Entangled biological, cultural and linguistic origins of the war on invasive species

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Abstract

The language of invasion biology reflects its sociocultural situatedness with three metaphorical elements: fears of invasion, an emphasis on competition, and prevalent militarism. These elements incorporate salient emotionally laden themes, which help to convince biologists and their audience that invasive species (IS) are a problem. I show that conceiving IS as invaders draws upon two congruent fears: that our bodies will be invaded by disease and our nations by foreigners. Once IS occur on a landscape, invasion biologists disproportionately perceive the interaction between IS and native species as competitive – a bias that is common in biology and alludes to the power of the competition metaphor. Finally, in concert with prevailing militaristic approaches to problem-solving, invasion biologists use militaristic language and actions to defend native landscapes and their species by exterminating IS. While biologists may not consciously manipulate public opinion about IS by using metaphors of invasion, competition and war, their uncritical use naturalizes an antagonistic way of relating to the natural world that may be counterproductive for conservation.

Keywords: competition, conceptual metaphors, CONTAINER image schema, evolutionary biology, invasion biology, invasive species, militarism, rhetoric

1. Introduction

Helicopters recently flew over Anacapa Island, one of the California Channel Islands, so that pellets of a deadly anti-coagulant could be dropped along precise GPS gridlines to exterminate resident rats (Faulkner, Howald and Ortega 2001). Because the rats were non-native,[1] abundant, and had

1. Non-native species – also known as alien, exotic, introduced or non-indigenous species – have been introduced by humans to "new, often distant, ranges"

been observed eating the eggs of rare (and native) seabirds, invasion biologists who oversaw the project could justify its $1 million cost. Invasion biology was founded on concerns about species such as these rats, defined as invasive species (IS) because they spread and become problematic after humans introduced them. Only a small percentage of introduced species become IS. However, these IS tend to have great effects on the pre-existent community (see Mack et al. 2000; Baskin 2002 for reviews), so conservation biologists[2] classify them as the second greatest threat to biodiversity (Wilcove et al. 1998). They also have tremendous economic costs (Pimentel 2002). In their influential review of biotic invasions, Mack et al. (2000) advised that

> Failure to address the issue of biotic invasions could effectively result in severe global consequences, including wholesale loss of agricultural, forestry, and fishery resources in some regions, disruption of the ecological processes that supply natural services on which human enterprise depends, and the creation of homogeneous, impoverished ecosystems composed of cosmopolitan species.

Consequently, invasion biologists feel justified in eradicating IS; the rats, for example, could gradually "homogenize" endemic communities of Anacapa Island.

Another classic case of an invasive species – the ruddy duck in Europe – shows how invasion biologists justify the removal of a species. The ruddy duck is native to North America, but escaped from wildfowl collections in the U.K. in the 1950s and began to spread through Europe (Milton 2000). They weren't considered a threat until the early 1990s when they entered Spain and began to hybridize with the rare, native white-headed duck. Since hybridization with the ruddy duck could lead to extinction of the white-headed duck, Spain began to kill its ruddy ducks. Trials to eliminate ruddy ducks from the U.K. began in 1999, and were overseen by a euphemistically named White-headed Duck Task Force. If ruddy ducks are not removed from Britain, the argument goes, there will always be a source for continued spread into neighboring European countries.

(Mack et al. 2000: 690). In contrast, native species occur in an area "naturally", having either evolved there or dispersed there from somewhere else.

2. Invasion biology is a major subdiscipline of conservation biology, which is concerned with the more general issue of how to maintain biodiversity.

As a biologist I sympathize with these concerns, but I am also skeptical because of how IS are framed.[3] In the words of Takacs (1997: 8),

> How can one feel about the natural world as strongly as I do, and as do the biologists whose exploits I narrate, and not believe that those feelings approach the truth in some sense? How can I balance my healthy skepticism about conservation biologists' proselytizing on behalf of biodiversity against my fervent hope that they succeed?

Invasion biologists derive substantial funding for and prestige from their cause, but numerous critics have questioned whether this is warranted (e.g., Sagoff 1999; Subramaniam 2001; Chew and Laubichler 2003). Invasion biology relies upon a narrative of native versus non-native that is seldom questioned by invasion biologists. In a recent critique of my research on potential implications of a metaphorical war against IS, for example, a well-known conservation biologist wrote: "The bottom line for me is that, given the abundant, massive, and seemingly insurmountable global conservation problems that we face, the semantics of dealing with invasive species is a low priority." This comment belies a scientistic view that overlooks the extent to which this issue is inextricable from pre-existent cultural lenses. These lenses force us to think primordially in terms of "us" and "them", which is reflected in the use of linguistic categories such as "native" and "invasive", respectively.

There is extensive evidence that ecologists do not see the world "as it is", but through the eyes of their professional culture. These cultural influences have been documented by numerous historical studies (e.g., Fine and Christoforides 1991; Journet 1991; Barbour 1995) and specific attention to the over-representation of the notion of competition[4] in ecological research

3. In a sense, conservation biologists have created IS, regardless of their effects. Humans are inscribed within IS, not only because we introduced them, but also because conservation biology itself is a human activity (Milton 2000). While cultural and linguistic features partly constitute IS, they do have effects (just as some native species do). Nonetheless, social problems only come about through communication, and one of my primary concerns is with the transformations that occur during this process.
4. Biologists classify competition, mutualism and predation as the three main types of biotic interaction. Competition is defined as an interaction where both partners are harmed by their interaction, whereas both benefit in mutualism (e.g., pollination systems, where insects derive nectar and/or pollen as "rewards" for enabling sexual reproduction between plants), and one (the predator) gains and the other (the prey) loses under predation.

(Boucher 1986; Keller 1991). The ecologist Keddy (1989: 163), for example, proposed that: "Scientists can only draw models from the possibilities of which they are aware, and perhaps ecology has been hampered by restricted access to individuals (and ideas) offering co-operative models for society and nature." Related arguments have been made about the bias towards militaristic metaphors in environmental science (Glotfelty 2000).

A recent paper in *Science* concluded that "we should be concerned about what the frequent use of 'natural enemies'[5] (and the notable absence of 'natural allies,' describing an equally familiar set of ecological interactions) reveals about the ways in which we interpret nature through metaphorical lenses, especially in the current historical situation" (Chew and Laubichler 2003: 53). Here, I argue that invasion biology unduly adopts competitive and militaristic metaphors because of the cultural context in which invasion biologists are situated. Specifically, invasion biology reflects three aspects of its sociocultural situatedness: contemporary fears of invasion; a bias towards a competitive view of life; and the habit of applying militaristic metaphors to nearly every challenging situation. Invasion, competition and war are large-scale metaphors that circulate nomadically between segments of society, including science and society (Bono 1990; Maasen, Mendelsohn and Weingart 1995). They also reinforce one another, as small-scale individualistic competition is consistent with larger-scale political militarism, which is often motivated by fears of invasion.

I employ the tools of Cognitive Linguistics to analyze these metaphors (Lakoff and Johnson 1980), while also attending to their rhetorical (persuasive) effects (Eubanks 2000). The Lakoffian view of metaphor underscores the extent to which our metaphors influence how we conceptualize *and* act (Schön 1993). Bono (2003: 228) calls them "material metaphors: embodied metaphors-in-action". As an example, the invasion biologists Davis, Thompson and Grime (2001: 3–4) observed that "ecologists during the past few decades […] have focused on the headline invaders, a small group of plants and animals that are not representative of the very large group of species that are currently colonizing new areas of the globe [in part because] funding and publication pressures prompt ecologists to promote new and exciting research themes". However, they neglect the possibility that the allure of "battling against invaders" itself creates the emotional excitement of this field and its focus on dramatic cases and narratives.

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5. "Natural enemies" are species that harm invasive species, but one of the points made by Chew and Laubichler (2003) is that the phrase is often used vaguely.

I will not simply claim that biologists use these metaphors rhetorically to convince the public of a problem; rather, in the spirit of Cognitive Linguistics I will utilize examples from within the flagship journal of invasion biology, *Biological Invasions*, to show how this "rhetoric" operates within the field itself, revealing endemic patterns of thought. My approach follows Fine and Christoforides' (1991: 377) study of the Great English Sparrow War[6]: "Our claim is not that the proponents of attacks on sparrows cynically manipulated nativist rhetoric in order to inflame passions, but rather this set of nativist beliefs made sense in explaining the dangers of a foreign interloper to the community of American birds." While it may be somewhat natural for invasion biologists to invoke prevailing metaphors and narratives – discourse metaphors, as they are called by Zinken, Hellsten and Nerlich (this volume), this militaristic language not only restricts the possibility of seeing their problem in other ways, but also links it to large-scale political trends.

2. The conceptualization of "fears of invasion"

The term "invader" is culturally resonant because of its embodied basis; that is, physiologically and mentally experienced fears that our bodies will be invaded by disease and our nations by foreigners. These two issues affect interpretation of IS because all three types of invasion are congruent, particularly in their reliance on the CONTAINER image schema (see Rohrer 1995: 124–125; Chilton 1996: 197–198). Because of this schema, it is easy to interpret the invasion of natural landscapes, simultaneously, as the invasion of a metaphorically projected "person" and a "nation". I will demonstrate the first point by providing evidence for the conceptual metaphor NATURAL LANDSCAPES ARE PERSONS, which allows IS to be understood as a disease, and the second by considering linkages to NATION IS A PERSON, where IS are interpreted as human invaders. In combination, these metaphors mutually reinforce one another and strengthen the case of invasion biology *within* an unquestioned ontological framework.

6. English sparrows were introduced into North America from Europe in the early 1850s to control insects, but when they began to spread they were vilified and attacked, just as IS today.

2.1. The image schemata structuring the conceptualization of invasion biology

The notion of boundaries evoked by the CONTAINER image schema contributes to fears of invasion, whether by disease, human invaders, or IS. This schema derives from the experience of embodiment, which differentiates our interior and exterior across a boundary (Johnson 1987). There is a range of opinion within Cognitive Linguistics concerning the extent to which image schemas are innate and individualistic versus developmentally – and culturally – conditioned. In light of numerous critiques of the former view (e.g., Gibbs 1999; Bono 2003; Zinken, Hellsten and Nerlich, this volume), I will follow Santibáñez (2002), who defines image schemata as "pervasive organizing structures in human cognition which emerge from our bodily and social interaction with an environment at a preconceptual level". However, I will assume that cultural conditions during the ontogeny of most biologists I am referring to (as well as Westerners in general) are relatively consistent so that the schema is conventional even though it is socioculturally situated. That is, this schema makes sense both to biologists and those they try to reach out to rhetorically because it is so consistent with everyday expressions and ways of relating.

The CONTAINER image schema distinguishes between *inside* and *outside*, a distinction that can be projected onto the world as a means to structure and understand it (Lakoff and Johnson 1999: 32, 117, 380). In the case of IS, this schema provides a powerful basis for reifying the boundary between native and non-native species. Milton (2000: 242) employed a case study of an IS, for example, to argue that "conservation [is] a boundary maintaining exercise. In order to conserve the things that constitute nature, the boundaries that separate them must be maintained, and in order to conserve nature's 'naturalness,' the boundary between the human and the non-human must be preserved". In some cases, these boundaries may correspond with national boundaries, but they may also occur at smaller scales, such as individual states, counties, biogeographic regions, national parks, or local vegetation communities (see Figure 1). Even though ecologists currently doubt that communities are integrated wholes (see Soulé 1990: 234; Woods and Moriarty 2001: 172), invasion biologists continue to metaphorically enforce their boundaries, which indicates how compelling this schema has become for understanding biological systems.

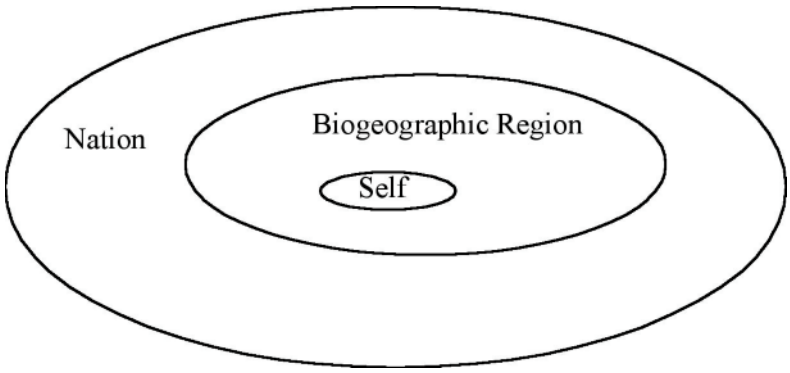

Figure 1. Nesting of self within biogeographic region within nation. Each of these levels depends upon an experiential CONTAINER image schema, which is metaphorically projected in the case of biogeographic regions and nations.

Invaders do not just equilibrate with their surroundings – they spread and expand. This conceptualization derives from two additional kinesthetic image schemas, PATH and FORCE, which depend on the CONTAINER schema and contribute to the ease with which IS are associated with other kinds of invaders. IS can expand into a predefined CONTAINER by expansion of their own CONTAINER via the addition of a PATH schema. This schema "involves structural elements such as starting point (origin), obstacle, destination (endpoint), path and directedness toward the endpoint" (Chilton 1996: 199). The prevalence of this schema in invasion biology is indicated by references to the "spread" and "expansion" of IS in 42 and 22 papers in *Biological Invasions*, respectively.[7] Typically, this is in terms of range expansion, such as the "rapid expansion of this species' range since its arrival in North America" (Shurin and Havel 2002).

As their perimeter spreads, IS also exert a metaphorical force on natural landscapes. The underlying schema of FORCE dynamics is constitutive of

7. I conducted an analysis of *Biological Invasions* because it is the only journal solely dedicated to invasion biology. I searched for keywords within the first five volumes (1999 through 2003) using the online Kluwer search engine. The search captured occurrences of terms within abstract text, titles and keywords, with each article counted only once in the totals given herein. A few matches were deleted from the total if their usage was distinct from the examples cited. There were a total of 166 substantive papers in the volumes covered here.

the field of invasion biology, as shown by use of the term "impact" in the journal *Biological Invasions*.[8] The first substantive article in the journal was entitled "Impact: Toward a framework for understanding the ecological effects of invaders" (Parker et al. 1999). In archetypal scientific prose, the authors attempt to use unbiased language and to work objectively from the evidence to conclusions. In this case, however, the authors reverse the usual logic when they foreground the word "impact" (a negative effect) by setting it off with a colon. Thereafter they refer to the potential "effects" of invaders. The unstated enthymeme is that invaders exert a negative force, and there is little need to discuss whether this is actually the case. Subsequently, another 37 papers refer to impacts of IS, and the term "impact" constitutes fully 6% (13/219) of the words in one abstract (Forrest and Taylor 2002).[9] Invasion biologists created the journal *Biological Invasions* in part to address their concerns about the expansive force of IS.

2.2. Invasive species conceptualized as disease

To understand IS as a disease, landscapes must first be personified. The metaphorical projection NATURAL LANDSCAPES ARE PERSONS is supported by two main lines of evidence. First, humans have utilized body-landscape metaphors for millennia. As explained by Porteous (1986: 10):

> The human body is the first landscape we encounter and explore. It is likely that we carry the cognitive imagery in our heads as well as the actuality of our own bodies as we approach the external environment. Landscape is our second major encounter. For both practical and magical reasons, the application of notions of the self to the environment of non-self makes sense. In this way we humanize our environment, reduce its primeval unknownness and terror, make it ours.

8. In the first five volumes of *Biological Invasions* there were two direct references to species exerting pressure, and an additional three in the first issue of volume 6. In some cases, however, native species exerted this pressure on invasive ones.
9. In other places, force dynamics take a militaristic twist. For example, in a book in the Worldwatch Environmental Alert Series on IS, Bright (1998: 24) reported that "there is little consolation in the fact that 90 percent of these impacts are 'duds,' and only 1 percent of them really detonate. The bombardment is continual, and so are the detonations."

But the strongest support for the NATURAL LANDSCAPES ARE PERSONS mapping is invasion biologists' use of the ecosystem health metaphor and its entailments (for discussion, see Ross et al. 1997). Three papers in *Biological Invasions* referred to health, including the claim that "'ecosystem management' strategies promoting healthy, undisturbed sites will not always be effective against invasive pest species" (Parker 2001) and two papers by Bonneau, Shields and Civco (1999) that analyzed "the health of hemlock forests infested by the hemlock woolly adelgid". Also, Mack et al. (2000: 693) discussed "community vulnerability to invasion", which bespeaks the idea of an integrated personified community. In each case, healthy sites are relatively free of IS, and it follows that invasion biologists can restore health and balance[10] by removing them. As examples, nine papers referred to "restoration", and Alpert and Maron (2000) entitled their article, "Carbon addition as a countermeasure against biological invasion by plants". Even though invasion biologists may sometimes decry health and balance metaphors they still help to define the field.

By extension from notions of human health, an ecosystem is considered healthy if it contains few IS: IS ARE A DISEASE. Chilton (1996: 197; and see Otis 1999), for example, observed that "[d]iseases are typically imagined as *invading* the body from outside, a notion which rests both on the CONTAINER schema and the warfare script". The editor-in-chief of *Biological Invasions* invoked this metaphor explicitly in his one page opening editorial for the journal: "The resulting scale of hourly *inoculations* has led to a proportional increase in successful introductions. The Earth is now virtually *itching* with new invasions" (Carlton 1999, italics added). A total of seven papers in the journal called IS an "infestation", a term often used to refer to parasitic disease, and Mack et al. (2000) included a section on the "epidemiology of invasions". By invoking the language of human health and disease, invasion biologists lend support to the operation of NATURAL LANDSCAPES ARE PERSONS, which provides one source domain for preferring landscapes that are free of IS.

10. Implying the operation of the BALANCE image schema. Another abstract states that introduced mammals have "pushed the competitive balance from native to exotic species" (Holmgren 2002).

2.3. Invasive species conceptualized as human invaders

To understand IS as human invaders, biogeographic regions must first be understood as nations. This is a natural association, since invasion biologists have been educated amidst realist political discourse, which presumes

> the individual 'in' the state; […] the state itself with its containing and protective perimeters; and […] the outside world, the domain of the anarchic international system. These elements, the inside, the boundary, and the outside, derive from a powerful and pervasive spatial image, that of an impermeable container. (Chilton 1996: 195)

Rohrer (1995: 125) has elaborated the resultant NATION IS A PERSON metaphor and its entailments in the context of political "rape", which can be applied to IS. Just as he observes that "The 'rape of Kuwait' is the rape of the body of a metaphorically projected person via the 'NATION IS A PERSON' metaphor," I claim that for invasion biologists the invasion of natural landscapes is the invasion of a metaphorically projected nation.

Although biologists may not be patriotic in the usual sense, their active defense of biogeographic boundaries suggests that these are partly conceptualized in terms of the culturally-prevalent NATION IS A PERSON metaphor. As Smart (1996: 276) has observed, "[t]he body of the nation is its land, and this is often the object of national piety". In the German context, for example, Eser (1998: 102) explains that

> Historically […] the idea of nature conservation has been part of the broader concept of the conservation of 'Heimat'. 'Heimat' means the place, where people feel at home. It is not pure nature but a place where humans and nature live together in harmony, dependent on each other. […] Spreading non-indigenous plants are not a part of 'Heimat' in every sense of the word. They are 'aliens', they 'don't belong', they are unfamiliar to the people. They seem to change the landscape more rapidly than humans are able to adapt to [these changes]. Thus, they afflict the major function of Heimat: to guarantee stability, safety and identity.

Once natural landscapes have been personified as nations, they can come under threat from others: IS ARE HUMAN INVADERS. Numerous similarities between IS and human invaders support this biological-political mapping (Table 1), and thus encourage repeated use of the term "invader" within

invasion biology.[11] This term ascribes purposiveness to the movement of IS, which is enhanced by explicit personification. Because IS are "invaders", they are given malicious intent, even if unconsciously, which makes them to some extent guilty simply by their name.

Table 1. Mapping between the concept of a human invader and that of a biological invader.

Human invader	**Biological invasion**
soldier or invader	species
originate from another country	originate from afar
cross national boundary	cross biological boundary
expand within new country	expand within new biological range
overcome citizens	overcome native species
threaten native culture	threaten native ecosystems

The term "invader" is culturally resonant because of fears that nations will be literally invaded. Davis, Thompson and Grime (2001: 3) posit that the founder of invasion biology, Charles Elton, was influenced by Britain's vulnerability to invasion:

> There is another reason why the war may have transformed Elton's perspective on invasions. Throughout the war years, British people were much more concerned about a very different kind of invasion, one far worse than a rodent infestation. They feared invasion by Germany. For Elton, invasion was at the center not only of his work but also of his country's psyche.

These authors demonstrate that Elton increasingly distinguished invading species from normal ecological processes over the middle decades of the 20th century, which reflected his nationalistic concerns. Given concerns about a "world without borders", Mack et al. (2000: 689) raise this fear in the present day when they claim that the spread of IS could create "homogeneous, impoverished ecosystems composed of cosmopolitan species". Fears of invaders have only intensified since September 11, 2001, which may increase the appeal of the anti-IS campaign for many people.

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11. Note that the cultural model of human invasion adopted here is that of Asiatic hordes overflowing Europe in the sixth century or Spanish or Anglo immigrants massively settling in the Americas and taking Indians' territories, but it is not compatible with the model underlying World War II type of invasions (R. Dirven, personal communication).

Fears of invasion are reinforced in the journal *Biological Invasions* by the intentional choice of metaphors whose entailments are potentially frightening to the reader. The second article in the journal, for example, was entitled "Positive interactions of nonindigenous species: Invasional meltdown?" (Simberloff and Von Holle 1999). It reviewed beneficial interactions among invaders that could "well lead to accelerated impacts on native ecosystems – an invasional 'meltdown' process", which invokes images of nuclear disaster. While this rhetorical ploy is clearly aimed at instilling fear, it also functions as a "clever diversionary tactic […] for social control" (Rediehs 2002: 76). Whether patriotism attaches itself to a nation or to biogeographic regions, when people identify with these bounded spaces their own human vulnerability is exaggerated. Militaristic language may help draw attention to an issue that is initially invisible to non-biologists. However, it may also exaggerate the emotional intensity of the situation.

Finally, since "immigration" is often portrayed as another form of "invasion", numerous writers have critiqued IS policy as having xenophobic tendencies (Pollan 1994; Sagoff 1999; Subramaniam 2001; but see Simberloff 2003). Fine and Christoforides (1991: 388) demonstrate that "the sparrow issue 'piggy-backed' on the larger issue of how to protect the American community from the presence of outsiders". Given that the U.S. media commonly invokes the metaphor IMMIGRANTS ARE ANIMALS (Santa Ana 1999), it should not be surprising that the reverse mapping (ANIMALS ARE IMMIGRANTS) can be interpreted as xenophobic. Xenophobic people have a dislike for "other" people that is somehow rationalized. Similarly, the ultimate cause of concern about IS is a dislike of what they do to native species (including humans). Although the strength of the charge that biologists are xenophobic is limited by the analogy between IS and people, it is supported by the ease with which this association can be made.

3. The conceptualization of a competitive bias within biology

Competition is a prevalent organizing metaphor within both contemporary culture and invasion biology. Keddy (1989: 161–165) hypothesized that its frequency in biology may result from cultural factors, i.e. its ability to provoke drama, conflict and excitement, the dominance of male researchers, a taxonomic bias, and ultimately, the level of competitiveness found among scientists themselves. While each of these is probably a contributing factor,

competitive views of life partly derive from evolutionary thought, which naturalizes them. Numerous scholars have discussed how Darwinism – particularly through the metaphor of a "struggle for survival" – became associated with competitiveness and militarism in both popular culture and science (e.g., McIntosh 1992; Maasen, Mendelsohn and Weingart 1995; Lakoff and Johnson 1999: 557–561). According to Keller (1991: 87), these implications derive from how "much of contemporary evolutionary theory relies on a representation of the 'individual' […] [whose] first and foremost need [is] the defense of its boundaries". Because of the affinity between invasion biology and evolutionary theory (see Ludsin and Wolfe 2001 for review), invasion biologists are prone to emphasize competitive interactions resulting from the occurrence of IS in a given region.

To demonstrate the embedding of competitiveness within the culture of modern biology, I surveyed[12] three contrasting groups of biologists: the Society for the Study of Evolution (SSE, evolutionary biologists), the Human Behavior and Evolution Society (HBES, evolutionary psychologists)[13] and the National Association of Biology Teachers (NABT, American biology teachers). I asked members to respond to two questions about an array of metaphorical statements:[14]

12. I administered a web survey in November-December 2003 using the email distribution lists of four organizations (one of which is excluded here; additional details about my protocol are available upon request). I was unable to survey ecologists or invasion biologists directly. There were 1892 respondents in the final data set, with minimum response rates of 16% (NABT), 33% (SSE) and 44% (HBES). For further details on methodology and results, see Larson (2004, 2006).
13. In contrast to evolutionary biologists, who predominantly restrict their studies to evolution among non-human species, evolutionary psychologists search for evidence of why humans are the way they are now because of their evolutionary history.
14. In this chapter I present their response to two statements – concerning struggle for survival and cooperation – that I claim are metaphorical based on extensive historical evidence (e.g., Maasen, Mendelsohn and Weingart 1995; Ruse 1996). The actual survey contained numerous metaphorical statements about competition (and progress), and the results of a preliminary factor analysis suggests that these statements reflect conceptual metaphors EVOLUTION IS A COMPETITIVE PROCESS and EVOLUTION IS A PROGRESSIVE PROCESS. My brief discussion here is consistent with overall results presented elsewhere (Larson 2004).

1. Do you believe this statement to be factually true? In your opinion, has biological research provided sufficient evidence to support it?
2. Do you believe it would be beneficial if applied within society? Would it be a good thing if people were to use this statement as a guide for social practices?

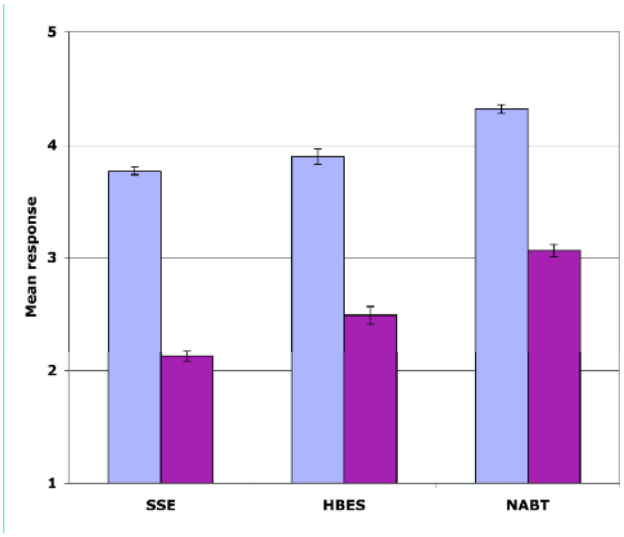

Figure 2. This figure shows responses to the statement "A struggle for survival characterizes evolution". The mean values along the left axis correspond to response options in the survey: 1 = strongly disagree, 2= disagree, 3= neutral, 4 = agree, 5 = strongly agree (that is, higher means greater agreement). The mean response (with standard error) is given for both question 1 (pale bars) and question 2 (darker bars). The organizations are all statistically different from one another ($p<0.001$, Kruskal–Wallis test), as are the responses to questions 1 and 2 for each organization ($p<0.001$, Wilcoxon signed-ranks test).

The results show that these groups disproportionately project competitive metaphors onto the natural world. On average, all three groups agreed that biological research supports the statement "A struggle for survival characterizes evolution"[15] (Figure 2, pale bars), whereas they disagreed that this

15. I used this statement about "a struggle for survival" as a metric of a competitive view of life because of the long association between these terms (McIntosh

is the case for the statement "Cooperation typifies the interaction between animals" (Figure 3, pale bars). Despite the historical linkage between "struggle for survival" and social Darwinism, the former is still accepted as a relatively accurate reflection of reality even by scientists.

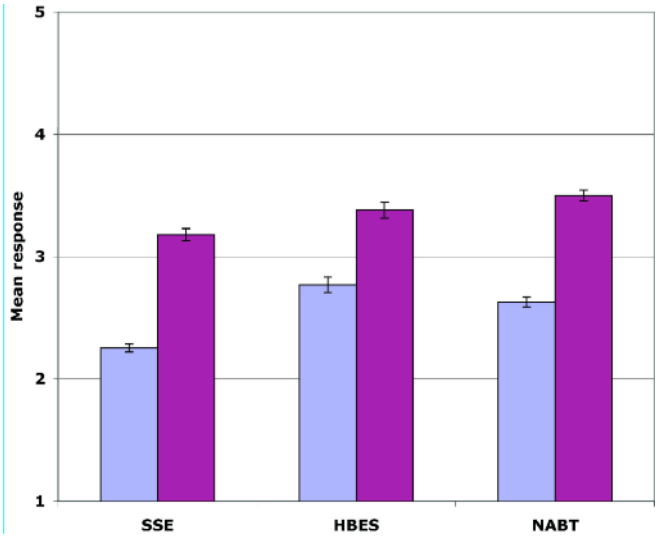

Figure 3. This figure shows responses to the statement "Cooperation typifies the interaction between animals." Other details as in legend for Figure 2.

The results of question 2 concerning application to society show a similar pattern among groups (Figures 2 and 3, dark bars). However, the respondents differentially evaluated the two statements. On average, all three groups disagreed with the assertion that it would be appropriate to apply the statement about a struggle for survival within society, whereas they agreed that it was factually true. In contrast, they agreed that it would be beneficial to apply the statement about cooperation even though they felt it was factually incorrect. Taken together, these results demonstrate that biologists recognize the potentially negative implications of applying com-

1992) and also because the expression "struggle for survival" is such a popular metaphor for evolution.

petitiveness within the social realm,[16] and thereby reveal a major dilemma of modern biology. Biologists often communicate scientific results metaphorically, and there is a bias towards presenting them in a competitive light, even though it is recognized that this bias could have undesirable implications. This conclusion, based on empirical data, is of fundamental importance in understanding the way in which such "scientific" metaphors actively recruit from and resonate within larger frames of reference (Bono 1990).

These results demonstrate that biologists generally personify the interactions between organisms as competitive. It is important to note, however, that each of the statements I asked centered around value-laden metaphors.[17] For example, what does competition describe? Consider "scramble" (or exploitation) competition,[18] which results from the passive use by more than one species of a common resource that is in short supply. The classic experimental test for scramble competition is to exclude a "competitor" and to observe whether the remaining species does better. However, no competition has actually been observed, and this is also the case for the more general term "struggle for existence". Hence, the imposition of these terms on the experimental or observational setting reflects attunement of an observer to competition as a prevalent cultural metaphor that can be applied to the biological world (Keller 1991). If biologists and others uncritically adopt the idea that nature is competitive, competition becomes "naturalized". It is just this type of bias towards competition that partially creates the problem of IS.

The bias towards competition in invasion biology is revealed in two main ways. First, there are many more studies of competition than of mutualism, indicating that invasion biologists preferentially project competi-

16. Note that the question of *how* it might be applied was left undefined to allow the respondents to provide their gestalt impression. It also forced them to recognize that biological statements *can be* and *are* applied in the social realm.
17. Respondents were given the option to choose a "not applicable" box rather than to respond on the disagree-agree scale, but fewer than 5% of them chose this option for the statements discussed here. Although many qualitative comments about the survey complained that statements were difficult to evaluate as scientific facts, only a handful of people stated that they were metaphorical, and in any case the results indicate that most individuals were content to agree with a competitive view of life.
18. A similar case could be made for contest (or interference) competition, which is a more direct behavior that limits access to a resource.

tiveness onto the interaction between native and non-native species. The aforementioned review by Mack et al. (2000), for instance, neglected the possibility of any population-level benefits arising from introduced species, while it provided a long list of assumed competitive interactions. They describe numerous cases of competition for resources, including introduced ant species that "devastate large fractions of native ant communities by aggression" (2000: 697). Plants are also portrayed as competitive: "invasive plants have diverse means of competing with natives. Usurping light and water are probably the most common tactics" (2000: 696). More generally, the first five volumes of the journal *Biological Invasions* mentioned mutualism and cooperation only twice, whereas competitive interactions were addressed in 25 papers. The emphasis on competitive interactions was implicit in both papers on mutualism, which examined whether mutualism between IS may intensify their effect on native species and communities (Simberloff and Von Holle 1999; Morales and Aizen 2002).

Finally, invasion biology often assumes that invading species compete with native ones, despite the limited evidence for this assertion. Hager and McCoy (1998), for example, demonstrate that frequent assertions about the competitiveness of the European species purple loosestrife in north American wetlands are over-stated. Similarly, a recent analysis of the effects of IS concludes: "Taken together, theory and data suggest that, compared to the effects of intertrophic interactions [predation] and habitat loss, competition from introduced species is not likely to be a common cause of extinctions of long-term resident species at global, metacommunity, and even most community levels" (Davis 2003: 488). In conclusion, the often untested hypothesis that IS compete with native species is in part ideologically-driven by the dominant competitive outlook in biology.

4. The conceptualization of militarism against invasive species

Once invasion biologists conceptualize IS as invaders that compete with native species, it becomes natural to think of them as having a negative valence and to defend "our" landscapes against them; that is, lands conceived as belonging either to us as individuals or as members of a nation. Drawing on the CONTAINER image schema, inside and outside are reified: what is inside is inherently good whereas what is outside is unknown, scary, an enemy. In *Biological Invasions*, IS are characterized with an array

of negative descriptors such as exotic, alien, weed and pest,[19] which contrasts with the purity of natural landscapes (Milton 2000; Lien 2005). In the words of Douglas (1966: 4): "Ideas about separating, purifying, demarcating and punishing transgressions have as their main function to impose system on an inherently untidy experience. It is only by exaggerating the difference between within and without, above and below, male and female, with and against, that a semblance of order is created." Invasion biologists engender order on the biological world with a good-bad opposition that is revealed by the prevalent frame of comparison between native species and IS,[20] one which relies on the establishment of a problematic distinction between them (see Woods and Moriarty 2001).

Once a duality is created between personified friends (natural communities and their species) and foes (IS), their imputed competitiveness can quickly escalate into militarism. This is demonstrated by ten papers in *Biological Invasions* that refer to "aggressive" interactions between native species and IS (e.g., Usio, Konishi and Nakano 2001). Another 22 papers refer to the "threat" that they pose. IS also govern a "sea under siege" (Galil 2000) and adopt a "'sit and wait' strategy" (Greenberg, Smith and Levey 2001). Finally, in their article entitled "Biotic resistance experienced by an invasive crustacean in a temperate estuary", Hunt and Yamada (2003) extend the war metaphor by attributing acts of resistance to the native species themselves. In summary, these language choices attribute agency to IS, which personifies them as competitive and thereby intensifies our perception of their effect and our antagonism toward them.

Consequently, biologists feel justified in waging a war against IS (see Larson 2005). For example, Webb et al. (2000: 350) stated that "[t]he third front in the war on invasives is restoration", and similar, yet more subtle references typify well-cited review papers (such as Mack et al. 2000). Although less common, militaristic metaphors were still detectable in *Biological Invasions*. Six papers referred to IS as "targets", including Campbell and Echternacht (2003), who envisioned introduced species as "moving targets". Ten papers invoked "strategies" for removing IS, and eleven referred to their "eradication". Two papers posited "non-target ef-

19. Each of these was used between 20–50 times in *Biological Invasions*. These terms make it easy to confound native and invasive with notions of good and evil. M. Chew (personal communication) has collected many examples of this phenomenon, including an article in a children's science magazine entitled: "Those wicked weeds."

20. 17 titles in *Biological Invasions* directly compared native and IS.

fects" in reference to the unintended effects of biological control agents[21] on native species. In four papers, these agents allowed an indirect "attack" on IS. It is apparent that while invasion biologists defend biodiversity and non-human species as having an intrinsic right to exist, they proclaim, Janus-like, that IS don't have these same rights. Indeed, they recommend that a "'guilty until proven innocent' approach" be used against them (Mack et al. 2000: 689).

5. Concluding thoughts

Bono (2003: 225) suggests that we "regard metaphor as a contingent, historical 'tool' which we use (and which 'uses' us) to approach, ultimately to inhabit, the unstable flux of things from which our world must emerge". This chapter, for example, shows that invasion biology is an expression of three metaphors used to conceptualize and respond to novel species. Invasion, competitiveness and militarism are interwoven into a narrative meta-metaphor (or perhaps "root metaphor") of contemporary American culture. One consequence of their resonance with that larger narrative is that those most committed to conservation may begin to have doubts about the intentions of invasion biologists who use these metaphors. In the words of Underhill (2003: 154): "A recurrent insistence on warfare metaphors does, therefore, tend to imply a fundamental (though perhaps largely unconscious) sympathy with, and desire for, the conflict and power struggle that warfare allows."

At a larger scale, militaristic metaphors may lessen the reality of war so it can be further used as political trope. Underhill (2003) has demonstrated a "switch" in the media whereby real war is presented with non-militaristic metaphors (WAR IS X), while everyday occurrences are transformed into wars via militaristic metaphors (X IS WAR). If these latter wars are portrayed uncritically, then they indirectly support the occurrence of actual wars. By using militaristic metaphors, invasion biologists create an artificial similarity that contributes to a semantic field of war. For example, President Bush recently merged part of the Animal and Plant Health In-

21. Biological control agents are species known to prey upon an IS in its native range and which have been introduced purposefully to control it in its new range. The term "control" is common in IS literature, occurring 38 times in *Biological Invasions*.

spection Service – which is responsible for IS among other tasks – into his new Department of Homeland Security. The Union of Concerned Scientists criticized this move, observing that "It's hard to imagine that a department rightfully focused on preventing terrorist activity will pay much attention to the movement of pests and weeds" (UCS 2002). Unfortunately, the way invasion biologists present IS may have contributed to the ease with which this link to international terrorism was made. If invasion biologists are deeply committed to conservation they may need to oppose all wars, especially given their tremendous ecological costs (Austin and Bruch 2000).

Invasion biologists need to carefully reconsider their language if they truly want people to connect with nature and to care for it. These objectives may not be met by employing metaphors of invasion, competition and militarism, which are founded on implicit dualities between self-other and good-bad. In this respect, Waldron (2003: 166) has observed that

> The nation has been sacralized by the same processes through which individuals, societies, and cultures are reified into selves or entities: by creating boundaries dichotomizing the world into us and them, coercing homogeneity within and excluding foreignness without, and imbuing all this with an emotionally charged aura of eternal truth and goodness that simultaneously sanctifies and obscures its contingent, constructed nature.

Although IS create problems for humans in certain circumstances, so do some native species. Rather than siring a scapegoat, founded in prevailing modes of relating, perhaps invasion biologists could better attend to just how much IS are like us, as a means to break-down the distinction between native-invasive, self-other. By any definition, humans are IS (Woods and Moriarty 2001: 177–178). We are sometimes competitive, but we also sometimes cooperate, even if the former is accentuated in our current cultural context. In the words of Rodman (1993: 152), "[w]hen we look at […] invasion, we look as if in a mirror and realize that restoring the balance must, in large part, come from within". Invasion biologists need to be aware of the entailments of the unconscious metaphors that they adopt, live by, and defend, and be open to alternative possibilities.

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