

Chapter 18

Between Nativism and Cosmopolitanism: Framing and Reframing in Invasion Biology

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18.1 Introduction

'Place' is a contested concept in conservation and restoration. In this chapter we will focus on invasion biology to examine some of the topics related to this controversial concept. The recent emergence of this discipline has gone hand-in-hand with heated debates on the so-called exotic species issue. Apparently, these debates have ended in stalemate, with only two extreme positions: nativism and cosmopolitanism. To break up this dichotomy and to give the debate a new impulse, we will explore the different metaphors that can be found within the scientific discipline of invasion biology in some detail.

In recent literature there has been growing attention for the role of metaphors in environmentalism and nature conservation. Our ordinary conceptual system is fundamentally metaphorical in nature. With the help of metaphors we can understand the abstract and unfamiliar in terms of the concrete and familiar. Metaphors not only structure how we perceive and think, but also how we should act (Lakoff & Johnson, 1980). The metaphor of nature as a book will provoke a different attitude and kind of nature management than the metaphor of nature as a machine, an organism, a network and so on (Mills, 1982; Ebenreck, 1996; Harré, Brockmeier & Mühlhäusler, 1999).

This chapter examines the metaphors that are frequently used in framing invasion biology. We will argue that these metaphors, like all metaphors, are restricted in range and relevance, and that we should adopt a multiple vision of metaphors. The adoption and development of such a multiple vision will open up new space for communication and cooperation across the borders between people from different disciplines, and between experts and laypeople.

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18.2 Bioinvaders: The Next Plague

Recently, invasive species have made headlines. In *Newsweek*, Marc Margolis (2007) sounded the alarm under the heading *Bioinvaders: The Next Plague*. 'An increasing number of scientists now agree that bioinvasion is the most immediate and surely the fastest-growing threat to plant and animal life on the planet after deforestation and breakneck development,' Margolis quotes Mark Spencer, an expert on invasive species at the Natural History Museum in London: 'We are at an ecological tipping point.'

Half a century ago, the famous zoologist Charles Elton was one of the first to draw attention to the dangers of invasive species. 'We must make no mistake,' he warned in *The Ecology of Invasions by Animals and Plants* (1958), a book which signaled the birth of invasion biology, 'we are seeing one of the greatest convolutions of the world's flora and fauna.' Elton framed the challenge confronting us as a 'battle' to 'determine the fate of the world,' the latter a quote from Conan Doyle's book, *The Lost World* (cf. Davis, 2006, p. 55).

To illustrate the menace of invasive species, Margolis mentions how *Achatina fulica*, 'a fat and ugly mollusc,' better known as the giant African land snail, extensively invaded Brazil after it was imported in 1988 as a cheap substitute for escargot.

Growing to the size of a man's fist and weighing one kilogram or more, it lays up to 2,000 eggs a year and eats a tenth of its body weight a day, devouring everything from lettuce to mouse droppings to its own dead comrades. Worse, it can also carry rat lungworm, a nasty parasite that burrows into the human brain and causes meningitis, and another that can rupture the intestines.

Other frightening examples of invasive species are the zebra mussels (*Dreissena polymorpha*) from the Caspian and Black Sea region that affect fisheries, mollusc diversity, and electric-power generation in Canada and the United States, the water hyacinth (*Eichornia crassipes*) from the Amazon that chokes African and Asian waterways, and the melaleuca tree (*Melaleuca quinquenervia*) that was imported from Australia to drain the swamps of south Florida in the 1930s, but that today has invaded more than 600,000 ha of wetland and threatens to destroy the Everglades.¹

Although Charles Elton warned of the threats posed by invasive species as early as 1958, it took several decades for invasion biology to develop as a recognized research area in its own right. By the end of the 1990s, the new discipline was becoming increasingly institutionalized with the establishment of two journals, *Diversity and Distributions*, founded in 1998, and *Biological Invasions*, founded in

¹Its impenetrable stands displace virtually all other vegetation, and its dense root mat oozes substances poisonous to other plants. Its airborne secretions are poisonous to humans and cause severe respiratory and skin irritation. Conservationists have tried to burn it out, but it is fire-adapted and spreads by burning. Its inner bark is a wet, insulating sponge, while its outer bark is dry, and its leaves are laced with a flammable oil. Although it sucks up water four times as fast as the native sawgrass, it burns with explosive force. Several days after a devastating fire, the tree sprouts new growth and rains millions of seeds onto burnt land. They germinate in only three days, and seedlings may reach six feet in their first year' (Shrader-Frechette, 2001, p. 508).

1999. In 1997 the United Nations launched the Global Invasive Species Programme (GISP). In 1998, the European Environment Agency called invasive species one of the principal threats to Europe's biodiversity. In 1999, President Clinton of the USA signed Executive Order 13112, which authorized federal agencies to prevent the introduction of alien invasive species, control the spread of alien invasive species in the United States, and restore native species and habitats that had been invaded (Davis, 2006).

Where does this overwhelming attention for invasive species come from? In fact, there is nothing new about wandering wildlife. However, since globalization took off, more plants and animals have become globetrotters than ever before. As trade, travel, transport and tourism boom, the world is becoming more and more borderless and, by the same token, it is becoming increasingly vulnerable to invasive species.

Bioinvasion has an enormous impact on the economy and the environment. Globally, bioinvasion's toll is estimated at approximately \$1.4 trillion a year (Margolis, 2007). Bioinvasion goes hand-in-hand with substantial decreases in biodiversity. According to a 1998 study, bioinvasion is the second largest cause of biodiversity loss in the USA, after habitat destruction (Enserink, 1999). Worldwide, about 80% of endangered species could suffer losses due to competition with, or predation by, invasive species. Economic losses occur due to production loss in agriculture and forestry, and to loss from recreational and tourist revenues. Because invasive species can serve as vectors for human disease such as malaria or mad-cow disease, bioinvasion also contributes substantially to health care costs.²

Although invasive species create complex and costly problems, getting rid of them can often prove equally problematic. Eradication programs for invasive species are often highly controversial. This is true for mechanical, chemical as well as biological methods.

Mechanical control involves removal of invasive species by hand or with machines. Mechanical methods for plant control include hand pulling, mowing and burning. Animals are removed by techniques such as hunting and trapping. Mechanical treatment is very labor intensive and must often be repeated several times to be effective.

Chemical methods that make use of biocides such as herbicides, insecticides and piscicides, can be very effective but also counterproductive due to possible contamination of land and water resources and the unintended but unavoidable killing of native species. Margolis mentions the dilemma of the chemical control of the mosquitofish that was imported from the Philippines to the marshlands of southern China to eat mosquitoes, and that lately has become a menace to the existence of several native aquatic species. 'The only way to kill the mosquitofish is by dousing the water with rotenone – a poison so potent it also kills almost everything else that swims. Still, doing nothing may threaten China's most important species.'

² Margolis points out that the burden of bioinvasion falls unevenly across the world. 'The human toll is often devastating to the poorest nations, where a failed crop can start a famine. Implacable exotic pests like the cassava mealybug, gray leaf spot and witchweed claim up to half the harvests in the poorest countries.'

Biological control programs involve the release of natural enemies (predators and parasites) to eliminate invasive species or at least restrict their spread. These programs are considered to be the cheapest, most efficient and least damaging to the environment, but they can also have disastrous effects if the released species do not prey upon the invasive species, but cause havoc to native species and ecosystems instead.

Of course, 'prevention is better than cure'. Many governments try to control and curb the entry of invasive species into their territory through customs controls and quarantine regulations. These practices, however, are inadequate safeguards against the flood of invasive species in a globalizing and increasingly borderless world. At present, 165 million sealed containers are being shipped around the world, a number that is far too large for detailed inspection by customs officers. In the USA, for instance, some 1,300 officers are responsible for inspecting 410,000 planes and 50,000 ships (McNeely, 2004).

Finally, in light of the aforementioned remedies, which often turned out to be more problematic than the disease they were supposed to cure or prevent, some are convinced that we have no choice but to learn to live with the enemy, and put bioinvaders to work. As an example, Margolis refers to a team of researchers who help rural families in India turn *lantana camara*, a weed that overruns native woodlands, to good use as a surrogate for bamboo.

18.3 Conflicts Over Welfare and Words

Chemical control programs are often counterproductive and can give rise to severe conflicts with local residents. A typical example is the controversy about the northern pike in Lake Davis in California, USA (Braxton Little, 1997). In 1994, authorities planned to spray Lake Davis with 26,000 gallons of poison to kill all the fish. This was to prevent the rapacious, non-native pike from migrating down the Feather River, where it could destroy the state's commercial sport-fishing industry. However, this plan faced opposition from Portola's 2,500 residents, whose domestic water supply came from the lake. While officials claimed that the chemicals used to kill fish would pose no threat to human health, critics of the state project feared that the poison would also affect the health of people who drank water from Lake Davis because it would contain confirmed animal carcinogens. Portola residents petitioned, protested, marched on the state capital and sued the Fish and Game Department. However, the controversial chemical treatment was still administered in October of 1997.³

³ The plan failed. Some of the pike probably survived in tributary streams above the lake. The voracious invaders were rediscovered in 1999 and now again threaten California's multimillion-dollar Chinook salmon and steelhead fisheries. Late in the summer of 2007, ten years after the first effort, government biologists will deploy lethal doses of fish poison once more. Only this time, most residents of Portola have accepted the plan (Bland, 2006).

In addition to health issues, animal welfare issues are another bone of contention in the resistance to eradication programs for invasive species. As Michael E. Soulé remarked in his presidential address on alien species at the third annual meeting of the Society for Conservation Biology in 1989, ‘Conflicts between animal rights groups and management agencies are increasing in frequency and cost – the cost being borne by endangered species and ecosystems as well as by the public that pays for expensive rescue operations and time-consuming court battles’ (Soulé, 1990, p. 235). A famous example is the controversy about feral pigs in Hawaii between the Nature Conservancy and People for the Ethical Treatment of Animals (PETA). While conservation biologists argued that the pigs should be killed and removed because they threaten Hawaii’s biodiversity, animal activists argued that it is wrong to harm and kill the pigs because they are sentient animals (Woods, 2001).

Human welfare is yet another contested area. In 1995 the government of South Africa introduced a Working for Water Programme that had to meet two objectives: biodiversity conservation and poverty alleviation. Local communities were given temporary employment using poverty relief funding to clear alien vegetation all over the country. However, two controversies arose.

The first is that many of the alien species serve as fuelwood or food for some of the poorest communities. In such cases the benefits brought by employment in the project are outweighed by the loss of such vegetation for local livelihoods. The second controversy is that commercial forestry, one of the enterprises seen as potentially making a contribution to poverty alleviation, notably through the transfer of state forests to community ownership, is largely dependent on alien species (Kepe, Saruchera, & Whande, 2004).

That these conflicts are often so contentious and difficult to solve is at least partially due to the language used to frame the problem of invasive species. Terms like ‘alien’, ‘exotic’ and ‘non-native’ have a racist or xenophobic ring to many people. As philosopher Mark Sagoff has noted, those who want to eradicate non-native species often attribute to them the same infamous qualities that xenophobes have attributed to immigrant groups. ‘These undesirable characteristics include sexual robustness, uncontrolled fecundity, low parental involvement with the young, tolerance for ‘degraded’ or squalid conditions, aggressiveness, predatory behavior, and so on’ (Sagoff, 1999).⁴

The use of such powerful language for purposes of persuasion in nature conservation and restoration projects often has a contradictory effect on those to whom it is addressed. This ‘boomerang effect’ occurred when the Fish and Wildlife Service in the USA launched a recovery plan for the San Francisco *lessingia* that included the removal of some Australian *eucalyptus* trees. *San Francisco Chronicle* columnist Ken Garcia bemoaned the plan for ‘killing trees in the name of some sort of ecological purity’ and took offence at the way the trees were described. In her coverage of this controversy, Kim Todd (2002) recorded a typical comment from a city official: ‘How many of us are ‘invasive exotics’ who have taken root in the San Francisco

⁴Daniel Simberloff (2003) believes that critics such as Sagoff have introduced a red herring and tend to ignore the ecological and economic impacts of bioinvasion.

soil, have thrived and flourished here, and now contribute to the wonderful mix that constitutes present-day San Francisco?’ She goes on to cite some similar comments:

A woman who runs a garden project in New York City says community members adamantly oppose creating a patch of native plants. They want to grow flowers from all over the world, reflecting their neighbourhood’s diversity. In Chicago, citizens rally behind the Argentinean monk parakeets that roost in city parks, adopting them as representatives of Chicago’s multiculturalism.

People not only take offence at metaphors with a racist and xenophobic resonance, they also feel annoyed at the frequent use of militaristic and combative metaphors within invasion biology (Chew and Laubichler, 2003). Comparing plant and animal species to ‘natural enemies’ and declaring ‘war’ on these species not only contributes to ‘a semantic field of war’ – which, as several authors pointed out, is especially irresponsible in the explosive political climate following the September 11th terrorist attacks (Larson, 2005; Larson, Nerlich & Wallis, 2005) – but it could also have a boomerang effect. This could lead to the alienation of the very communities the nature conservation and restoration movements need most. Herbert Schroeder has described how the use of warlike metaphors by volunteers has made it more difficult to resolve the Chicago restoration controversy. Whereas it had a positive effect on the volunteer’s commitment and dedication, the use of bellicose metaphors had an adverse effect on communication with local residents. Because volunteers saw themselves as combatants in a war to save nature, it was easy to view people who raised objections to restoration projects as enemies of nature. ‘The immediate impulse was to fight and try to defeat these enemies, rather than to try to understand their objections and look for ways to negotiate and compromise’ (Schroeder, 2000, p. 262).



Fig. 18.1 Invasive Old World climbing fern overtaking cypress trees in southern Florida. Photo: Peggy Greb, USDA Agricultural Research Service

18.4 Nativism Versus Cosmopolitanism

Some people came to the conclusion that invasion biology, by invoking xenophobic, racist and belligerent images and impressions, was telling the wrong story to gain acceptance and support from local communities. To reframe this story in a less counterproductive and more constructive manner, they suggested that bioinvasion should not be compared to immigration, i.e. the arrival of aggressive and sexually prolific intruders who threaten to degrade and destroy once stable native communities, but to cultural 'imperialism'. Exotic species should not be controlled and combated as unwanted aliens, nor should they be welcomed in the name of cosmopolitanism and multiculturalism, but they should be opposed and resisted in order to protect local diversity from the homogenizing forces of globalization.

William Jordan put this inversed storyline forward in his 1994 article *The Nazi Connection*. According to Jordan, preference for native species should not be compared to Nazism, but instead should be seen as a positive act designed to 'protect the oppressed and threatened group from extinction' (Jordan, 1994, p. 113), an example of which would be the creation of modern Israel.

More recently, this storyline was further developed by Ned Hettinger. Hettinger has accepted the claim made by some critics of racist and xenophobic anti-exotics rhetoric that invasions can add to the richness of species diversity. But this increase of biodiversity *within* local assemblages inevitably goes hand-in-hand with a decrease of biodiversity *between* the planet's ecological assemblages. If we shift the focus from intra-assemblage biodiversity to inter-assemblage biodiversity, it will become clear, Hettinger contends, that on a global scale bioinvasion will ultimately create 'biosimilarity' instead of biodiversity. 'In addition to this tragic loss in biodiversity, the spread of exotics also helps to undermine an important feature of human community. Globalisation of flora and fauna contributes to the loss of a human sense of place' (Hettinger, 2001, p. 217).

Jordan and Hettinger's reframing of bioinvasion from a reactionary rejection of disruptive immigration toward an argument for protecting local communities from cultural imperialism has met with criticism from William O'Brien. O'Brien admits that Jordan and Hettinger's reframing will be more acceptable and convincing among critics of anti-exotics rhetoric.

Concern about 'cultural survival' and protection of economic diversity in the face of corporate juggernauts like Wal-Mart reframes what might otherwise appear to be a reactionary anti-exotics argument, and presents it as an argument for justice. The anti-imperialism approach to the argument thus provides a potentially effective analogy that compares, for instance, European near-extirminations of the indigenous populations of North America with the ecological devastation wrought by exotic feral pigs in Florida and Hawaii. (O'Brien, 2006, p. 73)

At the same time, O'Brien is afraid that this new framework will only reproduce many of the more troubling aspects of the reactionary framework. The anti-imperialism approach corroborates rather than contradicts the rigid dichotomy between the purity of local 'authentic' cultures and the corrupting and contaminating influence of outside forces. However, the idea that globalization is equivalent

to homogenization has been challenged by postcolonial and cultural studies. These studies stress that globalization processes do not necessarily produce homogenization, but instead can create opportunities for hybridization, i.e. the mixing and blending of cultural identities that lead to new forms of diversity.

According to O'Brien, this shift of emphasis from homogenization to hybridization, and from nativism or provincialism to cosmopolitanism, should also affect our view of the exotic species issue. Here he refers to Michael Soulé's conception of a new area of ecological science – 'mixoecology' or 'recombinant ecology' – which rejects the premise that exotic species are a detriment (see also Peretti, 1998). We will come back to this concept at the end of the next section, which discusses the reframing of the exotic species issue within the scientific context.

Apparently the debate on the exotic species issue has ended in stalemate, with only two mutually exclusive positions: nativism, whether xenophobic or non-xenophobic, and cosmopolitanism. This is a typical example of dichotomistic reasoning where one is always forced to choose between no more than two options: *tertium non datur!* This black-and-white thinking inevitably brings conflicts to a head and leads to debate reaching a total deadlock.

To prevent such black-and-white thinking, we should first of all realize that every metaphor is restricted in range and relevance (Keulartz, 2007). Metaphors are like searchlights that highlight certain aspects and features, while obscuring others. According to Lakoff and Johnson, each metaphor 'is true for certain purposes, in certain respects, in certain contexts' (Lakoff & Johnson, 1980, p. 165). As Sara Ebenreck has written:

Rather than proceed as if any one metaphor is the finally correct metaphor, ethicists conscious of the constructive imagination at work in these basic metaphors might be more aware of the limits of any metaphorical construction and more open to the experiences and values embodied in alternate metaphoric constructions of the Earth. (Ebenreck, 1996, p. 14)

Moreover, the search for the single best metaphor is not without pitfalls and can lead to what Mark Meisner has called 'a sort of perceptual hegemony' (Meisner, 1995). This is the case if a metaphor ceases to be perceived as a metaphor and is taken literally, so that we are no longer able to recognize that it represents only a singular perspective.

In order to escape such one-sidedness, we should adopt what Donald Schön and Martin Rein used to call a 'double vision': 'the ability to act from a frame while cultivating awareness of alternative frames' (Schön & Rein, 1994, p. 207). We should learn to 'squint' so to speak, in order to see things from different angles simultaneously, or we should develop what philosopher of technology Don Ihde (1993) has called a 'compound eye'.

18.5 The Continuum from Restoration to Recombination

In the remainder of this chapter, we will try to break up the dichotomy of nativism versus cosmopolitanism and open up space for renewed debate by exploring the different frames that can be found within invasion biology. We argue for a double

vision, or more accurately, a multiple vision of the exotic species issue: nativism and cosmopolitanism should be considered as extremes of a broad continuum of options to frame this issue. We will start at the nativism pole, where invasive species are an anathema and gradually proceed from this pole to the cosmopolitanism pole, where invasive and native species are believed to coexist peacefully and with some degree of harmony.

18.5.1 The Impact of Restoration Ecology on Invasion Biology

Invasion biology is intimately connected to restoration ecology, a field of ecological inquiry that is close to the nativism pole. According to Davis, invasion biology and restoration ecology emerged at about the same time and developed as ‘sister disciplines’ during the late 1980s. They developed an increasingly strong synergy, with the objectives of each reinforcing those of the other.

Restoration ecology’s emphasis on restoring environments with native species affirmed the importance of invasion ecology, and invasion ecology’s emphasis on the harm caused by a small proportion of introduced species provided important justification for restoration ecology’s preference for native species. (Davis, 2006, p. 49)

From the outset, ecological restoration’s attempt to return degraded ecosystems to their original state has been interpreted in terms of the restoration of artwork. This metaphor was put forward specifically by environmental philosophers (see Gobster & Hull, 2000; Throop, 2000). At first, the comparison of nature to art was made in order to discredit ecological restoration. In his famous paper *Faking Nature* (1982), Australian philosopher Robert Elliot argued that ecological restoration is akin to art forgery. Just as a reproduction or a replicate cannot reproduce the value of an original piece of art, restored nature cannot reproduce the value of original nature. ‘What the environmental engineers are proposing is that we accept a fake or forgery instead of the real thing’ (Elliot, 2003, p. 383). A copy by Van Meegeren, will of course, always be inferior to a real Vermeer!

In his paper ‘The Big Lie: Human Restoration of Nature’ (1992), environmental philosopher Eric Katz further argued that whatever is produced in a restored landscape certainly cannot count as having the original value of nature, particularly wild nature, and that restored nature necessarily represents a form of disvalue and domination of nature. ‘Once we dominate nature, once we restore and redesign nature for our own purposes, then we have destroyed nature – we have created an artificial reality, in a sense, a false reality, which merely provides us the pleasant illusory appearance of the natural environment’ (Katz, 2003, p. 396).

Other environmental philosophers are less harsh in their judgment of restored nature. Andrew Light (2003), for instance, thinks that the criticisms of Elliot and Katz are only valid with respect to a particularly malicious kind of restoration – restoration that is used to justify the disturbance or destruction of nature. This could take place, for instance, for the benefit of some industrial activity, with the argument that it is now possible to create a piece of nature with the same value as the original at a later date or in a different place. But, Light insists, this kind of restoration is

relatively rare. Most restoration efforts are undertaken to correct past harm. In these cases, ecological restoration is more akin to art restoration than to art reproduction or art forgery.⁵

This art-nature analogy, however, is not unproblematic. A work of art is the creation of a specific artist working at a particular place and time. But, even if we allow for the existence of a master craftsman to whom we might attribute the authorship of nature, his or her creations could never be traced back to a particular place and time. Among ecologists and conservationists there is an ongoing discussion about the question of which historical reference one should choose. Should one go back to the last interglacial era when humankind did not yet even have projectile weapons such as the bow and arrow and was therefore not yet capable of defeating his natural enemies? Should one go back to the time before the emergence of agriculture, or should one only have to go back to pre-industrial times and resort to traditional agrarian techniques such as reed and brushwood cultivation, tree planting and felling, and mowing and turf cutting?

Moreover, nature, unlike art, is never solely the object of experiences of beauty or the sublime, but has many other functions. Water, for instance, is important to traffic, transportation, food supply, irrigation, recreation and domestic use. Yet another major difference between art and nature, as Holmes Rolston (2000) has argued, is that works of art are entirely passive and, left to themselves, inevitably decay. We restore them; they do not restore themselves. In contrast, left to itself, nature flourishes and can restore itself.

18.5.2 Restoration as a Performing Art

There is, however, another way to frame ecological restoration that can also redirect the way the exotic species issue is viewed. If we shift the focus from the visual arts to performing arts like theatre, dance or music, the restoration metaphor acquires a different meaning. A ballet, symphony or play is anything but static; it derives its very life from being recreated time and again. Such an artwork obtains its identity only through the multitude of its successive performances. The equation of ecological restorations with artistic performances was made by Jordan in numerous writings (see e.g. Jordan, 1987, 2006). He denounces ‘environmentalism’s blindness to the performative or expressive aspect of restoration – to what might be called its ritual value’ (Jordan, 2000, p. 215).

The performing arts cannot thrive without an audience. Because artistic performances are public rituals, this version of the art restoration metaphor is akin to the community metaphor, which has a long tradition in ecology, especially in the land ethic of Aldo Leopold. According to Leopold’s famous statement, ‘a land ethic

⁵Light mentions cleanups as the most obvious cases of benevolent restoration. Cleanups include the bio-activation of existing micro-organisms in soils to allow the land to essentially clean itself up, and cleaning out exotic plants that were introduced at some time into a site, allowing the native plants to reestablish themselves.

changes the role of *Homo sapiens* from conqueror of the land community to plain member and citizen of it' (Leopold, 1949, p. 240). Restorationists who have adopted the community metaphor perceive themselves as participants rather than curators of museum pieces. Participation is supposed to strengthen the ties between humans and between the human community and the larger ecological community.

The analogy between ecological restoration and artistic recreation does more justice to the dynamic interplay of nature and culture that follows from our multifunctional use of natural resources than does the analogy between ecological restoration and the restoration of parts or pieces of a museum collection. Moreover, the recreation metaphor allows for a less rigid framing of the exotic species issue than the restoration metaphor, which implies a sharp distinction between native (and desirable) and non-native (and undesirable) species. After all, the recreation metaphor does not put the emphasis on the original composition and the specific patterns of flora and fauna but rather on the performance of the system and the dynamic (biotic and abiotic) processes of succession, dispersion, migration, predation, grazing, sedimentation, erosion, fire and so on.

The main similarity between the restoration and recreation metaphors concerns the 'historic authenticity' to which both metaphors refer as the most important standard to evaluate ecological restorations. An artistic performance should be true to the original score, script or scenario. Although the players, props, scenery and costumes constantly change, the performance has to remain *Hamlet*.

18.5.3 Two Roads Within Invasion Biology

There is, yet another way to frame the exotic species issue. In his historical review of invasion biology since 1958, the publication date of Charles Elton's invasion classic *The Ecology of Invasions by Animals and Plants*, Davis distinguishes two different paths within this young discipline. The first path is the 'conservation approach' advanced by Elton and strongly influenced by restoration ecology (see previous section). Davis describes this approach as a top-down, deductive approach, in which an effort is made to apply general ecological theory and principles to biological invasions in order to help develop control management programs for specific invasions. The alternative path is the 'scientific approach'. This could be considered more of a bottom-up, inductive approach, in which individual invasions are examined in an effort to better inform general ecological theory and understanding of communities and populations. 'The conservation and environmental emphasis in invasion ecology has been motivated by the conviction that ecological knowledge and theory can be used to better understand and predict biological invasions. The alternative approach was motivated by the opposite conviction – that biological colonizations/invasions can be viewed as natural experiments and used to inform more general ecological theory and understanding' (Davis, 2006, p. 53).⁶

⁶Davis contrasts the two paths as Platonic and Aristotelian approaches, respectively.

The second path – the scientific – is less well travelled than the other. During the past decades, invasion biology has become increasingly more allied with the conservation approach, particularly in the United States. ‘No doubt part of the explanation for this difference is that a large number of ecologists are employed by conservation groups and governmental agencies where they work primarily on applied problems’ (ibid., p. 52).

Davis points to the difference in language used within the two approaches. The vocabulary of the conservation approach, which includes expressions such as ‘alien’, ‘exotic’, ‘invader’, ‘invasion’ and other explicit militaristic terms, is strongly value-laden, whereas the other vocabulary has a more value-neutral character, preferring phrases like ‘colonizer’, ‘introduced’, ‘new arrivals’ and ‘migration’. This language is typical for the dominant theory used to understand bioinvasion: island biogeography (see Shrader-Frechett, 2001).

18.5.4 Engineering the Ecosystem: The Reparation Metaphor

This theory goes back to the New Ecology, a new approach within the field of conservation biology that can be traced back to cybernetics, which flourished in the United States in the early post-World War II years in a climate of technocratic optimism.⁷ The politicians, having proved unable to cope with the problems of a complex industrial society, were urged to make way for social engineers who would then manage society as a self-regulating machine. One of these technocrats, Evelyn Hutchinson, was to leave an indelible mark on post-war ecology (Taylor, 1988).

In *Circular Causal Systems in Ecology*, a pioneering paper published in 1946, Hutchinson distinguished between two closely related approaches: the biogeochemical and the biodemographic approach. Seen from a *biogeochemical* perspective, the entire biosphere appears as a giant cyclical system of energy, matter and information, which is able to maintain a dynamic equilibrium thanks to a series of feedback mechanisms. This perspective was elaborated on, in particular, by Hutchinson’s student Howard Odum and his brother Eugene, who repeatedly compared the biosphere, including mankind and society, to a complex clockwork. The metaphor of nature as a clockwork reinforces our confidence in our ability to repair damaged ecosystems like we repair ‘the radio or the family car’, as Hutchinson once put it (Kwa, 1987, p. 427).

⁷When he first coined the word ‘cybernetics’ in 1945, Norbert Wiener defined it as ‘control and communication in the animal and the machine’. Wiener brought together two fields of research. On the one hand, he elaborated on the engineering-oriented research into the ‘servomechanical’ nature of control and communication in machines, using the ideas of information flow, noise, feedback and stability. On the other hand, he built on what physiologists like Walter Canon had developed under the headings of ‘homeostasis’: a variety of mechanisms in the organism to maintain fixed levels of blood sugar, blood proteins, fat, calcium as well as an adequate supply of oxygen, a constant body temperature and so on.

The *biodemographic* approach on the other hand, deals with groups or communities of organisms, the so-called ‘populations’. In conformity with the cybernetic principle shared by both approaches, these populations are also perceived as systems attempting to maintain their stability under ever-changing conditions by means of feedback mechanisms. This approach was further elaborated on by Robert MacArthur, another of Hutchinson’s students. In the 1960s, MacArthur, in collaboration with Edward Wilson, developed the ‘island theory’, a theory on the biogeography of islands.⁸ The theory predicts the number of species on a given island, using the size of the island and the distance to the mainland as its main parameters. MacArthur and Wilson also assumed a dynamic equilibrium: although the taxonomic composition on the island is subject to continuous change, the number of species, which is determined by the rates of extinction and colonization, remains constant.

The island theory takes no interest in the question of whether components of the ecosystem are identical in a material sense, but only whether they perform the same function within the ecosystem, for example, that of producers, consumers or decomposers (bacteria and fungi) (Keulartz, 1998, p. 149).

The island theory definitely puts invasive species in a different light than restoration ecology. Whether a species ‘belongs’ in an environment is not determined by its origin but by its function. Species are, so to speak, entitled to a green card as long as they do their job. In this respect there appears to be some overlap with the recreation metaphor that judges the importance of a species from the role it plays within a certain script or scenario. But the island theory lacks all the associations with artistic performances and public rituals that are typical of the recreation metaphor. Instead, its terminology of ‘producers’ and ‘consumers’ reveals the influence of modern economy. As Donald Worster has shown, exponents of the New Ecology view nature as a set of resources with cash value; they have transformed nature into a reflection of the modern corporate state, a chain of factories and an assembly line (Worster, 1992). So, in contrast to Davis, the scientific approach is in fact far from value-neutral; it only invokes other values than the conservation approach within invasion biology.

18.5.5 Health and Integrity: The Rehabilitation Metaphor

Recently, a third road can be identified within invasion biology, originating not from cybernetics but from medicine. The concept of health has had an amazing career within environmentalism and ecology since about 1990.⁹ Its domain of application has been extended from the level of the individual (clinical and veterinary medicine)

⁸Their book *The Theory of Island Biogeography* (1967) is one of the most frequently cited books in ecology and popular biology.

⁹The concept is mentioned more than once in *The SER International Primer on Ecological Restoration* (SER Science & Policy Working Group, 2004) (available from: <http://www.ser.org>).

and the population (epidemiology and public health) to the level of ecosystems. An interdisciplinary field of research has developed, in which the relationships between human activities, natural systems and health are being systematically explored. At present, the notion of health is a focal point for the integration of three strongly overlapping areas of research activity: ecosystem medicine, geographical medicine and conservation medicine.

'Ecosystem medicine' emerged in the early 1990s and gained momentum in 1994 with the establishment of the International Society for Ecosystem Health (ISEH). Since 1995, the ISEH has published the journal *Ecosystem Health*. The society is dedicated to the idea that a healthy ecosystem is one that provides services supportive of the human community, such as food, potable water, clean air, and the capacity for assimilating and recycling wastes. Ecosystem medicine aims at developing 'a systemic approach to the preventive, diagnostic, and prognostic aspects of ecosystem management, and . . . [at] understanding . . . [the] relationships between ecosystem health and human health' (Rapport et al., 1999, p. 84). This approach is not entirely new, since Aldo Leopold had already referred to 'the art of land doctoring' and 'the science of land health'.

Ecosystems are regarded as healthy as long as they have the capacity to maintain structure and function in the face of stress. Proponents of this approach talk about the Ecosystem Distress Syndrome (EDS). Some indicators of this syndrome are changes in primary productivity and nutrient cycling, loss of species diversity and a return to early stages of succession.

The second area of research activity that uses a broad concept of health is 'geographical medicine' or 'geomedicine'. Geographical medicine is a subdiscipline of epidemiology that studies the impact of the environment on the geographical distribution of health and illness. There has recently been a growing concern about the influence on the health of human populations by global economic, technological and environmental changes, including climate change, ozone depletion, loss of biodiversity, land degradation, desertification, deforestation, worldwide urbanization and mass migration due to war or natural disasters. From 2000 to 2004, the journal *Global Change and Human Health* provided a platform for scientific research into the health impact of these globalization processes (Martens, McMichael, & Patz, 2000).

The last area of research focusing on a broad health concept is called 'conservation medicine'. This new discipline combines techniques, facts and concepts from public health, veterinary medicine, conservation biology and plant pathology. Conservation medicine evolved out of a crisis: unprecedented levels of disease in many species as a result of the worldwide transformations of the host-parasite relationships caused by climate change, chemical pollution, animal trade, encroachment into wildlife areas and habitat fragmentation.

With the launch of the first issue of the journal *EcoHealth* in January 2004, the collaboration between these three areas of research activity took more definite shape. This journal aims to build on the legacy of both *Ecosystem Health* and *Global Change and Human Health* and also intends to cover the area of conservation medicine that has not yet been represented by a scholarly journal.

The health metaphor is akin to the reparation metaphor. The cybernetic approach of ecological restoration can be compared to clinical medicine in a hospital setting where the professionals take on the role of physicians or surgeons. However, the concepts of health and healing are much broader and encompass other approaches such as ‘rehabilitation’, the treatment of severely diseased or disabled people with the purpose of re-socialization and re-integration into community life. The emphasis on community renders the rehabilitation metaphor more akin to the recreation metaphor than to the reparation metaphor.

In fact, the health metaphor can be situated somewhere between the recreation metaphor and the reparation metaphor. On the one hand, the condition of health is not dependent on some historically authentic state because one can be quite healthy with a hearing aid, a bypass, an artificial kidney and other functional equivalents. On the other hand, the criterion of biological integrity, which is key to the health concept, sets a limit to a purely functional approach to remediation and rehabilitation.

18.5.6 The Other End of the Continuum: The Recombination Metaphor

The most radical reframing of the exotic species issue comes from Michael Soulé. In his presidential address on alien species at the third annual meeting of the Society for Conservation Biology in 1989, Soulé claimed that ‘the inexorable invasion of alien species from distant land masses and between heretofore isolated regions within continents may be the most revolutionary’ among the many environmental challenges of the coming decades (Soulé, 1990, p. 233). The flood of exotic species will homogenize and impoverish the world’s ecological communities, a process which Soulé refers to as ‘cosmopolitanization’. He is convinced that the flood of exotic species cannot be stopped and that we simply have to accept cosmopolitanization.

According to Soulé, the concept of natural versus artificial, already outdated due to the pervasive influence of humans, is further undermined by the universal and irresistible force of bioinvasion. It will therefore become nearly impossible to defend the ecological *status quo ante*. ‘A policy of blanket opposition to exotics will become more expensive, more irrational, and finally counterproductive as the trickle becomes a flood’ (ibid., p. 235).

Although the psychological adaptation to biogeographically recombined communities will be tough, Soulé believes that shifts in scientific fashion will facilitate the transition ‘from the traditional view of biogeographic integrity to the postmodern acceptance of cosmopolitanization’ (ibid., p. 234). The first shift is the decline in status of the so-called ‘niche paradigm’. ‘Niche’ is a key concept in biogeography that is based on a holistic view of biological communities as being highly integrated by competitive interactions.¹⁰ A niche is the role or function of an organism in a

¹⁰MacArthur’s ‘dissertation work, a study of community structure and niche partitioning among different species of warbler, also yielded a paper for *Ecology*, which appeared in 1958 and became recognized as a minor classic’ (Quammen, 1996, p. 410).

community of plants and animals. Each community, especially an island, has a limited number of niches, and therefore can hold only a limited number of species. In a certain area, no two species can occupy the same niche for long. The one that is better adapted for the niche will win the competition for food and habitat and will cause the other to leave or become extinct.

The second shift, which is perfectly in line with the first one, concerns the replacement of the holistic community concept by an individualistic community concept. The individualistic concept was developed as early as 1917 by Henry Allan Gleason who opposed the organicist views of his countryman Clements. According to Gleason, an association of plants or animals cannot possibly be likened to an organism. The development of associations cannot be explained or predicted with the help of a limited number of physical laws, but has a non-deterministic (stochastic) and distinctly historic character. Every association is the entirely unique outcome of a combination of migration patterns and environmental factors. Between the different associations there are only fluid transitions, not the fixed, clear-cut boundaries that would justify a comparison with organisms.

Among his colleagues, Gleason was seen, in his own words, as a 'good man gone wrong' and his arguments were ignored or even 'pulverized' (McIntosh, 1991, pp. 137, 265). This changed in the 1990s, when systems ecology (and the notion of 'Nature in Balance') increasingly had to compete with evolutionary ecology ('Nature in Flux'). Taking their cue from Gleason, the evolutionary ecologists gave up the 'top down' approach, in which the parts are viewed from the whole, and replaced it with a 'bottom up' approach, starting from the individual populations and ending up at the associations which they jointly form.

Soulé not only refers to Gleason but also to Hengeveld, who applied the individualistic community concept to the exotic species issue in his 1989 book *Dynamics of Biological Invasions* (see also Hengeveld, 1988). According to Hengeveld, species have no fixed roles in static communities, but move about, responding individually to options and opportunities in a basically dynamic environment. The following quotation eloquently captures the individualistic community paradigm:

Niches conceived as biotic community functions like a hole in the market, neither exist as independent entities, nor are they filled deterministically by one particular species. They are ephemeral, non-specific opportunities potentially to be occupied by more than one single, predetermined species, their selection depending partly on constraints put by the biotic and abiotic environment and partly by chance. Communities as sets of niches of opportunity are ephemeral, kaleidoscopic images, easily vanishing by the slightest movement of the outside world, thus being replaced by a next, unique image. (Hengeveld, 1994, p. 350)

After his discussion of the shift to the individualistic community paradigm, Soulé suggested that a new ecological discipline will develop to deal with the interactions within new, biogeographically complex assemblages that result from deliberate or accidental species introductions. He suggested calling this ecological discipline 'recombinant ecology' or 'mixoecology'. This field can be defined as 'the ecology of communities of plants and animals, the constituent members of which are drawn from a wide range of global biogeographic zones' (Barker, 2000; Gilbert, 2005). Although some might feel that Soulé's suggestion was not meant seriously

(Enserink, 1999), the new field has slowly begun to be recognized with work in Eastern Europe, and more recently in the UK (Rotherham, 2005, p. 53; see also Crifasi, 2005).

18.6 Towards a Multiple Vision on Invasive Species

We have shown in some detail that nativism and cosmopolitanism are in fact extreme positions within a broad continuum, ranging from restoration, recreation and rehabilitation to reparation and recombination. In this way we can bridge the gap between nativism and cosmopolitanism and open up space for a renewed debate that allows for a multiple vision on the exotic species issue. Taking our cue from environmental philosopher Baird Callicott and his colleagues Larry Crowder and Karen Mumford, we want to develop such a multiple vision by arranging the different frames on a scale from the least to the most severely invaded areas (Callicott, Crowder, & Mumford, 1999; see also Keulartz, 2007) (Table 18.1).

Callicott *cum suis* distinguish two contemporary schools of conservation philosophy, ‘compositionalism’ and ‘functionalism’. The compositionalist emphasis is on the process of returning a biotic community to its original condition of biological diversity and integrity, whereas the functionalist emphasis is more on the process of returning an ecosystem to a state of health. Callicott and his associates consider compositionalism and functionalism to be two ends of a continuum: the compositionalist emphasis on the ecological restoration of biological integrity and diversity is appropriate for the management of the less severely degraded areas such as wilderness areas, national parks and state parks. The functionalist emphasis on the ecological rehabilitation of ecosystem health is more suited for the much greater part of the world that is inhabited and economically exploited by humans.

Although our spectrum is somewhat broader than the compositionalism/functionalism spectrum of Callicott *cum suis*, their notion of a continuum between the least and the most severely degraded areas can certainly be helpful in the context of the invasive species issue. After all, ecological degradation is at

Table 18.1 Multiple vision on exotic species

	Restoration		
Least		Recreation	Most
Severely			Rehabilitation
Invaded			Reparation
			Recombination

once the cause and effect of bioinvasion. So, in general, the degree of degradation will correspond to the degree of invasion by exotic species.

This ordering has some *prima facie* plausibility. The restoration and recreation metaphors seem more appropriate for the management of the least severely invaded areas such as wilderness areas, national parks and state parks, whereas the reparation and recombination metaphors are more suited for the most severely invaded areas, including urban and industrial areas. It is significant in this respect that it was the Urban Forum which took the lead in setting up the first important workshop on recombinant ecology on 13 July 2000, because ‘although “recombinant” communities are found in rural as well as in urban areas in the UK, the most obvious, striking and easiest to study are those of large urban areas’ (Barker, 2000).

Of course, our proposal to arrange the various frames according to the degree of invasion by exotic species represents only one way to develop a multiple vision of invasive species. Moreover, whether or not it will hold water under closer scrutiny is an open question.

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