50,000-\$100,000	41%	American Indian	1.5%
\$100,000-\$150,000	17%	African American	1.5%
\$150,000+	10%	Hispanic	1.5%

Basic Factual Knowledge

I found my respondents had a strong understanding of basic factual knowledge on eucalyptus trees. For example, 98% of my respondents correctly identified eucalyptus trees as an invasive species, and 91% correctly identified eucalyptus trees as native to Australia. Similarly, 83% had heard of recent attempts to remove eucalyptus trees from East Bay land, and 79% believed that eucalyptus trees have been in the East Bay for at least 100 years. However, there was not consensus over how many types of eucalyptus species there are in California, with 49% of my respondents selecting “Unsure/Don’t Know” to that question.

I found there was a greater range in understanding among my respondents on questions concerning the ecological impacts of eucalyptus trees and their associative fire hazards. The majority of my respondents knew that eucalyptus trees have high levels of leaf litter, flammable oils, the capability of inhibiting native vegetative growth, and an easy time adjusting to the East Bay climate (Table 2). However, I found there were fewer people who knew that eucalyptus trees have poisonous toxins and a high water intake relative to native vegetation (Table 2).

Table 2. Ecological effects and associative fire hazards.

Question	True	False	Unsure/Don't Know
<i>Do eucalyptus trees have high leaf litter relative to native vegetation?</i>	92%	4%	4%
<i>Do eucalyptus trees have flammable oils in them?</i>	88%	0%	12%
<i>Do eucalyptus trees have a hard time adjusting to the East Bay climate?</i>	87%	9%	4%
<i>Do eucalyptus trees release toxins poisonous to native vegetation?</i>	51%	10%	39%
<i>Do eucalyptus trees suppress the growth of other plants by blocking out sunlight?</i>	80%	5%	15%
<i>Do eucalyptus trees have a high water intake relative to native vegetation?</i>	34%	10%	56%

Opinions and Perceptions

Most respondents felt that on the whole, eucalyptus trees are a fire hazard to the East Bay, and that they played a large role in the 1991 Oakland-Berkeley fire. Respondents agreed that eucalyptus trees were an increased fire hazard to the East Bay, but there was a wider range in responses when asked if eucalyptus trees were a fire hazard to their primary residence (Figure 1). Many believed that eucalyptus trees do pose a greater fire hazard than other types of vegetation (Table 3). Respondents generally agreed that eucalyptus trees played a large role in the 1991 Oakland-Berkeley fire, fire is a major threat to the East Bay, and that a large fire is more likely to happen in the East Bay than a large earthquake, defined as magnitude 6.0 or greater on the Richter scale (Table 3).

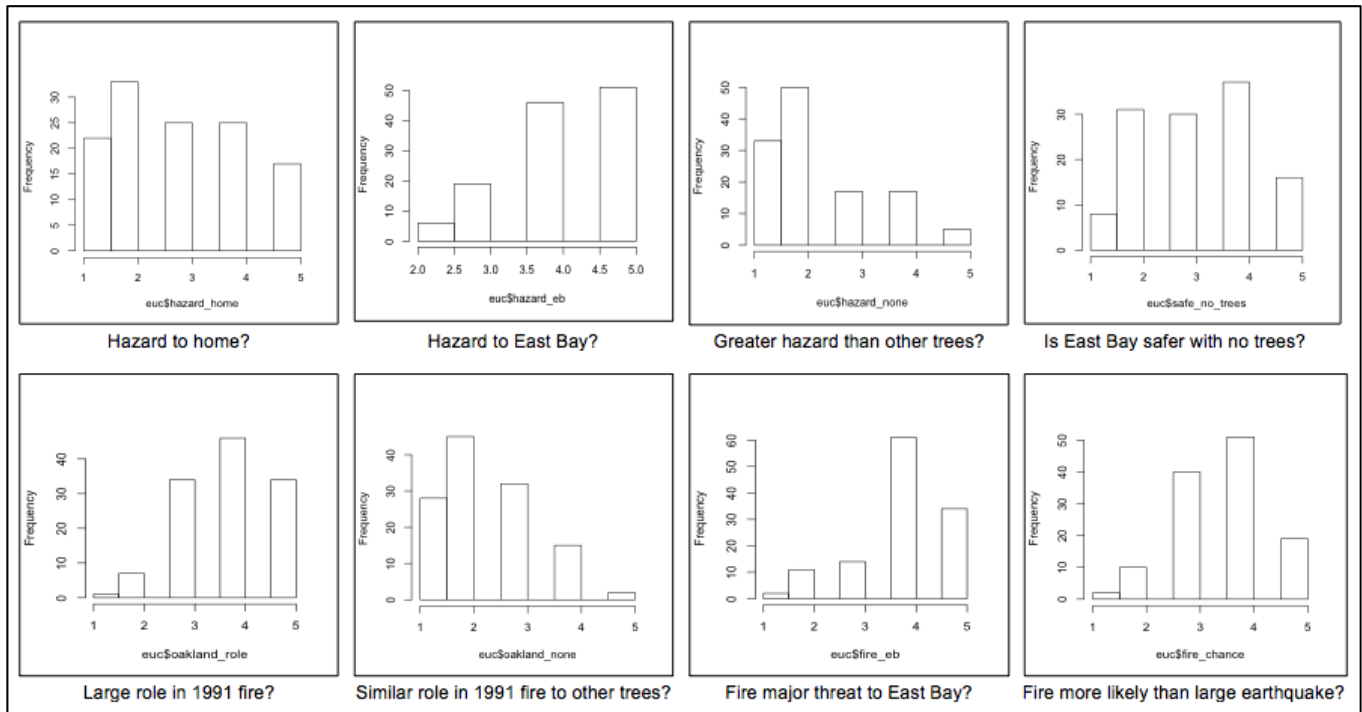


Figure 1. Distributions of responses of Likert scale questions on fire hazards of eucalyptus.

Table 3. Means of Likert scale questions on fire hazards. “Completely Disagree”=1, “Disagree”=2, “Neutral”=3, “Agree”=4, and “Completely Agree”=5.

Question	Mean	Overall Trend
<i>Do eucalyptus trees pose a threat to your primary residence?</i>	2.85	Disagree/Neutral
<i>Do eucalyptus trees pose a threat to the East Bay?</i>	4.16	Agree
<i>Are eucalyptus trees no greater threat than other vegetation?</i>	2.27	Disagree
<i>Would the East Bay be safer with no vegetation?</i>	3.18	Neutral
<i>Did eucalyptus trees play a large role in the 1991 fire?</i>	3.86	Agree
<i>Did eucalyptus trees play no greater role in the 1991 fire than other types of vegetation?</i>	2.33	Disagree
<i>Is fire a major threat to the East Bay?</i>	3.94	Agree
<i>Is a large fire more likely to happen in the East Bay than a large earthquake?</i>	3.62	Agree

Respondents also had varying opinions on perceived values of eucalyptus trees, but there was a general consensus that eucalyptus trees will be a part of the East Bay landscape indefinitely. I found there was a wide range in responses concerning the aesthetic value of eucalyptus trees, and whether my respondents liked having eucalyptus

trees in the East Bay (Figure 2). However, while my respondents could not come to a consensus about the appearance of eucalyptus trees, they felt very positively about the smell of the trees (Figure 2). There was more of a consensus on the pros of having native species of vegetation instead of invasive species, and more people wanted eucalyptus trees removed near their home than the number of people who wanted to keep eucalyptus trees near their home (Table 4). Finally, respondents agreed that eucalyptus trees would be a part of the East Bay landscape indefinitely (Table 4).

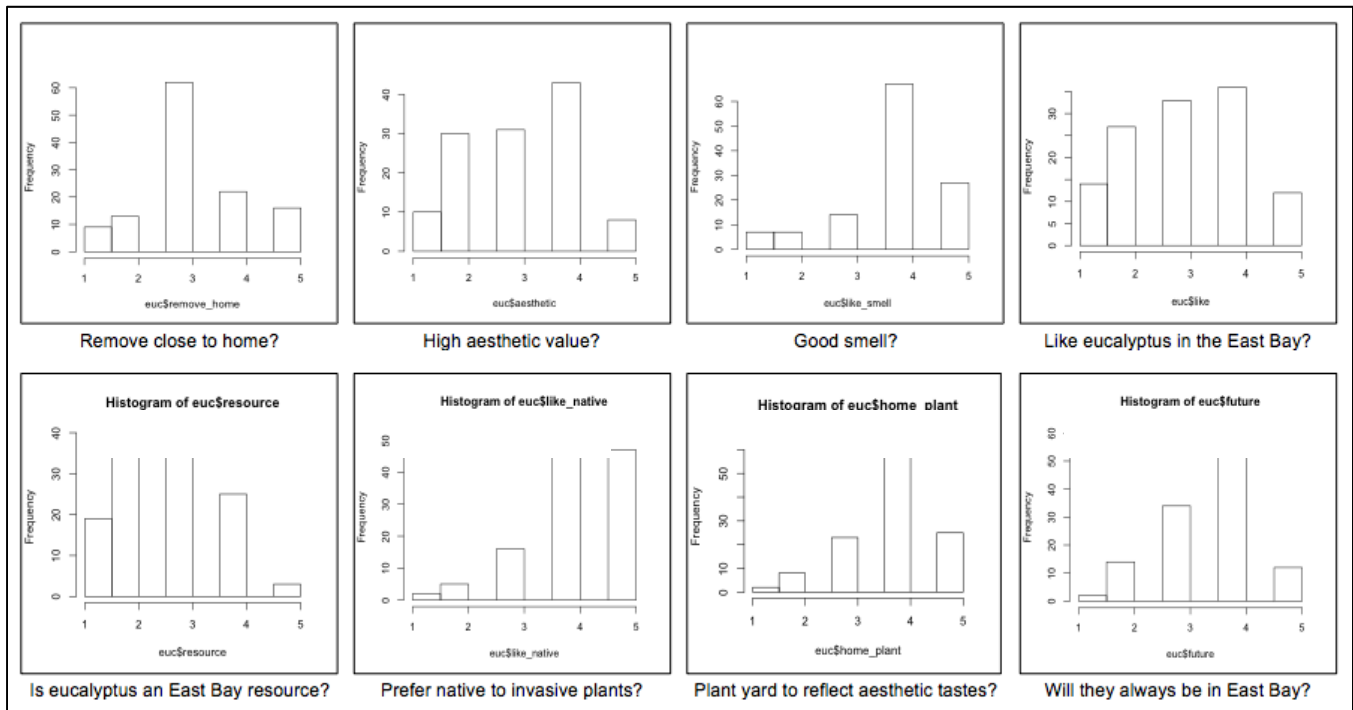


Figure 2. Distribution of responses of Likert scale questions on aesthetics, future of eucalyptus.

Table 4. Means of Likert scale questions on reasons to retain eucalyptus trees.

Question	Mean	Overall Trend
<i>I want eucalyptus trees removed near my home.</i>	3.29	Agree
<i>Eucalyptus trees have high aesthetic value.</i>	3.07	Neutral
<i>I like the smell of eucalyptus trees.</i>	3.82	Agree
<i>I like having eucalyptus trees in the East Bay.</i>	3.04	Neutral
<i>Eucalyptus trees can serve as a resource to the East Bay</i>	2.65	Disagree
<i>I prefer native vegetation to non-native vegetation in the East Bay.</i>	4.12	Agree
<i>I plant my yard to reflect aesthetic tastes.</i>	3.86	Agree
<i>I think eucalyptus trees will always be in the East Bay.</i>	3.54	Agree

DISCUSSION

The perceptions of East Bay residents of eucalyptus trees have been the driving force of action and policy in the history of these trees in this region. Due in large part because wealthy landowners saw eucalyptus tree as an exploitable resource with high aesthetic value, eucalyptus was planted the trees in the millions starting in the latter half of the 19th century (Groenendaal 1983, Ritter and Yost 2009). However, perceptions changed from initial excitement, with large shifts in perceptions often occurring around large or important historical events. For example, people view forests differently in times of war to reflect national security concerns and resource efficiency, while natural disasters like the 1991 Oakland-Berkeley fire serve to cast urban vegetation in a bad light (Morrison 1989, Le Billon 2001, Pagni 1991, Svihra 1992). In recent decades, negative perceptions of the trees have resulted in many eucalyptus removals in the East Bay (Boyd 1997). Though among my study participants there was a consistently high level of factual knowledge of the trees, there was a much a wider range in opinion about the present and future of eucalyptus trees in the East Bay. That said, different types of stakeholders will always have varied and evolving opinions, and to implement land management policy in the East Bay that is inclusive, effective, and comprehensive, land managers must take into account a wide range of perceptions and opinions (Alavalapati et al. 2005, Stokes et al. 2006).

Past Perceptions: Eucalyptus as a Resource

Eucalyptus was originally brought to the East Bay as a resource with multiple uses. European-American settlers came to the East Bay after the Gold Rush of the 1840's and 1850's, and after quickly decimating native tree resources they started to plant *E. globulus* for lumber, firewood, oil, and windbreaks, among other uses (Groenendaal 1983). At the time, eucalyptus was perceived to have medicinal properties, the ability to purify air, and was thought of as fireproof (McClatchie 1902, Zacharin 1978). Policymakers and scientists began urging people to plant the ever-popular eucalyptus to solve the growing need for lumber in the East Bay (Sparhawk 1949). Popular perception

was, and still is, heavily influenced by “trustworthy” news sources, and planting eucalyptus trees was seen as a patriotic act of resourcefulness throughout the 19th century and into the 20th century. (Selge et al. 2011, Groenendaal 1983). These positive perceptions of the eucalyptus trees paved the way for their ultimate success in the East Bay.

Past Perceptions: Aesthetics and Exoticism of Eucalyptus

19th century East Bay residents also saw eucalyptus trees as more aesthetically pleasing than native tree species, and the trees’ perceived exoticism added to their desirability. Eucalyptus trees were first brought to the East Bay for ornamental purposes by clipper ship captain Robert H. Waterman in 1853 (Weir 1957). Influential business owners like Walliam C. Walker and Frank Havens were instrumental in promoting eucalyptus as a desired tree, with the Tasmanian Blue gum in particular being, “just suited for the crests of those apparently barren hills away in the distance (Butterfield 1938).” In the decades to follow, state agencies like the California State Agricultural Society promoted eucalyptus plantings by offering large cash prizes to the land developer who planted the most eucalyptus trees in a given year (Transactions of the California State Agricultural Society 1870). It seemed most practical to plant a fast-growing, aesthetically pleasing tree with a specific image of the East Bay hills in mind (Groenendaal 1983). Over nine million eucalyptus trees were planted in the East Bay from 1880 to 1895 (Klatt 2010). So, positive perceptions of eucalyptus trees in their earliest California days were reinforced by resource management goals and promoted by wealthy landowners and influential members of society.

Past Perceptions: Changes Amidst Major Historical Events

While eucalyptus’ earliest days in the East Bay were met by nearly unchallenged positivity and excitement, East Bay residents grew more anxious about the trees’ presence in the 20th century. Americans’ perception of their forests changed during World War II, when Japanese bombing of forests in Oregon and California prompted people to

view forest resources as a national asset, and something worth protecting (Morrison 1989). People became more protective of their forest resources, particularly on the western coast of the United States (Morrison 1989). In the wake of landmark work by scientists like Rachel Carson, environmental concerns became a mainstream issue in the 1970's, and agencies like the Environmental Protection Agency were instrumental in securing important environmental legislation (Freeman III 2002). At this time, urban forestry concerns among the public greatly expanded, resulting in new perceptions of forests as an ecological benefit and management issue (Konijnendijk et al. 2006). As environmentalism continued to grow, East Bay residents paid more attention to the urban-wildland interface, increasing the general public's environmental education level (Konijnendijk et al. 2006). Around this time, local scientists began to express anxieties about the buildup of fuel in the East Bay hills, most notably due to the unmanaged growth of *E. globulus* (Agee et al. 1973). Finally, disaster struck the region in 1991, when a massive wildfire consumed the Berkeley and Oakland hills, burning over 1,500 acres and killing 25 people (Pagni 1993). As a consequence, eucalyptus trees are now viewed by many in the area as a massive fire hazard, reflecting a full shift in perception from positive to negative.

Present-Day Perceptions: Basic Factual Knowledge

As expected, I found a high level of basic factual knowledge about eucalyptus trees among survey respondents. Environmental education has become a vital and widespread part of school curriculum, making for the types of responses I received from my study participants (Rickinson 2001). And while there are a myriad of "misconceptions" in environmental education to this day, there was not a single instance in my results that reflected a large gap in basic knowledge on eucalypts trees (Strommen, 1995, Palmer, 1999). Perhaps most importantly, 98% of my respondents were able to correctly identify eucalyptus as an invasive species. Thus, nearly all respondents recognized the most important basic fact about this issue, indicating that this demographic is very aware of the presence of this invasive species in the East Bay.

Present-Day Perceptions: Eucalyptus as a Fire Hazard

Respondents felt there was a fairly high level of anxiety about eucalyptus trees as a result of their associative fire hazards. Yet, one of the most interesting dichotomies in opinion had to do with the perceived fire hazard eucalyptus poses. On the whole, respondents felt that eucalyptus was not a direct threat to their primary residence, but that it was a threat to the East Bay at large. It is possible that the bulk of respondents do not have eucalyptus trees on or near their property, but they were able to recognize the danger eucalyptus poses to the region at large. Alternatively, respondents may have felt more vested and confident in management practices directly affecting their property, but felt more anxious and disenfranchised on management across the entire region. As expected, respondents did believe eucalyptus trees played a large role in the 1991 Oakland-Berkeley fire, likely as a result of heavy negative press on eucalyptus trees in the wake of the disaster (Pagni 1991, Svihra 1992, Nowak 1993). While the actual role eucalyptus trees played in the 1991 disaster is still debated, negative perceptions initiated in the wake of the disaster were found to still persist in my study participants to this day. I was surprised to find respondents felt a large fire was more of a threat to the East Bay than a major earthquake, given the extensive earthquake awareness among the general public in the East Bay. However, it is very possible that the responses I obtained were influenced by the enhanced awareness of the issue by taking a survey on eucalyptus and perceived fire hazards, as is often seen in similar study methods (Bardsley et al. 2007, García-Llorente et al. 2008).

Present-Day Perceptions: The Future of Eucalyptus

Most respondents recognized that eucalyptus trees are not going away any time soon, and I found people have a wide range of opinions on the future of eucalyptus trees in this region. Interestingly, the average score on the aesthetic value of eucalyptus trees was neutral, meaning just as many people felt eucalyptus had aesthetic value felt eucalyptus did not have aesthetic value. The perceived aesthetic value of the trees was one of the main driving forces in bringing them to the East Bay in the first place, but that

perception no longer holds true for half of my respondents (Butterfield 1938, Weir 1957, Brown 1982, Groenendaal 1983). In contrast, respondents had a very positive perception about the smell of eucalyptus, a feature of the trees not focused on at the turn of the 20th century. Additionally, few people saw eucalyptus trees as a potential resource to East Bay residents, showing once more that the two original reasons for bringing eucalyptus trees here are no longer important to the majority (Sparhawk 1949, Groenendaal 1983). People had a high preference for native vegetation over invasive vegetation, and it is likely this perception that has exacerbated efforts to remove the trees throughout the East Bay (Boyd 1997, Stokes et al. 2006). But perhaps the most telling example of diverse stakeholder perceptions was that the average score on whether respondents liked having eucalyptus trees in the East Bay was neutral, meaning there was no clear consensus on the topic either way. In short, eucalyptus trees present a complex issue to this region, and it is not at all surprising to find a wide range in opinions on the continued existence of eucalyptus trees in the East Bay (Bardsley et al. 2007, García-Llorente et al. 2008).

Limitations

The study population was far from representative of the broader East Bay population, and as a result the level of inference for this study was not great. I was planning to use Chi-squared analysis to look for differences in opinion between different demographics, but was unable to do so after finding my respondents to be quite one-dimensional. My survey respondents were limited by my sampling methods; with increased time, funding, and access to email addresses studies like this can be more effective at reaching a wider range of respondents. Additionally, my analysis of past perceptions was limited by the sources I had easy access to years later; in this way minority viewpoints could very easily go unheard, causing misrepresentations of historical perceptions. The study adequately answered the questions I asked, but I could have included questions specifically targeting people's willingness to pay for various management strategies, like eucalyptus removals or efforts to reintroduce native trees species to East Bay land. Finally, this study could have benefited from personal

interviews of East Bay land managers, who may have given detailed insight into the history of land management, and thoughts on the future of eucalyptus in the region.

Future Directions

To make comprehensive decisions about land management in the region, we must fully understand the need, opinions, and perspectives of a diverse East Bay population. Future studies should seek a wider range of respondents, such that responses are more reflective of public perception as a whole rather than just one demographic. Teaching our youth about the environment and the dangers of urban fire is critical to maintaining awareness and education in the future (Rickinson 2001). Holding town-hall meetings can increase public awareness and empower local residents to have their voices and opinions heard, further enhancing coordination and discussion among community members on an issue that affects them personally (Lukensmeyer and Brigham 2003). Based solely upon comments sent to me from my survey respondents, nearly everyone has an opinion on the subject of eucalyptus and other invasive species in their homes. In short, policy makers and local governments need to understand perceptions of East Bay residents on eucalyptus trees for land management policy to be as comprehensive and effective as possible (Stokes et al. 2006, Lundberg 2010).

Broader Implications

Clearly, residents' perceptions of eucalyptus trees have changed over time, leading to widespread anxiety over the presence *E. globulus* continues to have in the East Bay. But is removing eucalyptus trees always the answer? It is unreasonable to think we can remove millions of eucalyptus trees safely and effectively (Klatt 2010). Managing the nature-urban interface is extremely challenging, particularly when human development has pushed that boundary ever harder (Alavalapati et al. 2005). Prescribed fire is often a viable management strategy in more rural areas, but is not pragmatic in such an urban setting (Stephens and Ruth 2005). Mechanical removal is difficult and many times ineffective, and even when removal strategies are enacted local opposition commonly

springs up to prevent the removal of eucalyptus (Boyd 1997, Klatt 2010). If not treated with herbicide within one minute of mechanical removal, eucalyptus trees will regenerate more vigorously than every before, and will grow several stems from the root ball instead of a single stem (Klatt 2010).

In short, *E. globulus* will continue to exist in the East Bay indefinitely, and the region's land managers must adapt policies that take into account the trees' presence. Additionally, policy that is understood and shaped by the people it is affecting enhances its effectiveness, inclusiveness, and level of embracement from the community (Lukensmeyer and Brigham 2003, Stokes et al. 2006, Lundberg 2010). Therefore, East Bay residents must continue to educate themselves not only on eucalyptus trees, but their entire environment, so they can be active and educated participants in the policies that will affect their livelihoods (Rickinson 2001). Local governments should recommend plantings of native species, and residents should be educated about the economic, ecological, and safety benefits of planting native vegetation whenever possible (Nowak et al. 2007). Eucalyptus trees have created similar management predicaments in places like Southern California, Portugal, and South Africa (Forsyth et al. 2004, Ritter and Yost 2009, Rodríguez-Suárez 2011). So, while the East Bay is not alone in the struggle to manage *E. globulus*, East Bay residents and land managers must continue to be aware of the trees' presence in the region, and must adopt land management policies that are conscious of the trees' continued existence.

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REFERENCES

- Agee, J. K., R. H. Wakimoto, E. F. Darley, and H. H. Biswell. 1973. Eucalyptus: fuel dynamics, and fire hazard in Oakland hills. *California Agriculture*. 27:13-15.
- Alavalapati, Janaki R.R., Douglas R. Carter, and David H. Newman. 2005. Wildland-urban interface: challenges and opportunities. *Forest Policy and Economics*. 7:705-708.
- Bardsley, D. K., and G. Edwards-Jones. 2007. Invasive species policy and climate change: social perceptions of environmental change in the Mediterranean. *Environmental Science & Policy* 10:230–242.
- Boer, M. M., R. J. Sadler, R. S. Wittkuhn, L. McCaw, and P. F. Grierson. 2009. Long-term impacts of prescribed burning on regional extent and incidence of wildfires: Evidence from 50 years of active fire management in SW Australian forests. *Forest Ecology and Management* 259:132-142.
- Blackburn, W. M. and T. Petr. 1979. Forest litter decomposition and benthos in a mountain stream in Victoria, Australia. *Arch.Hydrobiol.* 86:453-98.
- Boyd, David. 1997. Eucalyptus Removal on Angel Islands. California Exotic Pest Control Symposium Proceedings. 1997. Novato, California.
- Brown, Thomas. 1982. A list of California nurseries and their catalogues 1850-1900. Page 56. University of California Press, Berkeley, California.
- Butterfield, H. M. 1935. The introduction of Eucalyptus into California. *Madroño*. 3:149-154.
- Freeman III, A Myrick. Environmental policy since Earth Day I: what have we gained?. *The Journal of Economic Perspectives*. 16:125-146.
- Forsyth, G. G., D. M. Richardson, P. J. Brown, and B. W. van Wilgen. 2004. A rapid assessment of the invasive status of Eucalyptus species in two South African provinces. *South African Journal of Science* 100:75-77.
- García-Llorente, M., B. Martín-López, J. A. González, P. Alcorlo, and C. Montes. 2008.

- Social perceptions of the impacts and benefits of invasive alien species: Implications for management. *Biological Conservation* 141:2969-2983.
- Gilbert, M., and C. L. Brack. 2007. Changes in public requests to remove significant urban trees after severe bushfires in Canberra, Australia. *Urban Forestry & Urban Greening* 6:41-48.
- Groenendaal, G. M. 1983. Eucalyptus helped solve a timber problem: 1853-1880. Proceedings of a work-shop on Eucalyptus in California, June 14-16, 1983, Sacramento, California.
- Klatt, Tom. 2010. UC Wild-lands & Fire Mitigation Program Lecture. 2-11-2010. University of California, Berkeley, Berkeley, California.
- Konijnendijk, Cecil C., Robert M. Ricard, Andy Kenney, and Thomas B. Randrup. 2006. Defining urban forestry: a comparative perspective of North American and Europe. *Urban Forestry and Urban Greening*. 4:93-103.
- Laćan, I., V. H. Resh, and J. R. McBride. 2010. Similar breakdown rates and benthic macroinvertebrate assemblages on native and Eucalyptus globulus leaf litter in Californian streams. *Freshwater Biology* 55:739-752.
- Le Billon, P. 2001. The political ecology of war: natural resources and armed conflicts. *Political Geography* 20:561–584.
- Lukensmeyer, Carolyn J., and Steve Brigham. 2003. Taking democracy to scale: creating a town hall meeting for the twenty-first century. *National Civic Review*. 91:351-366.
- Lundberg, Anders. 2010. Conflicts between perception and reality in the management of alien species in forest ecosystems: a Norwegian case study. *Landscape Research*. 35:319-338.
- McClatchie, Alfred James. Eucalyptus cultivated in the United States. Bulletin No. 35 Washington, DC: Government Printing Office; 1902:18.
- Morrison, Ellen E. 1989. Guardian of the forest: a history of the Smokey Bear program. Morielle Press, Alexandria, Virginia.
- Nowak, D. J. 1993. Historical vegetation change in Oakland and its implications for urban forest management. *Journal of Arboriculture* 19:313-319.
- Nowak, D. J., R. E. Hoehn, D. E. Crane, J. C. Stevens, and J. T. Walton. 2007. Assessing urban forest effects and values: San Francisco's urban forest. Resource Bulletin – Northern Research Station, USDA Forest Service
- Pagni, P. J. 1993. Causes of the 20 October 1991 Oakland Hills conflagration. *Fire Safety*

- Journal 21:331-339.
- Paine, T., and C. Hanlon. 2010. Integration of tactics for management of Eucalyptus herbivores: influence of moisture and nitrogen fertilization on red gum lerp psyllid colonization. *Entomologia Experimentalis et Applicata* 137:290-295.
- Palmer, J.A. 1999. Research matters: a call for the application of empirical evidence to the task of improving the quality and impact of environmental education. *Cambridge Journal of Education*. 29:379-395.
- Rickinson, Mark. 2001. Learners and learning in environmental education: a critical review of the evidence. *Environmental Education Research*. 7:207-320.
- Ritter, M., and J. Yost. 2009. Diversity, reproduction, and potential for invasiveness of Eucalyptus in California. *Madroño* 56:155-167.
- Rodríguez-Suárez, J., B. Soto, R. Perez, and F. Diaz-Fierros. 2011. Influence of Eucalyptus globulus plantation growth on water table levels and low flows in a small catchment. *Journal of Hydrology* 396:321-326.
- Russell, W. H., and J. R. McBride. 2003. Landscape scale vegetation-type conversion and fire hazard in the San Francisco bay area open spaces. *Landscape and Urban Planning* 64:201-208.
- Selge, Sebastian, and Anke Fischer. 2011. How people familiarize themselves with complex ecological concepts: anchoring of social representations of invasive non-native species. *Journal of Community & Applied Social Psychology*. 21:297-311.
- Sparhawk, W. N. 1949. The history of forestry in America. *Trees, Yearbook of Agriculture*. Washington, DC: U.S. Government Printing office. 701-714.
- Stephens, SL, and LW Ruth. 2005. Federal forest-fire policy in the United States. *Ecological Applications*. 15:532-542.
- Stokes, K.E., K.P. O'Neill, W.I. Montgomery, J.T.A. Dick, C.A. Maggs, and R.A. McDonald. 2006. The importance of stakeholder engagement in invasive species management: a cross-jurisdictional perspective in Ireland. *Biodiversity and Conservation*. 15:2829-2852.
- Strommen, E. 1995. Lions and tiger and bears, oh my! Children's conceptions of forests and their inhabitants. *Journal of Research in Science Teaching*. 32:638-698.
- Svihra, Pavel. 1992. The Oakland-Berkeley hills fire: lessons for the arborist. *Journal of Arboriculture*. 18:257-261.
- Transactions of the California State Agricultural Society. Sacramento: O. M. Claves,

State Printer; 1868-73:28-35.

Weir, David Andrew. 1957. *That fabulous captain Waterman*. Page 111. Comet Press, New York, New York.

Zacharin, Robert F. 1978. *Emigrant eucalypts*. Page 129. Melbourne University Press, Melbourne, Australia.

Zavaleta, E. S., R. J. Hobbs, and H. A. Mooney. 2001. Viewing invasive species removal in a whole-ecosystem context. *Trends in Ecology & Evolution* 16:454-459.

APPENDIX A: Survey Instrument**Eucalyptus Trees in the East San Francisco Bay**

My name is Patrick Hennessy, and I am a fourth-year undergraduate student at the University of California, Berkeley. I am an Environmental Sciences major, in the College of Natural Resources (CNR). For my Senior Thesis, I am researching eucalyptus trees in the East San Francisco Bay.

Participation in this study is voluntary, and if you feel uncomfortable answering any question you may choose to exit the survey before completion. No responses will be received unless you press "Submit" on the final page. Responses are fully anonymous, and your name, email address, mailing address, and other contact information will not be collected at any time during this survey. Survey respondents must be over the age of 18 to participate in this study. If you are under the age of 18, please close this window.

Please feel welcome to submit any questions or comments about this survey at the very end of this survey. Additionally, you may contact me at patrickh602@berkeley.edu for further inquiries. This study was approved under "Exempt Research" by the UC Berkeley Committee for the Protection of Human Subjects (CPHS), under protocol number: 2012-01-3950.

For the purposes of this survey, the "East Bay" refers to the East San Francisco Bay (i.e. Berkeley & Oakland).

Thank you for your time and participation!

* Required

Part 1 of 3

Are eucalyptus trees native to California? *

- Yes
 No
 Unsure/Don't Know

If "No", where are eucalyptus trees from?

How long have eucalyptus trees lived in the East Bay? *

"Native to the East Bay" can be defined as living naturally, or occurring without direct or indirect human intervention.

- 50 years
 100 years
 150 years
 200 years
 1000 years
 5000 years
 Unsure/Don't Know

How many known species of eucalyptus trees exist today? *

- 1-100 species
 101-1000 species
 1001-2000 species
 More than 2000 species
 Unsure/Don't Know

Where have you seen eucalyptus trees in the East Bay? *

Select one or more.

- Hillsides
 Residential Land
 Commercial Land
 Street Medians
 Parks
 Other
 None of these

Please answer the following questions as either "True" or "False". *

	True	False	Unsure/Don't Know
Eucalyptus trees have high leaf litter. Leaf litter may be described as any plant matter (leaves, twigs, bark, etc.) that fall from the tree to the ground.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eucalyptus trees have flammable oils in their leaves.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eucalyptus trees have a difficult time coping with the East Bay's climate (warm, dry summers and moderate, moderately wet winters).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eucalyptus trees release toxins poisonous to other types of plants.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eucalyptus leaf litter can suppress other vegetation by blocking seedlings' access to sunlight.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eucalyptus trees take in water at higher rates than other East Bay vegetation.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Have you heard of recent (within the last 15 years) attempts to remove eucalyptus trees in the East Bay? *

Removal techniques include, but are not limited to: controlled fires, herbicide use, cutting trees down, etc.

- Yes
 No

If "Yes", what kinds of removal practices were attempted/employed?

If you're unsure or don't recall, please answer "Unsure" or "Don't Recall".

[Continue »](#)**Part 2 of 3****Please answer each of the following statements. ***

	Completely Disagree	Disagree	Neutral	Agree	Completely Agree
Eucalyptus trees pose a fire hazard to my residence.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eucalyptus trees pose a fire hazard to the East Bay at large.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eucalyptus trees aren't more of a fire hazard than any other tree of similar size.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would feel safer with less vegetation in my immediate vicinity, with regards to fire.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fire is one of the biggest concerns East Bay residents should have with regards to property damage and personal injury.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In my lifetime, a large fire is more likely to occur in the East Bay than a large earthquake (magnitude 6.0 or higher).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eucalyptus trees played a significant role in the 1991 Oakland-Berkeley fire.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eucalyptus trees weren't more hazardous than any other tree at the time of the 1991 Oakland-Berkeley fire.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would like eucalyptus trees in the East Bay hills to be removed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would like eucalyptus trees near to my home to be removed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think eucalyptus trees have high aesthetic value.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I think eucalyptus trees can serve as a valuable asset to East Bay residents.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like the smell of eucalyptus trees.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmentalism is an important issue to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like having eucalyptus trees in the East Bay.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to plant trees that can produce a product (i.e. fruit, firewood, etc.).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I prefer to see native vegetation growing in the East Bay, rather than introduced or invasive species.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I plant my yard to reflect aesthetic tastes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think eucalyptus trees will always be in the East Bay.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Part 3 of 3

How old are you? *

- 18-24 years old
 25-35 years old
 36-50 years old
 51-65 years old
 66-80 years old
 More than 80 years old

What gender do you associate yourself with? *

- Female
 Male

What ethnicity do you associate yourself with? *

- American Indian or Alaska Native
- Asian
- Black or African American
- White or Caucasian
- Hispanic or Latino
- Native Hawaiian or Other Pacific Islander

What is the highest level of education you've completed? *

- Some High School
- High School Diploma
- Some College
- 2-year or Associates Degree
- 4-year or Undergraduate Degree
- Masters Degree (M.B.A, M.A., M.F.A., etc.)
- Doctorate Degree (Ph.D., J.D., etc.)
- Post-Doctorate Work/Degree

What is your annual household income? *

- Less than \$25,000
- \$25,000- \$50,000
- \$50,000- \$100,000
- \$100,000- \$150,000
- \$150,000- \$200,000
- More than \$200,000

How long have you lived in the East Bay? *

- Less than 1 year
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- 31-40 years
- More than 40 years

What best describes your primary residence? *

- Apartment
- Condominium
- House
- Mobile Home
- Senior Center
- Other

What city is your primary residence located in? *

- Alameda
- Albany
- Berkeley
- El Cerrito
- Oakland
- Richmond
- San Francisco

Have you ever worked in any of these industries? *

Please select one or more.

- Real Estate
- Agriculture
- Logging/Forestry
- Government-sponsored environmental agency
- Non-government environmental agency
- Renewable Energy
- Non-renewable energy
- None of these.
- Land Management

Questions or comments?

Response not required.

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