Chapter Eight

BIODIVERSITY CONSERVATION IN A CHANGING WORLD[1]

Overview

This paper explores issues of biodiversity conservation in changing environments by focusing on the issues associated with native and exotic plants in the landscape. The definitions of native and alien status reveal that the concept is not founded on hard science, as often implied, but reflects a set of value judgements about the timescales of environmental change and forms of human impact regarded as acceptable within the landscape. However the definitions can be said to generate conflicts that can not be resolved, given that environmental change and human impacts are inevitable. Native plants are believed to be superior to introduced species because of improved growth, the reduced likelihood of them becoming invasive, their indirect and direct biodiversity value and their contribution to local sense of place. In all cases there are exceptions where non-native species are as valuable as natives. Moreover policies on exclusion on non-natives are unable to accommodate the tide of environmental change, and also move against the trends of effective conservation management.

Introduction

The general policy and legislative framework by which biodiversity conservation is promoted is gradually moving away from a focus on fixed reserves towards a focus on conservation through the wider landscape, and away from a focus on approaches that rely on human exclusion towards approaches that assume that people have a positive role to play in achieving biodiversity protection.[2] A clear exception is the increasing pressure across the globe for countries to introduce policies and procedures that attempt to exclude introduced and exotic species from arrival.[3]

As a means of focusing on the challenges associated with conservation during change, this paper reviews a range of philosophical as well as technical issues that underlie these policies. As will become evident, philosophy and practice cannot be separated; indeed it is the determination to do so that is sometimes at the root of many

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[1] Kendle A.D. & Rose J.E., Eden Project, Bodelva, St Austell, Cornwall PL24 2SG.
[2] Green B, *Countryside Conservation*. . (London, E & F.N. Spon, Ltd, 1996, 3rd Ed).
[3] Kendle A.D. & Forbes S, *Urban Nature Conservation*. (London, E & FN Spon, 1997).

environmental problems and false solutions.

The subject merits an initial consideration of the very concept and definitions of 'native'. We tend to use the terminology of native and exotic or alien as if these words represent a concrete reality that needs no explanation, but actually there are complex issues that need to be addressed. The very search for a definition that people feel accurately reflects their position tells us much about their implicit values and assumptions, and it is beyond doubt that this is a subject that is heavily value-laden.

What are the definitions of native?

Whilst everyone recognises the broad meaning of the concept of native, finding agreement about the definition in a way that allows for consensus about detail is not easy. Webb[4] reviewed the issue of how a native plant is defined within the context of the UK and Ireland and proposed the following, which seems to encompass the generally accepted usage of the term native in the UK: *A native plant is one that has arrived before neolithic times, or has arrived since without human agency.*

This definition embodies many (sometimes implicit rather then explicit) elements that can be examined through three perspectives – boundaries, timescales and the role of human agency.

a) Timescales

Webb's definition does not make it explicit that most botanists would exclude plants that were native once and that departed from the UK flora in the last ice age when "the botanical slate was wiped clean".[5] In his discussion Webb does note this issue, including pointing out that this list could include such contentious species as *Rhododendron ponticum*, now classed as an alien weed in the UK and the subject of extermination programmes, but he does not resolve it in the definition.

The definition is also ambiguous about the position of plants and animals that were native once, have been lost and re-introduced. Species recovery programmes seem set to make such developments more common. For example the decision to reintroduce

[4] Webb D.A. 'What are the criteria for presuming native status?' (1985) 15 *Watsonia* 231-236.
[5] Brown N, 'Re-defining native woodland' (1997) 70 (3) *Forestry* 191-198.

beaver into Scotland is based on its 'once native' status.[6] Clearly people will need limits to the re-introduction possibilities if selectivity is to be maintained.[7]

Some botanists contrast with Webb, in that they want to draw a line under the UK flora and explicitly state that there will never be any new native plants. Flora Locale, an organisation that campaigns to maintain the integrity of the UK flora, has a definition of native as 'anything that arrived without human agency more than 2000 years ago'.[8] Even amongst those who do not wish to be so explicit about the end to native status, there is a widespread skeptical assumption that any newly discovered species is highly unlikely to have arrived naturally rather than by direct or indirect human agency.[9] It is therefore difficult to imagine the list of natives expanding significantly except where existing but previously unidentified species are described.

b) Boundaries

In the UK, as with other islands, the clarity of the native species concept is greater than it would be in multi-national continents, especially where political boundaries are prone to change. Classification of native status would ideally be based on geographic rather than political boundaries, but the difficulties of achieving this in practice are significant,[10] not least because variation in the quality and intensity of botanical study, and also land use, tends to match political boundaries.

The problems and confusions that can arise when plant distribution patterns are superimposed on political boundaries are well illustrated by Schwartz[11] with reference to the United States. In particular, problems arise at the edge of ranges where plant colonisation patterns may reflect chance events, compounded by political rather than geomorphological alignment of boundaries. Plants may thus be classified as rare and requiring protection because they have just a foothold in one state, and non-native and requiring eradication in an adjacent state, even though both have comparable habitats, soils, climates etc.

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[6] Scottish Natural Heritage, *Progress and Plans*.(SNH, Edinburgh, 1998)
[7] Brown *op.cit*. n.5.
[8] Flora Locale, 'Definitions: British native-origin plants for landscaping, conservation, forestry and amenity schemes.' *Flora Locale Draft Technical Guidance Notes 1* (1997). Internet site: http://www.naturebureau.co.uk/pages/floraloc/guidenot.htm
[9] Schwartz M.W, 'Defining indigenous species' in Luken J.O. & Thieret J.W. (eds) *Assessment and Management of Plant Invasions*. (Springer, New York, 1997) 7-17.

Species move across space in response to environmental changes. Our definitions of native aim to filter between shifts caused by human agency and those that are not, but they have the tendency to fossilise plant and animal status.[12] Perhaps one of the greatest problems with the concept of nativeness is that it commits us to supporting a flora that reflected a particular environmental and climatic state that can not continue forever, indeed has probably already changed. (It is ironic that there is an increasingly strong condemnation of non-native species just at the time when we are launching on the adventure of rapidly modifying our climate.)

Drawing boundaries around the idea of 'human agency' can also be challenging. Previous climate changes will have lead to changes in plant distribution, but also to changes in human distribution and patterns of land use. Separating the two can be difficult. Humans also influence the climate and other ecosystem processes such as nutrient cycles in ways that induce species distribution changes. Botanists are not yet clear about their response to this issue, although Schwartz[13] reaches the conclusion that *"virtually all future shifts in plant distribution must be viewed as somewhat suspect no matter how 'natural' the expansion may appear"*. In a sense he is therefore arguing in favour of the 'never any new natives' perspective, and the consequences will be that the list of natives that are believed appropriate to a given country, and the actual flora or fauna that lives there reflecting the current climate, will slowly separate.

The wish to maintain the rigid boundaries of the native flora is of course something that can have no long-term rationale. Protection of local genetic character is a tactic within the broader campaign of global biodiversity protection, but ultimately this broader campaign will not be successful unless processes of evolution and speciation are allowed to progress. Many studies have shown the importance of factors such as organism invasion into novel habitats, and hybridisation, as a primary driving mechanism for speciation and biodiversity development.[14]

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[10] Brown *op.cit*. n.5.
[11] Op.cit. n. 9.
[12] Brown *op.cit*. n.5.
[13] Op.cit. n. 9.
[14] Orr M.R. & Smith T.B. 'Ecology and speciation' (1998)13 (12) *Trends in Evolution and Environment* 503-506; and Whitham T.G., Martinsen G.D., Floate K.D., Dungey H.S., Potts B.M. & Keim P. 'Plant hybrid zones affect biodiversity: tools for a genetic-based understanding of community

Conservation biologists would not really want to see an end to these processes and on reflection most would accept the need for native status to also change and evolve over evolutionary time. The conservation debate about natives is really concerned with halting what is seen as a process of uncontrolled anthropogenically initiated species changes that are erosive in the shorter term. To say that there can be no more natives is therefore a crisis-response tactic.

c) The Nature of Human Agency

Why is the neolithic period seen as significant in the definition? Webb[15] argues that it was during this time that man's technology evolved to the point where humans *"ceased to be in any ordinary sense a part of nature"*.

The time frame used in the UK to define native status is not automatically transferable to other circumstances. Historically there may not have been such clear floral transitions as we saw in our glaciations[16] making it harder to resolve gradual processes of floral change. In other countries the 'neolithic' period may also not match the local transition to intensive human influence. Schwartz [17] confirms that in the United States of America the arrival of European settlers often denotes the moment at which human effects became seen as no longer natural. However there is no absolute consensus. He gives examples from the USA of where native status is accepted for any plant recorded in the first comprehensive floras, which are often of a much later date. He also points to exceptions where plants that are known to have been introduced long before the Europeans arrived are classed as non-native.

Following the overall logic that native status is determined by the technological level of the people who influence plant distribution, many indigenous tribal people, such as within the Amazon forest, would even today be classed as being 'natural'. This means that contemporary human influence on species distribution in such countries would need to be sub-classified according to which group of humans we are referring to - a concept that seems strained at best and unfairly represents the adverse environmental impact that aboriginal people have had historically.

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structure' (1999) 80(2) *Ecology* 416-428.
[15] Op.cit. n.4.
[16] Brown *op.cit*. n.5.
[17] Op.cit. n. 9.

One paradox that arises in the UK relates to species that did not manage to cross boundaries by the critical Neolithic period but which were practically certain to colonise if only they had had more time,[18] such as *Acer pseudoplatanus* (sycamore). Imagine, for example, a species of continental Europe that was responding to environmental change by coming ever closer to the UK. If we stepped in just when it was on the verge of crossing the English Channel, and pre-empted its 'natural' arrival by moving it ourselves, that act will forever preclude from it native status. The concept is therefore so unforgiving of an individual action, the degrading consequences of which are borne by everyone and by the tainted species itself forevermore, that it is reminiscent of the fall from grace in Eden.

At first sight the extent to which the 'human touch' can cause a corruption of a species' status may seem surprising. Actually it is not uncommon to find the paradigms of conservation biology hinged on the presence or absence of human action. The fundamental hierarchy of habitat classification into *natural, semi-natural* and *artificial* is based on degree and nature of human impact,[19] whilst the concept that people and nature cannot co-exist is woven into policies such as the National Parks strategy of the USA.[20] Also in the USA, endangered populations of species known to have been cultivated by man have been denied legal protection.[21] In the UK naturalness is explicitly identified as a key criterion for assessing the value of habitats.[22]

It is worth noting however that the belief in the separation of man and nature is increasingly under attack on grounds that range from the most pragmatic through to a post-structuralist re-assessment of the philosophical bias of Western societies.[23] On functional grounds human influence is not only becoming globally pervasive, but is increasingly recognised as having widely been so through history. Many 'pristine natural' habitats have in fact been significantly modified by indigenous humans, but in

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[18] Brown *op.cit*. n.5.
[19] Op.cit.n.2.
[20] Budiansky S, *Nature's Keepers*. (Weidenfeld and Nicholson, London, 1995).
[21] Burgess M.A, 'Cultural responsibility in the preservation of local economic plant resources' (1994) 3 *Biodiversity and Conservation* 126-136.
[22] Ratcliffe D, (ed.) *A Nature Conservation Review: the Selection of Biological Sites of National Importance to Nature Conservation in Britain. Vol 1*. (Cambridge University Press, Cambridge, 1977).
[23] Peterken G, *Natural Woodlands* (Cambridge University Press, Cambridge, 1996); Katz C, 'Whose nature, whose culture? Private productions of space and the "preservation" of nature' in B. Braun and N. Castree (Eds) *Remaking Reality - Nature at the Millenium.* (Routledge, London, 1998) 46-63.

ways that were overlooked by the developed world or colonising Europeans. As Callicott[24] states, European immigrants *"in fact found a man-made landscape, but they thought it was a wilderness because it didn't look like the man-made landscapes that they had left behind*". As this evidence accumulates, and as human influence, good and bad, becomes more explicitly pervasive, we can either prepare to 'lose' naturalness in the coming decades, or we have to rethink some of our defining concepts.[25]

So complicated are these issues of definition in practice that some authors have argued that the term native and alien should be dropped entirely[26] suggesting that a functional classification of the effects and behaviour of a species is more valuable and would inspire a clearer focus. Very few conservationists are yet prepared to even imagine such a radical step, but if nothing else the debate serves to emphasise that the concept of native and non-native are based on value judgements associated with a selective timeframe, and a selective categorisation of which types of humans can legitimately act as modes of dispersal, rather than reflecting biological absolutes.

Luken[27] argues that the recent growth in concern about the global spread of non-natives does not simply reflect a growing problem, since the 'problem' has existed for centuries. Instead it represents an evolution of value judgements. Given that the introduction of non-native plants is effectively inevitable, the perceived conflict is actually being aggravated by the processes of nature preservation that define impossible boundaries, conceptual as well as physical, to species movement. Climate change is bound to influence the distribution of species - if they cross our conceptual boundaries then they become 'invaders'.[28]

One issue is that conservation and preservation of nature are really value-driven activities that get confused with objective science. The denial of human influence on

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[24] Callicott J. B, (1991) 'The wilderness idea revisited: the sustainable development alternative' (1991) 13 *Environmental Professional* 236-245.
[25] Op.cit.n20.
[26] Brown *op.cit*. n.5; Luken J.O, 'Valuing plants in natural areas' (1994) 14 *Natural Areas Journal* 295-299; Salisbury E. (1961) *Weeds and Aliens*. Collins New Naturalist Series 43. (Collins, London, 1961).
[27] Ibid.
[28] Dukes J.S. & Mooney H.A., 'Does global change increase the success of biological invaders?' (1999) 14(4) *Trends in Ecology and Evolution* 135-139.

nature reflects our values rather than the reality of our environment. Luken[29] argues that *"the unwillingness – or inability – of ecologists to successfully incorporate the human species in ecological theory has by default devalued ecological processes associated with human activity"*. This can lead to bizarre situations, for example the paradox of how conservationists increasingly pour resources and management effort into sites to keep them 'natural' is explored by various authors.[30]

Environmental change is a reality, and the consequences of that can not be denied. For example Kellman[31] argues that fragmentation will change the components and organisation of plant and animal communities, and the role of the species in them, to such a degree that the ecology of these systems will almost have to be learnt anew. Organisms respond to the context that they live in, and when the contexts change the organisms will also change. Kellman also argues that attempts to conserve pre-conceived models of how communities should be, as intact microcosms of original communities, is unrealistic and can become *"a form of nostalgia for a world that can no longer exist"*. He argues that the pre-occupation with study of species' specialised roles has diverted attention from the study of ecological flexibility. Indeed any even superficial awareness of how global and local environments have changed over just a few hundred years shows that autecological and synecological flexibility must be widespread in nature. The threats that come from fragmentation are threats to a pre-conceived model structure, and are not always real threats at all. Allowing plants and animals to assume new and 'unnatural' roles may be important to the maintained integrity of these fragments.

Perhaps the most sterile and ultimately self-defeating aspect of such traditional philosophical distinctions is that they cannot properly accommodate the role that humans will have to play in biodiversity protection in the future. Classifications such as *native* and *natural* provide full scope for humans, or at least developed world humans, to act as forces of degradation but make no allowance for positive influence where we are acting in harmony with nature.[32] . There is not room for a full analysis

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[29] Op.cit.n26.
[30] Duffey E., *Nature Reserves and Wildlife*. (Heinemann Educational Books, London, 1974): and see Peterken op.cit.n 23..
[31] Kellman M. (1996) 'Redefining roles: plant community reorganization and species preservation in fragmented systems' (1996) 5 *Global Ecology and Biogeography Letters* 111-116.
[32] Jordan W.R., '"Sunflower forest": ecological restoration as the basis for a new conservation

here, but it is apparent that traditional, defensive, site-focused conservation strategies are fundamentally flawed. Nature reserves are poorly located, too small and simply unable to cope with fluid processes such as climate change.[33] More and more often conservation thinkers anticipate the need for active repair, restoration and management of even what were once natural landscapes.[34] The UK Biodiversity Action Plan hinges on remedial strategies such as Species Recovery programmes.[35] What is the future of nature conservation if every restorative intervention is instantly degraded by the fact that people did it?

Functional Implications of Nativeness

Of course definitions and philosophies are often muddy when dealing with the complex realities of the natural world and arguably the more important issue is the functional importance of the native/alien classification. Let us therefore accept even the most conservative concept of native. Why is the distinction significant?

There are five common arguments that are forwarded concerning the importance of native plants and the dangers of introduced aliens or exotic species.[36]

1) Natives grow better, or are more hardy or disease resistant than exotics.

Simple observation and common experience quickly refute this argument. Whilst it is always possible to find instances where poorly chosen exotics perform badly, agronomists, foresters and horticulturists have shown over centuries that many of them can grow outside of their places of origin without problems.

At sub-specific level a lot of work on 'provenance' of seed source has been done by foresters. Whilst again it is possible to find comparisons where locally adapted

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paradigm' in Baldwin A.D., De Luce J & Pletsch C (eds) *Beyond Preservation - Restoring And Inventing Landscapes.* {University Of Minnesota Press, Minneapolis, 1994).

[33] Shafer C.L. *Nature Reserves: Island Theory and Conservation Practice* .(Smithsonian Institution Press, Washington, 1990); Kendle and Forbes, op.cit.n.3.

[34] See for example Wilson E.O (1989) 'Conservation: the next hundred years' in Western D & Pearl M (eds) *Conservation For The Twenty First Century*. (Oxford University Press, New York, 1989) 1-10.

[35] Department of the Environment *Biodiversity: the UK Action Plan*. (HMSO Cm 3556, London, 1994).

[36] Hitchmough J. and Dunnett N. (1996) Sustainable Planting Schemes (1996) 251 *Landscape Design* 43-46; Gilbert O.L. & Anderson P. *Habitat Creation and Repair*. (Oxford University Press, Oxford, 1998); Worrell R. 'Choosing seed sources for native species' *Tree News* Autumn 1998. 12-14; Flora Locale 'Putting wild plants back where they belong: what to plant and where to plant it (restoring native vegetation in the countryside and in towns)' *Flora Locale Draft Technical Guidance Notes 2.* Internet site: http://www.naturebureau.co.uk/pages/floraloc/guidenot.htm

provenances outperform imported stock,[37] there are also examples where the opposite is true.[38] This is not surprising. Natural selection is not perfect, and could never be in a world where the environment changes, and where stochastic processes affect survival and dispersal. There is no absolute rule that says that oak or beech trees that grow in the UK today, reflecting post glacial migration patterns, must have a gene set that is better than those growing in France.[39]

Not only can non-natives grow well, and not only are we dependent on many of them for food, shelter clothes etc. but some can perform functions that ultimately benefit native species, such as the use of soil-building species in derelict land reclamation. These potential benefits are reviewed by Williams[40] who argues that possible functional benefits of non-natives in natural habitats include:

- structural diversification and niche creation
- food supply
- facilitation of regeneration of natives (nurse species)
- modification of disturbance (e.g. reducing erosion or fires)
- directly compensating for the loss of a native that was important for ecosystem function.

All of these positive functions have been performed by non-natives that in other ways have no harmful effects on the system.[41] The benefits will be particularly clear where environmental conditions are different from those normally encountered by natives, such as on urban or post-industrial soils.

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[37] Jones A.T. and Evans P.R. 'A comparison of the growth and morphology of native and commercially obtained continental European *Cratagus monogyna* Jacq. (Hawthorn) at an upland site' (1994) 20 *Watsonia* 97-103; Worrell R. 'A comparison between European continental and British provenances of some British native trees: a comparison of growth, survival and stem form' (1992) 65 *Forestry* 253-80; and Worrell, op. cit. n. 36.
[38] Lines R. (1987) *Choice of Seed Origin for the Main Forest Species.* Forestry Commission Bulletin 66. (HMSO, London 1987).
[39] Brown, op.cit. n.5.
[40] Williams C.E. 'Potential valuable ecological functions of non-indigenous plants'.in J.O. Luken & J.W. Thieret (Eds) *Assessment and Management of Plant Invasions.* (Springer, New York 1997) 26-34.
[41] See for example Lugo A.E. 'Maintaining an open mind on exotic species' in Meffe G.K & Carroll C.R. (eds) *Principles of Conservation Biology* (Sinauer Asociates, Sunderland Massachusetts 1997) pp 245-247.

It is true that many exotic species are not so well adapted as to form reproducing and self-sustaining populations out of their range, but that is actually one of their advantages in many land use situations as they are unlikely to become weeds (see below).

2) Exotics are likely to become invasive and outcompete natives

Whilst being identified as less well adapted to our climate than natives, exotics are simultaneously expected to grow much better and to become invasive weeds.[42] In the UK we have carried out an experiment with great breadth and gusto to see how true this may be. For centuries a vast list of plant importations has been superimposed over what, in European terms, is a depauperate and incomplete native flora open to many anthropogenic disturbances. As a consequence we do have a set of difficult introduced weeds to contend with, but it is also striking how few of the full range of introduced exotic plants are aggressive and problematical.

Invasiveness is of course a serious problem and weed invasions are causing havoc in habitats worldwide. An extensive range of legislation and policy necessarily underpins international and national attempts to control the spread of potentially damaging species, but for this to be effective it is important for implementation to be well focused. The greatest source of confusion is that it is false to attribute the risk of invasion to aliens alone.

Despite frequent implied associations in the literature, invasiveness and exotic status are not really closely correlated. Most aliens in the UK are not exotic weeds, whilst some natives are. The native Purple Moor Grass, *Molinia careulea*, has recently been identified as invasive and damaging within National Parks and other important UK upland sites.[43] Bracken, *Pteridium aquilinum*, is also a serious 'weed' of many areas particularly heathland despite being again a natural member of the plant community.[44] Habitat invasions by other invasive natives such as *Ulex*, *Rubus*, *Epilobium*, *Salix*, *Betula* and *Fraxinus* are also commonly seen but less commonly identified as a problem because they are native and therefore much less frequently categorised as 'not wanted' or 'out of place'.

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[42] Gilbert and Anderson op. cit. n.46.
[43] Brown P. 'Moorland succombs to advance of purple grass' (1999) *The Guardian* 7 January.
[44] Pakeman R.J & Marrs R.H. 'Bracken' (1993) 40(3) *Biologist* 105-109.

There is therefore a subtle issue of classification involved that helps to explain why aliens are 'weeds' more often than natives. P?sek[45] even goes so far as to suggest that the term 'invasive' should only be applied to alien species, whilst for natives we should use the less pejorative term 'expanding', which is more like semantic politics than an objective assessment.

On reflection, the invasive ability of natives is not surprising. These are plants that have proven reproductive ability within their climatic range and they are often very able to exploit opportunities created by, say, excessive habitat disturbance or land use change. If exotics have any unique capability to be weeds, it is because out of those that can reproduce, some of them may lack local pests or pathogens that would put constraints on their reproductive ability. However the disappearance of constraints can also happen to natives, for example if a major predator goes through a population decline.[46] Randell[47] presents interesting cases that illustrate how values can be complex. Sometimes existing but rare indigenous species can become weeds because of changes in land management. For example in the USA several *Quercus* spp. invade prairie remnants when fires are suppressed. Prescribed burns then have to be introduced to maintain a 'more natural' plant community, but it is unclear whether the original burning frequency itself was really natural or a result of management by indigenous Americans that has been 'overlooked' by European settlers.[48]

The concept of a weed as a plant where it is unwanted is emphasised by Randell[49] who argues that in natural areas it is necessary for managers to first clarify what they are managing for before they can decide whether a species may interfere with those goals. However in conservation work, goals are often poorly elucidated or self-referencing. For example to state that all non-natives will be controlled is to identify the tactic, but not its purpose.

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[45] P?sek P.'On the terminology used in plant invasion studies' in P?sek P, Prach K, Rejmanek M and Wade M, (eds) *Plant Invasions – General Aspects and Special Problems.* (SPB Academic Publishing, Amsterdam, 1995) 71-81.
[46] Garrott R.A., White P.J. & Vanderbilt White C.A. 'Overabundance: an issue for conservation biologists?' (1993) 5 *Conservation Biology* 283-296.
[47] Randell J.M. (1997) 'Defining weeds of natural areas' in J.O. Luken J.O. & Thieret J.W.(eds) *Assessment and Management of Plant Invasions.* (Springer, New York,1997) 18-25.
[48] Budiansky op.cit.n. 20.
[48] Randell J.M. (1997) 'Defining weeds of natural areas' in J.O. Luken J.O. & Thieret J.W.(eds) *Assessment and Management of Plant Invasions.* (Springer, New York,1997) 18-25.
[49] Op.cit n. 47.

3) Natives support many more associated species than exotic species.

It is known that there can be a close relationship between native plants and co-adapted feeding invertebrates. In the UK the single most important paper presenting this case is Kennedy & Southwood[50] who tabulated the range of leaf-feeding species associated in literature with a selection of native and non-native woody plants. The trend of higher levels of invertebrate association with native plants is convincingly real. (Although of course the trend is not absolute, some natives (e.g. *Ilex*) score much lower than some introduced species.) However there are many exceptions to this rule and the assumption that native plants inherently support more associated wildlife does not hold true for all circumstances or for other forms of plant-animal and plant-plant relations. For example:

- Non-natives can carry a high biomass of those invertebrates that they do support, thereby fuelling a food chain.[51] This may be because they lack some of the defences against invertebrate feeding that would be shown by the co-adapted native plants.

- Non-natives may have beneficial structural effects within a habitat, such as providing shelter for over-wintering birds or habitats for lower plants (the lichen flora association with non-natives seems much more complex than the invertebrate pattern with sycamore scoring highly).[52]

- They may produce animal food at times when the native flora does not. In the UK *Buddleja davidii* is usually welcome in wildflower gardens because of the large butterfly populations supported even though it has invaded many natural habitats.

- Non-natives may be able to survive in unusual circumstances where the native flora will find it difficult. For example sycamore is one of the most wind tolerant species available for planting in the UK and provides some woodland cover in areas too exposed for native trees.

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[50] Kennedy C.E.J. & Southwood T.R.E. 'The number of insects associated with British trees; a re-analysis' (1984) 53 *Journal of Animal Ecology* 455-478.
[51] Gilbert, O.L., *The Ecology Of Urban Habitats*. (Chapman and Hall Ltd, London 1989).
[52] Harding P.T. & Rose F. *Pasture Woodlands in Lowland Britain*. (Institute of Terrestrial Ecology, Abbots Ripton, 1986).

- The range of associated species may not be able to colonise all habitats or all life stages of the natives they are associated with. The number of invertebrates found on young oaks in inner cities may not be very different from those found on young sycamore in similar locations. Conversely for most of our introduced species we have never explored the invertebrate list that they may support if allowed to become veteran trees in ancient woods in the countryside.

So on balance, natives do often support more feeding invertebrates, but this does not merit an assumption that the conservation value of non-natives is negligible.

4) Native genetic diversity needs to be protected as part of the world's store of biodiversity

It is unquestionable that native plants represent each country's own slice of the world's genetic diversity and there is a local responsibility to protect them. It is, however, worth balancing this point with a recognition that, from a global perspective, non-natives may represent a resource of genetic diversity that has been lost or suffered massive depletion in its country of origin. One example is the Bermuda Cedar (*Juniperus bermudiana*), which is a self regenerating timber tree in St Helena but is a threatened species in Bermuda.[53] Lugo[54] tells a similar story with *Delonix regia*, naturalised and common in Puerto Rico, and in danger of extinction in its country of origin, Madagascar.

Increasingly conservationists will be faced with situations where a species' original habitat has become unsuitable because of environmental change, and deliberate translocation outside of its former range is the only option.[55] Similarly where there is only a constrained vulnerable population, extension outside of the native range may be seen as an important insurance strategy.[56]

5) Native plants are regionally appropriate and define our landscape character

The concept of regionally appropriate vegetation clearly has importance. Plants do

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[53] Spooner B., Upson T., Kendle A.D. & Drucker G. (1993) 'Environmental Profile of St Helena' in Mander M, Dala-Clayton B and Bass A. *Sustainable Environment and Development Strategy and Action Plan for St Helena. Vol 2*. (RBG Kew and the International Institute for Environment and Development. Government of St Helena, St Helena Island, 1993).
[54] Op.cit.n.41.
[55] Davis M.B. 'Lags in vegetation response to greenhouse warming' (1989) 15 *Climatic Change* 75-82.

help to define the landscape character of an area. However once again it does not follow that native plants are *always* the most appropriate and it certainly does not follow that non-natives do not have a place. The pine forests of Scotland (*Pinus sylvestris*) are a fundamental part of the atmosphere and character of the region, but many would feel that the landscape of Breckland, East Anglia in England would also be compromised if we lost the introduced shelter-belts of the same tree.[57] How much truer this is for the rich and eclectic cultural and historical mix reflected by urban civilization. The planted Plane trees of London (*Platanus x hispanica*) now define the character of the city, as can the unique communities of natives and naturalised aliens that add so much richness to the environments we live in, but are so often dismissed as 'weeds'.[58]

In Britain, the Black Environment Network (BEN) works to open up opportunities and involve ethnic minorities and disadvantaged people in environmental debates, which are frequently dominated by white middle classes.[59] To understand why, BEN have developed a concern for the different, often subtle, barriers to participation. One issue that they have identified is that the 'native plant good, alien plant bad' terminology, although not directed at people, nevertheless can have undesirable overtones for immigrant communities.

A more positive social message, that also makes sense from an urban ecological perspective, is to celebrate the rich origins of the species that co-exist in cities, including those we use and love and depend upon. This requires that we appreciate plants for their diversity, interest, beauty and geographical and cultural histories rather than condemning them because they 'did not originate here'. This perspective opens doors to ethnic groups, by recognising the positive side of the urban mix and providing opportunities for dialogue to begin. More fundamentally it also reminds all of us that protection of local nature is just a tactic in the wider issue of protecting global nature.

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[56] Maunder M. Plant reintroduction: an overview. (1992) 1 *Biodiversity and Conservation* 51-61.
[57] Brown, op.cit.n.5
[58] Op. cit. n. 51.
[59] Wong J.L. 'The cultural and social values of plants and landscapes' in Stoneham J.A. & Kendle A.D. (eds) *Plants And Human Well-Being*. (The Federation To Promote Horticulture For Disabled People, Gillingham, 1997).

Conclusions

The above review amounts mostly to an illustration of how, in a complex environment superimposed with equally complex human history, culture, values and aspirations, it is impossible to characterise one group of plants as 'superior' than others. This is especially true when the classification system is as nebulous and as value-laden as our definition of native. In essence it is clear that all of the arguments given to favour the use of native plants in the landscape contain truths, but they can never be always true and they can not all be acted on. To turn instances into over-arching certainties is to fall foul of eco-political correctness.

Some sources of disquiet arise from deep philosophical issues associated with how we see our environment and our place in it. Luken[60] identifies the contemporary fascination with the subject as being rooted in cultural values as much as in biological realities. We are creatures of our time, and to some extent reflecting current cultural values is inevitable, but it is worth reflecting on what these cultural values actually are.

Leaving aside the convoluted details, we have seen that the definition of native hinges on the perception that human agency can only be opposed to nature, and indeed to be human is to be the very embodiment of what is not nature. This is a deeply rooted perception in our society but one that is perhaps at the root of our current environmental crisis, an ultimately sterile distinction that is not valid but that effectively undermines the goal of fostering positive human influence by denying us a place in a sustainable world.[61]

Non-natives have been part of our lives, landscapes and civilisations for a long time, especially in Europe. What drives the recent evolution of value systems that categorises these species as 'not appropriate'? Latour[62] sees environmental arguments that hinge on the idea that 'something is better because it belongs here' as a revival of what he classes as a *domestic* position in debate. He argues that domesticity as an unquestionable validation has largely disappeared from social debates over the last

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[60] Op.cit.n.26.
[61] Jordan op.cit.n.32; Brown op.cit.n.5; Budiansky op.cit.n. 20.
[62] Latour B, 'To modernise or ecologise? That is the question' in Braun B and Castree N (eds) *Remaking Reality - Nature at the Millenium.* (Routledge, London, 1997) 221-242.

century as horizons have become wider, but it has been revived by some ecological movements in ways that surprisingly ally them with far-right philosophies.

It may not be surprising therefore, although it is disturbing, that Nazi Germany had a strong policy on landscape quality and nationally correct vegetation.[63] Only appropriate German species were to be encouraged. In modern day Germany there are still regions where planners insist that only natives can be used in the public landscape. We are living through times when politics are dominated by revival of ethnic boundaries and the resulting conflicts. This puts a sobering slant on Luken's argument[64] that directions of scientific and ecological concern closely reflect social attitudes.

Latour[65] also raises a more fundamental question concerning the very role that ecological principles can play in society. Ecology as a science is something of a paradox - it aims to study relations and holism, but the scientific method is inevitably concerned with isolation and reduction because the wider picture is always uncertain and unknowable. The political dimensions of ecology, the environmental movements, show similar paradoxes. We can aim to see the whole picture, but we know that we will not succeed and the temptation to focus on isolated issues and campaigns is always great.

In essence Latour[66] argues that ecology's greatest contribution as a political, and perhaps scientific, movement would be if it recognised and faced this ultimate uncertainty and considered the implications. We need a politics, and a science, which is explicit about the limits to our understanding. He argues that ecology forces people to question, to look for relations and inter-connections. At its best it requires that we consider not only superficial issues but also to be prepared to raise questions such as what it is to be human and whether our very humanity is defined by our relation to nature. Conversely he sees an insistence on raising nature above humans as being as impossible and as damaging as saying that humans must dominate nature. He also argues that an awareness that things are connected does not merit any claim that we understand these connections and therefore always know what to do. From this

[63] Hottentrèger G. (1992) 'New flowers, new gardens' (1992) 12(3) *Journal of Garden History* 207.
[64] Op.cit.n.26.
[65] Op. cit.n 62.

perspective, if we insist, incorrectly, that 'native is inevitably superior' this is not just a trivial matter. Such a stance reflects a sort of fundamentalism that betrays the very value of ecology as a means of problem solving.

So in conclusion, are attempts to produce policies or legislation against non-native species justified? Too often the use of natives is justified with arguments that sound strong but are actually naive or anecdotal. If nothing else, such positions are too weak to hold and ultimately self-defeating. A proper defense of the role of natives comes from a realistic and thorough assessment of the part that non-natives have played in the development of the human landscape, and of the impossibility and undesirability of removing that history. Perhaps more significantly, an attempt to legislate against non-natives will increasingly crumble against the realities of environmental change – a Canute-like attempt to demand that the environment remains static. This seems particularly short sighted at a time when we are facing great environmental change, and the priority is to rapidly develop techniques and policies that allow us to deal with environmental shifts rather than deny them.

[66] Ibid.

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