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The Australasian-Californian Forest Exchange:
Ecological Exchanges, Novel Ecosystems and Attitudes Towards Nature

Morgan SALETTA
University of Melbourne
m.saletta@unimelb.edu.au

Abstract
This paper examines the exchange of trees and forests that began during the Victorian era and is ongoing between South-eastern Australia, California and New Zealand. This exchange predominately featured eucalyptus trees, Monterey pines and Monterey cypress, but increasingly is also featuring Californian coastal redwoods. The continuing, transnational history of this exchange is situated within a context of changing attitudes toward nature, environmental management, economic and commercial interests and cultural and historic heritage in these regions. Conceptions of novelty, hybridity, métissage and authenticity as they are found in both ecological theory and the historical and social sciences are applied to the exchange and its cultural and historical contexts. A transnational historical perspective regarding this exchange and its context within evolving attitudes to nature is of interest not only to the environmental historian, but also to historians and philosophers of science. Such a perspective may also be useful for environmental and cultural heritage managers and stakeholders involved in managing the impacts and ecological transformations resulting from this and other similar ecological exchanges.

Keywords
Australia, New Zealand, California, Pacific, botanical exchange, eucalyptus, Monterey pine, Monterey cypress, novel ecosystems, nature, invasion biology, redwoods, transnational history

Introduction: the Australasian-Californian Forest Exchange

The exchange of trees and forests between South-eastern Australia, New Zealand and California has played an important role in the production of a humanized cultural landscape and human modified ecologies in these regions. Numerous exchanges of biological species between continents and regions due to human migration, trade and contact have been analysed by environmental historians and these exchanges form an important focus of transnational and environmental history. These exchanges are also the subject of biological/ecological theories as

well as practical efforts by conservation and restoration biologists, environmental managers, and other stakeholders in environmental and land-use management and policy making. At times the landscapes these exchanges have helped to create are also the focus of cultural and historic heritage management debate, policy and efforts. This paper will focus primarily on aspects of the exchange of trees and forests which began in the Victorian period between California, South-eastern Australia and New Zealand and whose influences- ecological, cultural, economic, ideological and aesthetic continue to the present day. This exchange is in large part differentiated from other "Pacific Exchanges," [1] as well as other American-Australian/Australasian exchanges, by the types of climate involved- temperate and Mediterranean climate type regions rather than tropical and sub-tropical climate regions.[2]

In South-eastern Australia, California and New Zealand, we can point to forests and landscapes composed of, or in which eucalyptus, Monterey pine, Monterey cypress and mixtures thereof form an important component. These species have become naturalized in these regions, and in some areas these trees and forests form iconic landscapes with significant heritage, touristic and recreational value in addition to their economic value as plantation species. They are also the subject of policy and intervention on the part of environmental managers and agencies on the basis that they are invasive species. However, it is also increasingly recognized that these trees and forests can also fulfil important ecological functions and services- in California, for example, eucalyptus trees provide a crucial resource for over-wintering Monarch butterflies, and indeed their introduction may have been a factor in the possibly recent evolution of the migration.[3] Carbon capture and pollution mitigation by these and other is also of increasing importance.[4]

Although one focus of this paper is on the transnational exchange and transfer of forests and tree species between California and Australasia and the ongoing environmental and landscape transformations that resulted, this exchange also took place within a much larger geographical network of cultural, ideological, biological,

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[1] Ian Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910,"*Journal of World History* 8, no. 2 (1997): 295. For a discussion of the Pacific Islands and environmental exchanges see Jennifer Newell, *Trading nature : Tahitians, Europeans, and ecological exchange* (Honolulu: University of Hawai'i Press, 2010).

[2] During the 19th century European settlers and scientists experimented extensively with tree species from many parts of the world and climate comparisons played a part in this. See, for example, Brett M. Bennett, "Naturalising Australian Trees in South Africa: Climate, Exotics and Experimentation," *Journal of Southern African Studies* 37, no. 2 (2011).

[3] Richard I Vane-Wright, "The Columbus hypothesis: An explanation for the dramatic 19th century range expansion of the monarch butterfly," *Biology and conservation of the monarch butterfly*, no. 38 (1993); Jared Farmer, "Gone Native: California's Love-Hate Relationship with Eucalyptus Trees," Huffington Frontiers, http://www.academia.edu/322875/Gone_Native_Californias_Love-Hate_Relationship_with_Eucalyptus_Trees.

[4] Francisco J Escobedo, Timm Kroeger, and John E Wagner, "Urban forests and pollution mitigation: analyzing ecosystem services and disservices," *Environmental Pollution* 159, no. 8 (2011).

technological and economic exchanges and this paper will necessarily touch on some of these.[5] Rather than focussing on technical and economic facets however, I will place this exchange within a larger discussion about attitudes to nature and biological and ecological theory including the concept of novel ecosystems.[6]

Ian Tyrrell has analysed the 19th and early 20th century ideological, technological and economic context of what he has called the California-Australia Exchange in considerable detail.[7] While aspects of this exchange have either ended [8] or been eclipsed[9] following California's integration into the larger American economy in the early 20th century, I will argue that the exchange itself (enlarged to include New Zealand) and its effects are ongoing. It is important to include New Zealand; while it did not contribute trees to the exchange, its forestry industry and much of its landscape was transformed by Monterey pine and cypress,[10] and it is in New Zealand that one of the most interesting new developments of this ongoing transnational environmental history is developing- the large-scale planting of California coastal redwoods as a timber species.

In the mid-19th century, when the exchange began, California, Australia and New Zealand were all remote peripheral colonial regions in terms of Wallerstein's world systems theory[11] which underwent rapid economic development and population growth from European immigration. All three were also connected by networks of exchanges both in terms of physical trade routes[12] but also in the exchange of ideas which notably included early forms of environmentalism and approaches to land management, forestry and ecology [13] including acclimatization which, though traditionally associated with the British Empire, Tyrrell has shown to have been active in the U.S. through the work of George Perkins Marsh.[14] Acclimatization was especially important, if informally so, in California due in large part to the

[5] Viola Lockhart Warren, "The Eucalyptus Crusade," *Southern California Quarterly* 44, no. 1 (1962). For a discussion of the larger technological and ideological framework of the exchange see Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910." See also Jared Farmer, *Trees in Paradise: A California History* (New York, N.Y.: WW Norton & Company, 2013).
[6] Lauren A. Hallett et al., "Novel ecosystems: theoretical and management aspects of the new ecological world order," ed. Richard J. Hobbs, Eric S Hall, and Carol Hall (Wiley, 2006).
[7] Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910."; Ian Tyrrell, *True gardens of the gods: Californian-Australian environmental reform, 1860-1930* (University of California Pr, 1999).
[8] Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910," 302.
[9] Tyrrell, *True gardens of the gods: Californian-Australian environmental reform, 1860-1930*: 223.
[10] Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910," 287.
[11] Immanuel Maurice Wallerstein, *The modern world-system* (New York: Academic Press, 1974).
[12] The introduction of a regular steamship route in 1871 especially facilitated the exchange both of ideas and of botanicals, see Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910," 294.
[13] Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910," 277.
[14] Ian Tyrrell, "Acclimatisation and environmental renovation: Australian perspectives on George Perkins Marsh," *Environment and History* 10, no. 2 (2004).

influence of the Australian botanist Baron von Mueller, who played a crucial role in the biological exchanges this paper focuses on.[15]

This exchange predominantly featured Australian trees of the genre eucalyptus and two Californian species, the Monterey pine (*Pinus radiata*) and the Monterey cypress (*Cupressus macrocarpa*). However, many other trees were part of this exchange, both for experimental forestry and timber production and as ornamentals- including Australian acacias and California redwoods.[16] Indeed, renewed interest in coastal redwoods (*Sequoia sempervirens*), particularly in New Zealand[17] but also in South-eastern Australia[18] is one piece of evidence suggesting the exchange is actively ongoing as I will discuss in more detail shortly.

In the broadest historical perspective the Pacific exchanges and the Australasian-Californian Forest Exchange can be seen as part of Alfred Crosby's "ecological imperialism", and indeed his seminal works *The Columbian Exchange* (1972)[19] and *Ecological Imperialism* (1986)[20] have cast a "long shadow" in which environmental historians work (Bennett 2010: 127).[21] However, there are important differences between the Columbian Exchange and the Pacific exchanges. According to Tyrrell, "The 'Pacific exchanges' were later in time and…the interaction was different from 'the expansion of neo-Europes', and more nearly equal than that portrayed in Crosby's *Ecological Imperialism*."[22]

The globalization of eucalyptus trees in particular has received much attention and has often been interpreted as a sort of reverse ecological imperialism.[23] Brett Bennet argues, however, that this is not evidence of an inherent adaptiveness and should be viewed not as a "biological phenomenon, but as the result of a long-term attempt by powerful states and state-sponsored scientists to select and breed Australian species that could grow in a variety of climates and conditions."[24] *Pinus radiata* and *Cupressus macrocarpa* have also been extensively globalized and indeed *Pinus radiata* is one of the

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[15] Ellwood Cooper, a major advocate of eucalyptus planting in California included lectures and a paper by von Mueller as part of his campaign to plant eucalyptus in California, see Ellwood Cooper and Ferdinand Baron von Mueller, *Forest culture and eucalyptus trees* (San Francisco: Cubery & Co., 1876).
[16] Brett Bennett, "A Global History of Australian Trees," *Journal of the History of Biology* 44, no. 1 (2011). Tom Gaman, "California's coast redwood in New Zealand," (2012).
[17] Jim Rydelius, "The New Zealand Redwood Company," *New Zealand Tree Grower* 28, no. 1 (2007); David John Palmer et al., *Predicting the spatial distribution of Sequoia sempervirens productivity in New Zealand* (Ministry of Agriculture and Forestry, 2009).
[18] Rowan Reid, "Californian Redwood," agroforestry.net.au, http://www.agroforestry.net.au/main.asp?_=Californian%20Redwood.
[19] Alfred W. Crosby, *The Columbian exchange : biological and cultural consequences of 1492* (Westport, Conn. : Greenwood Pub. Co., 1972).
[20] Alfred W. Crosby, *Ecological imperialism : the biological expansion of Europe, 900-1900* (Cambridge: Cambridge University Press, 1986).
[21] Bennett, "A Global History of Australian Trees," 127.
[22] Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910," 295.
[23] Bennett, "A Global History of Australian Trees."
[24] Bennett, "A Global History of Australian Trees," 210.

most commonly planted pine tree in the world. Both species have also been the subject of intensive experimental planting programs in Australia and New Zealand[25] and more recent breeding, hybridization and genetic improvement programs, especially since the mid-20th century.[26]

The early exchange

The exchange of trees and forests between Australia, New Zealand and California involved a complex transnational network of institutional and individual actors including botanical gardens and botanists, foresters, nurserymen, government agencies and officials and ordinary citizens. Moreover, in the earliest period (the 1850's-60's) the exchange was often indirect- the earliest *Pinus radiata* seeds and seedlings, for example, appear to have been introduced to both New Zealand and Australia via England, where they had been imported and planted, along with many other exotic conifers at Chiswick and in the Royal Botanical Gardens at Kew since the 1830's.[27]

The best known aspect of the Australasian-Californian Forest Exchange, certainly for most North Americans in any case, is the importation of eucalyptus trees (especially the Tasmanian blue gum or *Eucalyptus globulus*) to California, where they have become a prominent and iconic part of the landscape, biologically naturalized yet contested 'aliens' and the subject of conflicting attitudes toward nature and conservation.

California went through two major planting episodes, the first, what Viola Warren called the "eucalyptus crusade"[28] in the 1870's and the second between 1907 and 1913, although the earliest known plantings are recorded from the 1850's and seeds were probably originally brought aboard one of the ships carrying Australians eager to participate in California's Gold Rush. The earliest propagation was probably carried out by two people: W.C. Walker, a nurseryman who by 1857 was selling seedlings and Dr Berh, a friend and student of Alexander von Humboldt who had been twice to Australia and had worked with Baron Ferdinand von Mueller there.[29] The motivations for planting that accompanied the "eucalyptus crusade" were as much aesthetic and ideological as economic and this history has been analysed extensively.[30] But the importation of eucalyptus in California was mirrored by the

[25] RW Shepherd, "Early importations of Pinus radiata to New Zealand and distribution in Canterbury to 1885: implications for the genetic makeup of Pinus radiata stocks," *Horticulture in New Zealand* 1, no. 1 (1990).
[26] Liz Hamilton, "Cypress for farm foresty," Department of Environment and Primary Industries, State Gov. of Victoria, http://www.dpi.vic.gov.au/forestry/private-land-forestry/individual-species/cypress-for-farm-forestry; Harry X Wu et al., "Achievements in forest tree improvement in Australia and New Zealand: Successful introduction and breeding of radiata pine in Australia," *Australian Forestry* 70, no. 4 (2007); Gerry Vincent et al., "Forest Research develops superior macrocarpa and lusitanica," Proseed, http://www.proseed.co.nz/cypresses_clonal.php.
[27] Shepherd, "Early importations of Pinus radiata to New Zealand and distribution in Canterbury to 1885: implications for the genetic makeup of Pinus radiata stocks."
[28] Warren, "The Eucalyptus Crusade."
[29] Robert L Santos, "The Eucalyptus of California," *Alley-Cass Publications, California* (1997).
[30] Farmer, *Trees in Paradise: A California History*.

importation into Australia as well as New Zealand of Californian trees, especially the Monterey pine (*Pinus radiata*) and the Monterey cypress (*Cupressus macrocarpa*).

In Australia, the earliest recorded importation of *Pinus radiata* was around 1857[31] when the Sydney Botanical Gardens received a tree from England but it may have been brought earlier by gold-miners coming from California for the Victorian gold-rush.[32] Another important player in the exchange was an Englishman, Exeter nurseryman James Veitch, who received a shipment of seeds from California in 1850-1 and who was probably the earliest source for *radiata* seeds imported to New Zealand and probably a major source for Australia as well.[33]

Subsequently there were two main sources of importation. One through Ferdinand von Mueller, who was appointed the Victorian Government botanist in 1853. Mueller's earliest sources appear to be from England (via Kew, but also probably from Veich, who visited the Melbourne gardens in 1866). Certainly by the mid-1860's he was also receiving seed directly from Californian sources, possibly including Luther Burbank.[34] The second early source of seed importation to Australia was via New Zealand seed merchants, who in fact remain an important source of conifer seeds for Australia.[35] Mueller distributed a wide variety of conifer seeds, including *radiata* widely in Victoria and South Australia during the 1860's.[36] Both in New Zealand and in Australia, *Pinus radiata* came to dominate the plantation timber industry. It remains the dominant plantation species in New Zealand but in Australia, while it remains the most important local source of softwood, it was surpassed by native hardwood plantations in the late 20th century.[37]

The "remarkable pine", as *Pinus radiata* is sometimes known, was not alone however- the Monterey cypress was particularly popular in windbreak plantings, but it was and is also an important plantation timber species, especially in New Zealand and increasingly in South-eastern Australia.[38] Furthermore, the Monterey cypress is a remarkable feature of the cultural landscape in Victoria and the south island of New Zealand, forming shaded avenues and a checkerboard mosaic of fields divided by farm windbreaks.[39] Indeed, in both Australia and New Zealand some avenues

[31] J.M. Fielding, "The introduction of Monterey pine into Australia," *Australian Forestry* 21, no. 1 (1957).
[32] Santos, "The Eucalyptus of California," 70.
[33] Shepherd, "Early importations of Pinus radiata to New Zealand and distribution in Canterbury to 1885: implications for the genetic makeup of Pinus radiata stocks."
[34] Shepherd, "Early importations of Pinus radiata to New Zealand and distribution in Canterbury to 1885: implications for the genetic makeup of Pinus radiata stocks."
[35] Wu et al., "Achievements in forest tree improvement in Australia and New Zealand: Successful introduction and breeding of radiata pine in Australia."
[36] Tyrrell, *True gardens of the gods: Californian-Australian environmental reform, 1860-1930*: 87-92.
[37] Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910."
[38] Hamilton, "Cypress for farm foresty"; Vincent et al., "Forest Research develops superior macrocarpa and lusitanica".
[39] Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910," 287.

and windbreaks of Monterey cypress are recognized as having significant cultural heritage value, in some cases officially and in others, unofficially.[40]

The ongoing exchange: biological control and eucalyptus in California and redwoods in New Zealand and South-Eastern Australia

While aspects of the "transnational Pacific interchange in irrigation, biological control, and forests"[41] between Australian and California may have been eclipsed or halted with the full integration of California into in the national economy of the United States in the early 20th century, the exchange did not end in the early 20th century. I will highlight two examples that demonstrate the ongoing nature of the exchange. One example is the biological control program in California directed at protecting eucalyptus trees from imported pests from Australia. After all, forests are much more than simple collections of trees- they are complex ecosystems in which soil microbes and fungi, insects, and other flora and fauna are intimately intermeshed. Thus, I have chosen this example because in addition to exemplifying the ongoing cultural, and to a lesser degree economic importance of eucalyptus in California, it is also an example of biological exchange and biological control efforts more generally, which according to Tyrrell were an important part of the California/Australia "Pacific Exchange".[42]

The second example consists of the increasing interest, in New Zealand particularly, but also in Victoria (South-eastern Australia) in Californian coastal redwoods (*Sequoia sempervirens*) as a plantation timber species. Redwoods have been grown in Australia and New Zealand as ornamentals since the mid to late 19th century and as part of experimental softwood plantations in both countries in the late 19th and early 20th centuries. However, it is only in the last two decades or so that coastal redwoods have again become the subject of intense research as well as active plantation. [43]

Biological Control and Eucalyptus in California

In the mid-1980's the eucalyptus longhorned borer (*Phoracantha semipunctata*) was first discovered in California[44], and while it may have hitched a ride in crates made from eucalyptus timber, there has been ongoing speculation that it and subsequent

[40] "Victorian Heritage Database," Heritage Victoria- Department of Planning and Community Development, http://vhd.heritage.vic.gov.au.; "The New Zealand Tree Register," New Zealand Arboricultural Association and the Royal New Zealand Institute of Horticulture, http://www.notabletrees.org.nz/.

[41] Tyrrell, "Peripheral visions: Californian-Australian environmental contacts, c. 1850s-1910," 302.

[42] Tyrrell, *True gardens of the gods: Californian-Australian environmental reform, 1860-1930*: Chapter 9.

[43] Peter Harris and Mark Stone, "Caring for Country—the Otways and You," ed. Parks Victoria and DSE (2009); Gaman, "California's coast redwood in New Zealand."; Reid, "Californian Redwood".

[44] TD Paine and JG Millar, "Biological control of introduced pests of Eucalyptus in California" (paper presented at the 1st International Symposium on Biological Control of Arthropods, 2003).

pests were imported by radical environmentalists and native plant activists to kill off the non-native eucalyptus.[45] Since then a number of Australian pests have been introduced, either accidently or deliberately, and an active program of biological control focussing on the release of a parasitic wasp and several larval parasites has been introduced with some success.[46] The motivations for such control are both economic (i.e. to protect farm shelter belts and plantations) and cultural. In many parts of the state, in parks, cities and university campuses such as Stanford and the University of California San Diego, the trees are iconic and have important aesthetic, cultural and historical heritage value.[47] In urban and peri-urban areas, these trees and forests also provide important ecosystem services including both habitat for plants and animals and pollution mitigation and carbon sequestration.[48]

Redwoods in New Zealand and South-eastern Australia

There are a number of relatively old groves of redwoods in New Zealand, some dating from the 19th century. The 1920s saw a spike in interest in the trees by foresters and the New Zealand Forest Service as part of their larger experimental plantation projects. Redwoods were also planted for ornamental purposes. Largely due to poor site selection, but also to fire, many of these plantations did not survive, but there remain redwoods at several hundred locations in New Zealand.[49] The best known is the Tokorangi forest, known as "The Redwoods", which forms 6 hectares of the much larger Whakarewarewa Forest which was planted from 1899 as an experimental forest. The largest of the trees is now some 67 metres (219 feet) tall and 169 centimetres in diameter, and the grove composed of these "charismatic mega-flora"[50] is an important local tourist and recreational resource and attraction.[51] Thus, despite the fact that *Pinus radiata* became New Zealand's dominant timber species, the surviving plantings of redwoods, including the grove at Whakarewarewa, have provided useful data for New Zealand wide spatial models linking site specific conditions and productivity.[52]

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[45] Timothy D Paine, Jocelyn G Millar, and Kent M Daane, "Accumulation of pest insects on eucalyptus in California: random process or smoking gun," *Journal of economic entomology* 103, no. 6 (2010); Heather Henter, "Tree Wars: The Secret Life of Eucalyptus," http://ucsdmag.ucsd.edu/magazine/vol2no1/features/wars.htm.

[46] Paine, Millar, and Daane, "Accumulation of pest insects on eucalyptus in California: random process or smoking gun."; Paine and Millar, "Biological control of introduced pests of Eucalyptus in California."

[47] Farmer, *Trees in Paradise: A California History*; Henter, "Tree Wars: The Secret Life of Eucalyptus".

[48] Escobedo, Kroeger, and Wagner, "Urban forests and pollution mitigation: analyzing ecosystem services and disservices."

[49] Dave Cown, "Redwood in New Zealand-an end-user perspective," *New Zealand Journal of Forestry* 52, no. 4 (2008); Gaman, "California's coast redwood in New Zealand."; Lindsay Poole, "The first introductions of American redwoods to New Zealand," *New Zealand Tree Grower* 28, no. 1 (2007).

[50] C. Michael Hall, Michael James, and Tim Baird, "Forests and trees as charismatic mega-flora: implications for heritage tourism and conservation," *Journal of Heritage Tourism* 6, no. 4 (2011).

[51] Bhubaneswor Dhakal et al., "Recreational users' willingness to pay and preferences for changes in planted forest features," *Forest Policy and Economics* 17(2012).

[52] Palmer et al., *Predicting the spatial distribution of Sequoia sempervirens productivity in New Zealand.*

In large part, the renewed interest in redwood plantations in New Zealand has been spurred by the market effects of political and environmental regulations in California which have led to the protection of 95 per cent of the remaining old growth forest. Because of the limited geographic range in which re-growth forests exist, as well as stringent environmental and sustainability regulations, the output from second and third growth forest is decreasing; thus it is now considered possible for New Zealand grown redwood timber to compete in the international market. As a result, thousands of hectares of redwood have been planted in the last decade.[53]

Redwoods also attracted early if unsustained interest in Australia, both as a potential timber species and as an exotic ornamental. In the 1930's in Victoria, for example, redwoods were planted as part of an experimental forestry project along the Airy River in the Otway Mountains and now form a beautiful riverside grove next to a picnic ground which is an important part of the local cultural and recreational landscape.[54] While redwood as a plantation timber species has not yet taken off in Australia, new plantations do exist and there are significant signs that its importance is growing.[55]

Attitudes toward nature: wild nature vs. cultured nature

Because of a number of factors, including shared cultural and linguistic heritage, a settler or pioneer history, as well as ongoing exchanges of both popular and scientific conceptions of nature and environmental management, there are substantial similarities in attitudes toward and conceptions of nature in New Zealand, Australia, and in the United States and Canada.[56] With specific regard to the early Australasian-Californian Forest Exchange of trees and forests, for example, one such shared attitude toward nature was the late 19th century 'forest influence concept'- the belief that forests were climatic ameliorators, an attitude that was displaced in importance by an emphasis on water resources and flood protection but which, like the latter, provided an active justification both for forest protection and planting. Tree planting in all three regions was also motivated by late 19th and early 20th century fears of timber shortages.[57] Tyrrell has also argued persuasively that late 19th century environmentalism, and in particular ideas of acclimatization and what he has termed "environmental renovation" were bound together with the desire to create a garden or horticultural landscape in both Australia and California. The exchange of trees and forests between these regions, as well as with New Zealand was motivated in part by this complex ideological context. [58]

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[53] Palmer et al., *Predicting the spatial distribution of Sequoia sempervirens productivity in New Zealand*; Gaman, "California's coast redwood in New Zealand." Cown, "Redwood in New Zealand-an end-user perspective."

[54] Harris and Stone, "Caring for Country—the Otways and You."

[55] Reid, "Californian Redwood".

[56] See for example Thomas Dunlap, *Nature and the English diaspora: environment and history in the United States, Canada, Australia, and New Zealand* (Cambridge University Press, 1999).

[57] Michael Roche, "Growth rates: debating pathways for New Zealand forestry," *Australia's Ever-changing Forests III*.

[58] Ian Tyrrell, "Peripheral Visions: Californian-Australian Environmental Contacts, c. 1850s-1910,"

Peter Coats[59] has detailed the changing and oscillating attitudes- both positive and negative- toward exotic species in the United States since the 19th century and these were often paralleled by attitudes in Australia and New Zealand, as is evidenced by contemporary narratives in Australia of "ecological assault by alien plants". [60] While there was a great deal of enthusiasm for foreign plants on the part of European settlers and scientists in the 19th and 20th century, the late 19th century also saw a celebration of native plants paralleled with rising nationalism. Since the mid-20th century, changing attitudes of both scientists and the general public toward 'nature' that have been accompanied by an increasingly negative view of non-native plant species as destructive of native ecosystems and 'alien'. [61] Emblematic of this has been the changing perception in California of the eucalyptus where, according to Farmer, popular environmentalism and ecological thinking led to an expansion of the concept of weed in the 1990's with the result that eucalyptus became "ecological pariahs" in the Bay Area- a region where these trees had become truly naturalized in self-seeding forests.[62]

In a review of public attitudes toward a forested area in North America, R. Bruce Hull et al[63] identified two dichotomous attitudes toward nature. These have also been identified in New Zealand in a similar context : the 'wild nature' view which sees nature as separate from human culture and influence and the 'cultured nature' view which integrated human activity and 'nature', particularly through recreational and interpretive activities. [64] Although in these regions, ecologists and many environmentalists have tended toward the 'wild nature' view, there is a growing recognition that human activities cannot be separated from nature and that an exclusive focus on non-human elements is insufficient to achieve sustainable environmental management.[65] Thus, on the one hand there are paradigms which are more or less biocentric and on the other those that are more or less anthropocentric, the latter including 'stewardship' approaches held, for example, by

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Journal of World History, no. 2 (1997): 283.

[59] Peter Coates, *American perceptions of immigrant and invasive species: strangers on the land* (Univ of California Press, 2007).

[60] Christian A Kull and Haripriya Rangan, "Acacia exchanges: Wattles, thorn trees, and the study of plant movements," *Geoforum* 39, no. 3 (2008): 1259.

[61] Ian A. Dickie et al., "Conflicting values: ecosystem services and invasive tree management," *Biological Invasions* 16, no. 3 (2014). See for example Susan M Timmins and P A Williams, "Weed numbers in New Zealand's forest and scrub reserves," *New Zealand journal of ecology* 15, no. 2 (1991).

[62] Farmer, "Gone Native: California's Love-Hate Relationship with Eucalyptus Trees" 21.

[63] R. Bruce Hull, David P. Robertson, and Angelina Kendra, "Public Understandings of Nature: A Case Study of Local Knowledge About "Natural" Forest Conditions," *Society & Natural Resources* 14, no. 4 (2001).

[64] Bronwyn M Newton, John R Fairweather, and Simon R Swaffield, "Public perceptions of natural character in New Zealand: wild nature versus cultured nature," *New Zealand Geographer* 58, no. 2 (2002).

[65] Fikret Berkes, "Rethinking Community-Based Conservation," *Conservation Biology* 18, no. 3 (2004); Zoe Car, "Seeing through others' eyes: towards a hybrid ecology of marine turtle and dugong in Australia," (2012).

some indigenous peoples.[66] The roots of these differences are longstanding and can be partially traced back to differences in 19th century and early 20th century preservationist and conservationist approaches, and as early as 1935 Aldo Leopold noted the problematic divide within ecology between those studying the human community and those that focussed on plants and animals. [67] Certainly the effect of these multiple paradigms and approaches can also be detected in modern public attitudes toward 'nature'.[68]

In significant areas of South-eastern Australia, New Zealand and California the exchange of trees and forest has resulted in what biologists refer to as naturalization- that is, of populations that can reproduce without human intervention. And, in all three regions, the species in question have become part of ongoing debates concerning native and non-native species in which a complex set of scientific concepts, cultural and historical heritage values, and differing attitudes to nature which range from ecocentric conceptions of 'wild nature' to more anthropocentric 'cultivated nature' are contested, put into play and mobilized by various stakeholders in environmental and land-use management. Thus paradoxically, in these regions one or more of the trees (and forests) in question have become the subject of varying degrees of regulated intervention and removal by government agencies in the context of the protection of indigenous or 'native' ecosystems, while at the same time also the subject of ongoing economic exploitation, horticultural activities, research by both private and publicly funded entities, and also the subject of cultural heritage protection and considerations. [69]

Divergent ethical paradigms based on differing attitudes and conceptions of nature and humanity's place in it is a major problem for environmental managers trying to accommodate a wide range of stakeholders with often divergent world views. Difficulties arising from differing attitudes toward nature are further exacerbated by complex debates surrounding terminology internal to biological science that have also been ongoing since the mid-18th century. [70] Robert Colautti and Hugh MacIsaac have highlighted the problem in ecology and invasion biology of labelling complex phenomenon with simple and emotionally charged words such as 'invasive',

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[66] Berkes, "Rethinking Community-Based Conservation."; Robert Manning, William Valliere, and Ben Minteer, "Values, Ethics, and Attitudes Toward National Forest Management: An Empirical Study," *Society & Natural Resources* 12, no. 5 (1999).

[67] As evidenced in his unpublished notes- see Marcus Hall, *Earth repair : a transatlantic history of environmental restoration* (Charlottesville: University of Virginia Press, 2005). 164.

[68] Hull, Robertson, and Kendra, "Public Understandings of Nature: A Case Study of Local Knowledge About "Natural" Forest Conditions."; Manning, Valliere, and Minteer, "Values, Ethics, and Attitudes Toward National Forest Management: An Empirical Study."

[69] See for example Timmins and Williams, "Weed numbers in New Zealand's forest and scrub reserves." Monterey cypress were frequently planted as memorial avenues in South Eastern Victoria, see for example "Soldiers' Memorial Avenue, Port Arthur Conservation Management Plan," ed. Port Arthur Historic Site Management Authority (Tasmania: Port Arthur Historic Site Management Authority, 2011). For a discussion of political controversies concerning eucalyptus see Farmer, *Trees in Paradise: A California History*.

[70] Mark A. Davis, *Invasion biology* (Oxford ; New York : Oxford University Press, 2009). 2.

'noxious' and 'naturalisation', "which can can confuse ideological debates and undermine management efforts."[71] There has also been particularly vigorous debate surrounding the field of 'invasion biology', debates which reflect deep rooted philosophical world views concerning nature, the role of humanity within nature and "what in nature is natural and desirable and whether non-native species have any role in nature."[72] Aspects of these debates can be traced back to classifications of plants as native and non-native that emerged in the 18th century but were systematized in the 19th and the early 20th centuries.[73]

Ultimately, these attitudes are intimately related to more general cultural attitudes both toward nature as well as to cultural identities. Bennett addresses some of these issues in his study of Australian trees in South Africa, and his analysis, in its general form, is valid for the present discussion as well:

> Many of the scientific studies and concepts used to judge the impact of Australian trees remain mired in historical debates over expertise arising out of conflicts in the 1930's rooted in the disciplinary differences of ecologists and foresters who pursue different types of scientific programs. Ultimately, the belief that native plants are "good" and exotic plants are "bad" has troubling and conflicted political and scientific precedents that should make us wary of rigidly using these categories to determine environmental management practices.[74]

Jozef Keulartz and Cor van der Weele propose that there exist two extreme positions with regards to the debate about exotic species, both with resonances to debates about immigration- nativism on the one hand and cosmopolitanism on the other. They nuance this, however, arguing that between these extremes there exists a continuum of approaches ranging from restoration and re-creation to Michel Soulés' "recombinant ecology".[75] Keulartz and van der Weele also explore the metaphorical framing of invasion biology and the problematic way its language makes frequent use of military terms as well as metaphors with "a racist and xenophobic resonance"[76] and highlight the manner in which these resonances are manifest in public debates over exotic species. They use the example, cited from

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[71] Robert I. Colautti and Hugh J. MacIsaac, "A Neutral Terminology to Define 'Invasive' Species," *Diversity and distributions*, no. 2 (2004): 135.
[72] Daniel Simberloff, "Nature, Natives, Nativism, and Management," *Environmental Ethics* 34, no. 1 (2012): 7.
[73] Simberloff, "Nature, Natives, Nativism, and Management."
[74] Brett Bennett, "A Contested Past and Present: Australian Trees in South Africa," Social Science Research Council, http://www.ssrc.org/pages/A-Contested-Past-and-Present-Australian-Trees-in-South-Africa/.
[75] Michael E. Soulé, *Conservation biology : the science of scarcity and diversity* (Sunderland: Sinauer Associates, 1986). 235.
[76] Jozef Keulartz and Cor van der Weele, "Between Nativism and Cosmopolitanism: Framing and Reframing in Invasion Biology," in *New visions of nature: complexity and authenticity* ed. Martinus Antonius Maria Drenthen, Jozef Keulartz, and James D. Proctor (Dordrecht; London: Springer, 2009), 242.

Todd[77], of a San Francisco official saying, "How many of us are 'invasive exotics' who have taken root in the San Francisco soil, have thrived and flourished here, and now contribute to the wonderful mix that constitutes present-day San Francisco?".

While acknowledging the importance of biodiversity, it is tempting to see some of the fervour with which native plant enthusiasts have adopted the emotive terms of invasion biology as to some extent a result of ongoing and lingering societal guilt in which the desire to turn back the clock and restore pre-colonial ecosystems, even where such a process is practically impossible and possibly even detrimental[78], as part of an effort to expiate or atone for the sins of the colonial past.

According to Richardson et al[79] there is significant confusion as well as debate within the scientific community about how to describe and understand the processes of naturalization/invasion/colonization and the complexities of cultural landscapes. While vocabulary is important, Simberloff stresses that the issues are deeper, relating to underlying world views of nature and humanity and thus that it is unlikely that changes in terminology will result in a consensus on how to categorize, conceptualize and manage non-native plants.[80] However, while biologists debate how and when terms like 'naturalization', 'invasive', 'weed' and 'pest' can and should appropriately be applied, environmental managers and government agencies must contend with a complex cultural and economic situation in which "stakeholders compete over which definitions of nature and environmental quality are ultimately used to set land-use goals and policy."[81] It is here that appropriately nuanced conceptual terminology drawn from both the biological sciences as well as the humanities and social sciences may be usefully deployed, whether by historians or by policy makers, managers and other stakeholders in environmental management.

Novel ecosystems, authenticity, hybridity, and ecological métissage

In many parts of the world, including Australia, New Zealand and California, non-native species have resulted in ecological assemblages that are increasingly being labelled and conceptualized as 'novel ecosystems', though this concept is not uncontested.[82] Hobbs et al[83] identify a gradation between historical ecosystems, hybrid ecosystems and novel ecosystems. Historical ecosystems (often defined by reference to Western colonization) have traditionally been the target for restoration

[77] Kim Todd, "Botanically correct: a new language is needed to win the day for native species," http://grist.org/article/correct/.
[78] Necessitating, for example, the ongoing application of herbicides and other methods of intervention.
[79] David M Richardson et al., "Naturalization and invasion of alien plants: concepts and definitions," *Diversity and distributions* 6, no. 2 (2000).
[80] Simberloff, "Nature, Natives, Nativism, and Management," 13.
[81] Hull, Robertson, and Kendra, "Public Understandings of Nature: A Case Study of Local Knowledge About "Natural" Forest Conditions," 325.
[82] See for example James Aronson et al., "The road to confusion is paved with novel ecosystem labels: a reply to Hobbs et al," *Trends in Ecology & Evolution* 29, no. 12 (2014).
[83] Richard J Hobbs, Eric Higgs, and James A Harris, "Novel ecosystems: implications for conservation and restoration," *Trends in Ecology & Evolution* 24, no. 11 (2009): 599-600.

ecology though for many reasons this has become problematic, including the growing recognition that human beings have long altered their ecosystems.[84] Hybrid ecosystems retain some features and dynamics of the historical system but have been subject to some modification in function and or composition. According to Hobbs et al, "A novel ecosystem, by contrast, is one in which the species composition and/or function have been completely transformed from the historic system: such a system might be composed almost entirely of species that were not formerly native to the geographic location or that might exhibit different functional properties, or both."[85]

It is worth remembering that the idea that humans are creating new ecosystems is not entirely new[86] and it is worth quoting Arthur Tansley, who coined the term ecosystem, in this regard:

> We must have a system of ecological concepts which will allow of the inclusion of all forms of vegetational expression and activity. We cannot confine ourselves to the so-called "natural" entities and ignore the processes and expressions of vegetation now so abundantly provided us by the activities of man… The "natural" entities and the anthropogenic derivates alike must be analysed in terms of the most appropriate concepts we can find.[87]

Novel ecosystems are the result of human action but importantly do not depend on human action to maintain themselves.[88] There is a growing awareness based on numerous field studies and restoration attempts, notably including that of Santa Cruz Island of the Galapagos Islands, that it is often either impractical or impossible to return to a 'historical ecosystem', however temporally defined. Thus, there is a corresponding recognition that novel systems require "a new way of thinking about our interventions and responsibilities toward ecosystems."[89] There is also a growing recognition of a need for research and conservation action frameworks that have a more nuanced approach to anthropogenic ecosystems than more traditional approaches to conservation biology and ecology.

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[84] Lauren M Hallett et al., "Toward a Conceptual Framework for Novel Ecosystems," in *Novel ecosystems: intervening in the new ecological world order*
ed. R. J. Hobbs, Eric Higgs, and Carol M. Hall (Chichester, West Sussex, UK ; Hoboken, NJ: Wiley-Blackwell, 2013), 25.

[85] R. J. Hobbs, Eric Higgs, and Carol M. Hall, "Introduction: Why novel Ecosystems," in *Novel ecosystems : intervening in the new ecological world order*, ed. R. J. Hobbs, Eric Higgs, and Carol M. Hall (Chichester, West Sussex, UK ; Hoboken, NJ: Wiley-Blackwell, 2013), 600.

[86] For an in depth discussion of the history of the concept see Joseph Mascaro et al., "Origins of the Novel Ecosystems Concept," in *Novel ecosystems : intervening in the new ecological world order*
ed. R. J. Hobbs, Eric Higgs, and Carol M. Hall (Chichester, West Sussex, UK ; Hoboken, NJ: Wiley-Blackwell, 2013).

[87] Arthur G Tansley, "The use and abuse of vegetational concepts and terms," *Ecology* 16, no. 3 (1935): 304.

[88] Hallett et al., "Toward a Conceptual Framework for Novel Ecosystems."

[89] Hobbs, Higgs, and Hall, "Introduction: Why novel Ecosystems," 3.

In the San Francisco Bay Area, for example, where eucalyptus trees have become a naturalized self-propagating part of the landscape and forests, their presence is politically contested - valued by some and detested by others. Some environmental managers and agencies are calling for their removal for a number of reasons, including fire hazard. At the same time, a local citizens group, supported by some scientists and academics[90] is exerting political pressure for the protection of these trees and forests because of their value for recreation as well as for historical and cultural heritage concerns. Even more interestingly, the action group "Death of a Million Trees" is actively citing ecological function and service- providing roosts to urban hawks and owls as well as for the Monarch butterfly, and using the concepts of hybrid and novel ecosystems to support their cause- the protection of all trees and forests in the heavily urbanized Bay Area.[91]

Ian Dickie et al have catalogued a number of examples of conflicts surrounding non-native and invasive tree species from around the world and suggest that most of these conflicts occur in three areas: "urban and near-urban trees; trees that provide direct economic benefits; and invasive trees that are used by native species for habitat or food." [92] The authors suggest that assessing ecological services and changes in services may help managers to manage conflicts and move beyond simplistic debates about whether exotic species are "good" or "bad". The theoretical framework of the novel ecosystem approach may usefully be deployed in evaluations of ecological service and is part of a growing recognition of the need for new approaches to ecology that consider both "the well-being of both humans and other species."[93] Ultimately, appropriate conceptual terms, analogies and metaphors for discussing human relationships with ecosystems, and in particular anthropogenic ecosystems, will be part of this nuanced approach.

For the environmental historian, as well as for historians and philosophers of science, the concept of the novel ecosystem offers a framework which both fits the temporal perspectives of the historian while also converging in interesting and potentially fertile ways with existing terminology and conceptual frameworks in the humanities and social sciences. Indeed, the conceptions of historical, hybrid and novel ecosystems have some very direct parallels with issues that have been faced in the humanities and social sciences and thus we are presented with a fortuitous situation in which, for once, we can see the chasm between C.P. Snow's "two cultures"[94] so often created and maintained by disparate and divergent language instead being bridged by the convergent use of concepts and vocabulary.

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[90] Joe McBride, "Professor Joe McBride defends the forest on Mount Davidson," Death of a Million Trees, http://milliontrees.me/2013/07/05/professor-joe-mcbride-defends-the-forest-on-mount-davidson/.

[91] "Are critics of invasion biology pessimists or realists?," Death of a Million Trees, http://milliontrees.me/2013/10/22/are-critics-of-invasion-biology-pessimists-or-realists/.

[92] Dickie et al., "Conflicting values: ecosystem services and invasive tree management," 706.

[93] Hobbs, Higgs, and Hall, "Introduction: Why novel Ecosystems," 4.

[94] C. P. Snow and Alfred D. Chandler, *The two cultures and the scientific revolution*, Rede lecture: 1959

One such fertile convergence is the broader concept of hybridity itself which may be usefully deployed by historians, biologists and environmental managers alike as part of a more nuanced approach to human ecological interactions. In calling for a "hybrid ecology" that integrates human cultures and activity with scientific ecological approaches, Zoe Carr maintains that ecologists and managers "need to engage with the knowledge held by other academic disciplines…where many of the issues now faced by ecology have been discussed for some time"[95] and highlights both the biological meaning of the word 'hybrid' and its use in post-colonial theory and literature.[96]

There are also specific and direct parallels with issues that have been faced in anthropology and ethnology. In particular, the parallels are striking between these ecological concepts and debates and changing conceptions regarding culture and "authenticity" in anthropology and ethnology. In the late 19th century and early 20th century, anthropologists' and ethnologists' attitudes to culture was such that any aspects of post-Contact influence in indigenous or non-Western cultures were generally treated as "contaminated" as opposed to "authentic" pre-Contact culture.[97] Similarly, "historical ecosystems" are generally (though not always) defined with respect to the arrival of Westerners and thus temporally the same as 'pre-Contact'. Moreover, invasion, conservation and restoration biologists have tended to see hybrid and novel ecologies as 'contaminated' by invading species, though this is not the word they employ, preferring the terms degraded, disturbed or damaged.[98] Insofar as hybrid and novel ecosystems have departed from the reference point of the historical ecosystem it is also clear that many conservation and restoration biologists, as well as environmentalists, view these ecosystems as 'inauthentic' where an 'authentic' historical ecosystem (however arbitrarily defined) is generally perceived as unsullied and unmodified by human action, however problematic in terms of the erasure of indigenous populations such a view might be. Such visions of authenticity have been challenged, for example, by environmental philosophers such as Eric Katz using the art forgery analogy.[99] Kenneth Olwig has also identified the notion of authenticity as central to biological discourses about the native and the alien he sees as rooted in cartographic conceptions of landscape and territory which

(New York: Cambridge University Press, 1961).

[95] Car, "Seeing through others' eyes: towards a hybrid ecology of marine turtle and dugong in Australia," 31.

[96] See for example Homi K Bhabha, "Signs taken for wonders: questions of ambivalence and authority under a tree outside Delhi, May 1817," *Critical Inquiry* 12, no. 1 (1985).

[97] See for example Sackman's description of Kroeber's attitude toward Ishi's glass arrowheads and other 'tainted' objects in Douglas Cazaux Sackman, *Wild men: Ishi and Kroeber in the wilderness of modern America* (Oxford University Press, 2009). 101.

[98] Contamination in ecology generally is used for chemical or industrial pollution. Interestingly however, a different medical analogy "health" has gained increasing momentum, for discussion see Keulartz and van der Weele, "Between Nativism and Cosmopolitanism: Framing and Reframing in Invasion Biology."

[99] Eric Katz, "The big lie: human restoration of nature," in *Readings in the Philosophy of Technology*, ed. David M. Kaplan (Plymouth: Rowman and Littlefield, 2009).

he terms 'cartographic-pictographic' and in which "Something deemed to be native to the space of this landscape is authentic and desirable, whereas that which is alien is inauthentic and undesirable."[100]

A similar term to 'hybrid' that is used in the social sciences and post-colonial theory may also be appropriate to discussions of hybrid and novel ecosystems: métissage.[101] Like the word hybrid, for which it is in some (though not all) ways directly synonymous- métissage is complexly polysemic and in French has been used in both a cultural and biological context. Thus, while it has been applied on the one hand to mixes of culture in post-colonial theory, it is also a term that is applied more generally to people of mixed 'race' or ethnicity. Deploying this term more broadly, we can say that the processes which have led to anthropogenic modification of ecosystems, particularly through exchanges such as the Australasian-Californian Forest Exchange are processes of ecological métissage, in which individual species from previously biogeographically distinct and often distant ecosystems have been combined in both hybrid and novel ecosystems. Certainly it would seem that the use of the word métissage to describe the process in which hybrid and novel ecosystems are formed would be consistent with Colautti and MacIsaac's[102] call for a more neutral vocabulary to refer to the processes generally studied under the umbrella of invasion biology. It would also avoid some of the genetic engineering and implicitly (and perhaps unintentional) technologically triumphalist resonances of Soulés' "recombinant ecology".[103]

Certainly many of the concerns regarding biodiversity on the part of restoration and conservation biologists are absolutely valid, and I follow Hobbs et al[104] in asserting that it is not my intention to question the value of protecting biodiversity and ecosystems which do retain some historical form and composition, however this is defined. On the other hand, in many areas, where the trees I have spoken of have become integral parts of novel ecosystems, as well as in areas where they have important historical and cultural heritage value, such as parks, university campuses, neighbourhoods, even landscapes, they may well be worth protecting and maintaining, as is indeed evidenced by heritage actions and listings concerning these trees in New Zealand, Australia and California.[105] In many cases, novel ecosystems may have passed irreversible thresholds making it impractical or impossible to return to a historical system. Moreover, the ecological services these trees and

[100] Kenneth R Olwig, "Natives and aliens in the national landscape," *Landscape research* 28, no. 1 (2003): 63.
[101] See for example Robert Alvin Miller, "The Poetics of Mixed Marriage in Le Clézios La Quarantine," in *Francophone Post-colonial Cultures: critical essays*, ed. Kamal Salhi (Lexington Books, 2003).
[102] Colautti and MacIsaac, "A Neutral Terminology to Define 'Invasive' Species."
[103] Soulé, *Conservation biology : the science of scarcity and diversity*.
[104] Hobbs, Higgs, and Hall, "Introduction: Why novel Ecosystems," 3.
[105] Heritage listings of trees and groupings of trees in New Zealand can be found for example on "The New Zealand Tree Register". For Australia see for example the "Victorian Heritage Database".

forests provide in some areas[106] need to be carefully evaluated and humans need to be taken into consideration in environmental management- "the value that humans derive from some aspects of novel ecosystems may form a social threshold that cannot, and possibly should not, be reversed."[107] In any case, the continued aesthetic, cultural, and economic value of the tree species I have considered here assures that their presence and "propagule pressure"[108] in these regions is unlikely to end, and the case of the redwood tree in New Zealand, for example, serves to highlight that the exchange of trees and forests is an ongoing one.[109]

Conclusion

In California, New Zealand and South-eastern Australia, the exchange of trees and forests which began in the Victorian era, fuelled in part by Victorian ideologies regarding acclimatization and what Tyrrell has called ideologies of environmental renovation,[110] as well as by economic concerns and forestry practices, has had a profound impact on the ecosystems, landscape, and to varying degrees the cultural identity of these regions. I have briefly examined the history of this exchange and highlighted ways in which the exchange is ongoing- as exemplified by the major new interest in redwood plantations in New Zealand and biological control programs related to eucalyptus pests in California. I have also highlighted the fact that in these regions these trees have become integral parts of cultural and historical heritage and the landscape. I have situated this within a more general discussion of attitudes toward nature, emerging concepts and debates in ecological theory and the manner in which an understanding of these may be of use to historians as well as in environmental management decision making processes and the political dynamics which surround them.

In all three regions these trees and forests have created both hybrid and novel ecosystems which are challenging conventional approaches to conservation and restoration biology, including where these approaches overlap with historical and cultural heritage management.[111] These and other challenges are reflected in emerging environmental management approaches.[112] Concepts such as métissage

[106] Escobedo, Kroeger, and Wagner, "Urban forests and pollution mitigation: analyzing ecosystem services and disservices."
[107] Hallett et al., "Toward a Conceptual Framework for Novel Ecosystems," 20.
[108] Colautti and MacIsaac, "A Neutral Terminology to Define 'Invasive' Species."
[109] Ongoing genetic research and hybridization projects concerning Pinus radiata and Cupressus macrocarpa also demonstrate ongoing exchanges of genetic material between the regions- see for example Ken G Eldridge, "Seed Collections of Pinus Radiata and P. Muricata in California," FAO-Forest Genetic Resources; Wu et al., "Achievements in forest tree improvement in Australia and New Zealand: Successful introduction and breeding of radiata pine in Australia."
[110] Tyrrell, "Acclimatisation and environmental renovation: Australian perspectives on George Perkins Marsh."
[111] Hobbs, Higgs, and Harris, "Novel ecosystems: implications for conservation and restoration." R.J. Hobbs, E.S. Higgs, and C. Hall, *Novel Ecosystems: Intervening in the New Ecological World Order* (Wiley, 2013).
[112] Berkes, "Rethinking Community-Based Conservation."

might be usefully deployed to refer to the exchanges and other processes which produce hybrid and novel ecosystems. Such vocabulary may help historians and philosophers to better conceptualize and describe the complex relationship between human beings and ecosystems both historically and heading into what Hobbs et al[113] have called the "new ecological world order." A more nuanced conceptualization of humanity's place in ecosystems and nature may assist historical and cultural heritage experts and environmental managers in more effectively communicating with each other and with other stakeholders possessed of diverse and divergent attitudes toward nature and heritage. With specific regard to the Australasian-Californian Forest Exchange and its continuing history, I have situated the ongoing exchange within evolving approaches to and conceptions of nature which are also being exchanged between these regions. The Australasian-Californian Forest Exchange is part of a continuing history shared by these regions both separated and united by the Pacific Ocean, a colonial past and a common language.[114] As with many other ecological exchanges and transfers, it is a continuing history of flora, fauna, people, ecosystems and landscapes. In seeking to understand and to manage these exchanges we can well be served by a perspective which includes an understanding of diverse and evolving attitudes toward nature and a nuanced perspective on humanity's role in ecological systems.

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[113] Richard J Hobbs et al., "Novel ecosystems: theoretical and management aspects of the new ecological world order," *Global ecology and biogeography* 15, no. 1 (2006).

[114] With apologies to Oscar Wilde, *The Canterville Ghost. [electronic resource]* (Project Gutenberg, 2004).

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