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Embodied realism and invasive species

Brendon M. H. Larson

Department of Environment and Resource Studies, University of Waterloo, Waterloo, Ontario, Canada N2L3G1

1 Introduction

In summer 2002, a new species of beetle, the emerald ash borer (EAB), was detected on ash trees in southwestern Ontario and in adjacent Michigan. It was new to this region, at least, having recently arrived in solid wood packing material from Asia. Given that ash species were a dominant component of regional forests and that EAB soon demonstrated its ability to spread and to kill most adult trees, the potential economic impact of its spread in the United States alone was estimated at \$282 billion [Poland and McCullough, 2006], not including tremendous aesthetic and ecological changes to both rural and urban landscapes. Consequently, government agencies enacted a number of measures to prevent its spread. In Essex County, Ontario, healthy ash trees in the vicinity of an infestation were cut down and burned. Furthermore, all ash trees within a 10-km wide “firewall” zone along the eastern edge of the county were cut down to help slow the eastward spread of EAB. The entire county was quarantined by regulations that prevented people from moving ash wood out of the region.

To conservation biologists and ecologists, narratives such as this one are by now familiar, with the EAB simply the latest in a long list of “invasive species” [for review, see Mack et al., 2000]. For biologists, invasive species provide opportunities to study diverse questions in ecology, evolutionary biology, and related fields [Sax et al., 2005]. In the case of EAB, for example, there has been extensive research into how it spreads and how we might manage it [e.g., Muirhead et al., 2006]. There has been much less consideration of our conception of this situation, and of invasive species in general. It simply seems commonsensical that there is a

border between areas that have been invaded and those that have not, between an inside and an outside. It also seems commonsensical to think of these species as moving across this boundary, exerting effects on species on the other side. Hence, we erect firewalls to prevent their spread. It is this commonsense characterization, however, that I wish to investigate here.¹

I will first introduce two general ways that invasive species have been defined, and then consider how these echo the long-standing debate between realist and constructivist philosophies of nature. This debate tends to reinforce conceptual dualities, and I thus propose embodied realism as a means to navigate between the extremes. I specifically examine how the metaphors of invasion biology exemplify embodied realism, with the core of the chapter investigating the image schemata of the field. Finally, I conclude by revisiting the extent to which embodied realism helps us to understand the conceptual underpinnings of invasion biology.

1.1 Two definitions of invasive species and their implications

There is extensive debate about the concept of an invasive species [reviewed in Colautti and MacIsaac, 2004]. A key element of the usual definition is that they are non-indigenous (also called non-native or alien); that is, people have introduced them to a new region, either intentionally or unintentionally.² Either way, the definition then dichotomizes [Lodge et al., 2006; Ricciardi and Cohen, 2007]. To many ecologists, invasive species are defined as non-indigenous species that spread and tend to become abundant in the new region. In contrast, policy papers, legislation, and some ecologists tend to append an additional component to this

¹ Ecologists also investigate the process of invasion in contexts other than that of invasive species, such as how tree seedlings invade an old field. While the issues considered herein can be generalized to such cases, I will focus on invasive species because invasive in this context has a more normative overtone that exacerbates the dualities discussed below.

² Normally, native species are not included in definitions of invasive species, though some ecologists would broaden the definition of invasive species to include native as well as non-native species [e.g., Houlihan and Findlay, 2004]. The recent literature has begun to refer superabundant species, either native or non-native ones that have invasive tendencies.

definition: invasive species are not just invasive, but they *also* cause some form of ecological or economic harm.

Both definitions have in common the concept of invasion, but they differ in terms of their emphasis on impact. This reflects a broader debate about the moral implications of invasive species. Brown and Sax [2004], for example, “plead for more scientific objectivity and less emotional xenophobia [p. 531]” in the study of invasive species, since they are simply “unintentional experiments” that provide a novel opportunity for obtaining insight into how the natural world functions. A key basis of this perspective is that species have always spread around the globe, and that the current biotic interchange is no different. Implicitly, or sometimes explicitly, such views tend to contribute to a less policy-oriented science [see Larson, 2007a]. Some might fear that they lead to apathy by reducing the incentive to protect “natural” systems.

In contrast, other ecologists emphasize the distinctiveness of modern invasions relative to historic ones, and thus the detrimental effect of some invasive species on native communities and species [Cassey et al., 2005; Ricciardi, 2007]. They feel compelled to actively defend these landscapes, and tend to more actively advocate for policy regarding invasive species. They might also feel betrayed by the first camp; Simberloff [2006], for example, denounces the work of some critics as “a rearguard action to convince biologists and the lay public that the ecological threat from introduced species is overblown [p. 915].” By implication, the scientific questions addressed by this group tend to emphasize more applied dimensions of how to reduce the impacts of invasive species.

1.2 Constructivism and realism in invasion biology

This debate can be put in the broader context of the long-standing debate between realist and constructivist philosophies of nature. A realist view of the natural world assumes that it is “real and knowable” and that “facts are not just made-up things ... but rather are claims about the real world that are true to the extent that they correspond to this reality [Proctor, 2001, p. 231].” It thus makes claims to universality. Whereas many environmental and ecological thinkers have taken for granted this scientific view of the world, some have begun to question the extent to which the resulting understanding is “constructed” [Evernden, 1992; Cronon, 1995]. The perspective of social constructivism serves to remind us

that any descriptive or normative pronouncement people make on nature is never innocent of its human origins ... we cannot say anything more about [nature] without relying on human modes of perception, invoking human conceptual apparatus, involving human needs and desires – in short, when we speak of nature we speak of culture as well [Proctor, 2001, p. 229].

In its extreme form, however, critics have argued that this view denies what is actually significant in nature, thus stealing the thunder of those intent on protecting it from plundering humankind [Soulé and Lease, 1995; Crist, 2004].³ Unfortunately, something has been lost in the extremism and smoke-and-mirrors of this debate. On the one hand, many scientists acknowledge a basic constructivism in human knowing, and on the other, few constructivists deny there is a “reality out there.”

Nonetheless, this discussion may underlie some of the recent debate about invasive species cited earlier. A geographer has concluded, for example, that “the native/alien polarity is

³ This debate was part of the more general science wars between those standing behind the authenticity of scientific truth claims and those arguing for their constructedness, evinced in the polemic of the Sokal [1996] hoax.

a subset of the discredited nature/culture duality, [so] its conceptual foundations seem irredeemably fractured [Warren, 2007, p. 427],” or, as another put it, “The status and identification of any species as an invader, weed, or exotic are conditioned by cultural and political circumstances [Robbins, 2004, p. 139].”⁴ From the other side, an outspoken ecologist denounces a particular conception of invasion biology because it is

essentially a version of the strong program of social construction of the science, an example of an approach by a small minority of sociologists who construe developments in the sciences as reflecting social factors and the psychology of its practitioners rather than advances in understanding the workings of the universe [Simberloff, 2006, p. 916].

Such exchanges typify the misunderstanding between the two parties in realist-constructivist debates, with each side presenting a caricature of the other. I wish to skirt simplistic and extremist versions of this discussion that were propounded during the science wars by recognizing that environmental problems are both real *and* constructed. The main challenge lies in explicating that that might mean [Proctor, 2001]. As a starting point, we might recognize that there is truth to both sides. We cannot deny that there are species moving here, and scientists can certainly study that phenomenon as they have any other. Nonetheless, the narrative of invasive species depends on particular notions of space, time and human agency that have seldom been explicated. Thus, we certainly need to question how the category of invasive species has been created here, and even more so, the political and social elements of its construction. In particular, why and how has the leap from “is” to “ought” occurred? Numerous philosophers have explored such issues in relation to invasive species [Botkin, 2001; Shrader-Frechette, 2001; Woods and Moriarty, 2001; Lodge and Shrader-Frechette, 2003] yet “The

⁴ Note, however, that the emphasis here is on “conditioning” rather than causation, a marker that this form of construction does not deny material reality.

ambiguities [they have uncovered] may perhaps have been neglected or glossed over in the haste to sound the alarm of a crisis [Foster and Sandberg, 2004, p. 180].”

To further clarify social constructivism, we can turn to Hacking [1999]. He explains that it simply interrogates the status quo by demonstrating that X, being what is constructed, “appears to be inevitable [p. 12],” yet “need not have existed, or need not be at all as it is. X ... is not determined by the nature of things; it is not inevitable [p. 6].” In the current context, we largely take invasive species for granted as a phenomenon because they certainly seem real enough as “objects” [sensu Hacking, 1999]. It is our “idea” of invasive species, our way of thinking about them, that is more questionable, and which I will thus examine here.⁵ Complex facts such as this are likely to be profitably examined from a constructivist perspective.

Realist and constructivist philosophies related to invasive species particularly appear in terms of the nature of communities. If we perceive native communities as natural kinds, as static entities, then we are more likely to adamantly defend them against invasive species. In the case of EAB, for example, we seek to prevent its impact on “native ash forests” [Muirhead et al., 2006, p. 76]. More generally, we might be realists about invasive species if we perceive them as unproblematically there, as a real ongoing phenomenon out there in the world. The solution thus becomes a scientific one. Furthermore, realism about facts typically correlates with realism about values – that is, that we need to prevent them from spreading. While this perspective allows us to scientifically examine the phenomenon, it tends to overlook the theory-ladenness of our observations, the extent to which the observer is always present [Larson, 2008b]. In contrast, if we perceive native communities as temporary assemblages of individualistic species, we might

⁵ Hacking [1999] further notes that constructionist arguments are often extended in a normative and activist direction that devalues X and thus seeks to transform it by “raising consciousness.” While part of my motivation for examining invasive species derives from concern about whether our framing of them is appropriate or helpful [Larson, 2005; Larson, 2007b], I will only briefly consider this normative aspect here.

be less concerned about invasive species [Soule, 1990; Botkin, 2001; Brown and Sax, 2005; Vermeij, 2005]. They become less convincing as a category, instead being mere instances of the propensity for all species to move around. Their significance is thus constructed. Though these perspectives are quite oppositional they both contain important elements, so in what follows I seek another way to engage our conception of these species.

1.3 Constitutive metaphors and embodied realism

The concept of invasion underlies the field of invasion biology, as exemplified by its role in both of the definitions given above. It is thus a critical concept to examine in terms of the realist-constructivist debate over invasive species because it is taken for granted. And given its metaphorical basis, we first need to consider the role of metaphor in science. Many scientists historically denigrated metaphors such as this as deviant, rhetorical embellishment. However, they are no longer considered mere rhetoric because myriad historical, philosophical and sociological studies have demonstrated that they are integral to scientific practice [e.g., Kuhn, 1979; Bono, 1990; Brown, 2003]. Cognitive linguists have also shown that metaphor is not just a matter of words, but of thought as well [Lakoff and Johnson, 1980; Johnson, 1987]. In particular, many “dead” metaphors – which have become so ossified that we consider them literal – are “metaphors we live by.” Two classic examples include the conceptual metaphors Time is Money (e.g., “How will you spend your weekend?”) and Argument is War (e.g., “His criticisms were right on target”), metaphors that structure our normal understanding of time and argument, respectively. Metaphors such as these are neither deviant nor expendable. Rather, they may constitute our interpretation of the world, thereby undermining standard conceptions of

the distinction between literal and metaphoric and even of “truth” itself. The concept of invasion in the field of invasion biology is a case in point.

Furthermore, metaphors such as these may in fact be constitutive, defined by Boyd [1979] as those which form “an irreplaceable part of the linguistic machinery of a scientific theory; cases in which there are metaphors ... for which no adequate literal paraphrase is known [p. 360].” It is often debatable whether particular scientific metaphors are actually constitutive or merely heuristic. Two ecologists, for instance, recently accented the importance of metaphors yet limited them to an heuristic role: “Metaphors ... are crucial stimuli to synthesis and innovation ... [but] in a mature science, the metaphorical assumptions must be stripped from the core definition [Pickett and Cadenasso, 2002, pp. 6, 8].” Unfortunately, the conceptual foundations of our language may neutralize this intent. For example, while Simberloff [2006], citing Boyd, states that “constitutive metaphors are invitations to future research, including research into the degree of analogy between the developing concept and the referent of the metaphor [p. 917],” that is only true to the extent that we remain conscious of the power of the metaphors that already hold us. I will show herein that metaphors such as invasion may not be that accessible.

The accessibility of constitutive metaphors may relate to their scale. Metaphors may range across a scale from cognitive metaphor [Lakoff and Johnson, 1980], through discourse metaphor [e.g., metaphor used at the level of everyday conversation to promote ecological ideas, Zinken et al., 2008], and on to root metaphor [such as large-scale underlying meta-tropes, including those at the scale of "system" or "holism," Taylor, 1988]. Each of these may influence the way we conceptualize and thus approach ecological systems. These levels may also reinforce one another, thus making particular metaphors more naturalized and, hence, less open

to change. Take invasion for example. Otis [1999] magisterially analyzed the constitutive role of invasion metaphors in nineteenth-century medicine and demonstrated how they interwove literature, politics and science. In the case of invasion biology more specifically, an historian has claimed that the use of the invasion metaphor in this field derives from political geography [Moore, 2005], and some ecologists have opined that initial concerns about invasive species arose from related concerns about Nazi invasion [Davis et al., 2001]. In short, these large-scale cultural factors may instantiate a metaphor and simultaneously make it relatively inaccessible and intransigent. At the same time, they may be reinforced by cognitive factors that are the focus of this chapter.

Specifically, constitutive metaphors may provide an avenue to what Hayles [1995] calls constrained constructivism. This perspective seeks a middle ground for environmentalist concern between the extremes of scientific realism and social constructivism. Her main claim is that access to the “unmediated flux” is mediated by the form of our embodiment, our particular ways of interacting with the world from specific positions within it. Thus, the key insight here is that there is no view from nowhere. However, constrained constructivism *also* recognizes that scientific inquiry puts constraints on possibility, so it is not totally deconstructive. Science can reject some possibilities. Constrained constructivism simply acknowledges the limitations on our knowing and thus that other possibilities exist.

A related view has been developed in the field of cognitive linguistics, which investigates the specific ways in which our embodiment influences our interaction with the world. Some of these ideas reflect Kantian precursors, specifically the notion of embodied or experiential realism that describes how metaphors reflect the cognitive structure of our way of being in the world [Lakoff and Johnson, 1980; Brown, 2003]. As explained by Brown [2003], embodied realism

“makes a case that we know the world only in terms of perceptions, categorizations, and reasoning, both conscious and unconscious, grounded in our bodily capacities and life experiences and inherently limited by them [p. 187].” Surprisingly, this cognitive linguistic perspective has seldom been considered within the philosophy of ecology, except for occasional blanket citation of Lakoff and Johnson [1980] yet without up-dated analysis that reflects how the field of cognitive linguistics has developed over nearly three intervening decades [Lakoff and Johnson, 1999; e.g., Frank et al., 2008].

It may be that philosophers of biology resist metaphor analysis because it is “just linguistics” and seems to be a throw-back to the antiquated view that language is representational [Bono, 2003]. As we well know, however, even semantic analysis can contribute to a science such as invasion biology. For example, Ricciardi [2007] provides evidence that “invasive species” are not necessarily harmful ones, so it might bring clarity if the term referred to species that tend to spread rather than confounding this tendency with their impact. While such analyses are important, this chapter instead examines how we conceptualize the process of invasion, specifically in terms of the boundaries we invoke. I also aim to show that rather than just being a representational issue, such metaphoric constitution contributes to action and practice – metaphors are performative. As explained by Bono [2003], this means that “the work of metaphor ... is not so much to represent features of the world, as to invite us to *act upon* the world *as if* it were configured in a specific way *like* that of some already known entity or process [p. 227].” Let us now examine how this might operate in the field of invasion biology.

2 The image schemata of invasion biology

This chapter focuses on image schemata as an instantiation of embodied realism in our conception of invasive species. Image schema are “dynamic analog representations of spatial relations and movements in space [Gibbs, R. W., Jr., 1999, p. 354],” and they are studied extensively in the field of cognitive linguistics. They are crucial to human understanding because they organize our cognition in fundamental, preconceptual ways, as will be demonstrated below.⁶ Image schemata are metaphoric in that they derive from our bodily experiences and are projected so that we can understand “external” phenomena. In invasion biology, three key schemata are CONTAINER⁷ and PATH (which together give rise to the inside-outside duality and motion implicit in invasion), and FORCE dynamics (giving rise to how we think about the pressure exerted by invasive species). Here, I will follow cognitive linguistic tradition by providing textual examples that reveal these underlying schemata and patterns of thought so that we have a better understanding of our conception of invasive species.

2.1 The CONTAINER and PATH image schemata

The concept of invasion relies on a particular way of understanding and relating to the world around us. A key component is the CONTAINER image schema, which envisions one’s relation with the world in terms of the human as a container, with the human inside and the rest of the world outside. This distinction between *inside* and *outside* can be projected onto the world as a means to structure and understand it, a process which derives in part from the familiar human experience of having a boundary, the skin [Johnson, 1987; Rohrer, 1995; Chilton, 1996; Lakoff and Johnson, 1999]. Given extensive bodily experience of separate inside and outside, we

⁶ Mandler [2006] reviews some of the empirical evidence that psychologists have found for the existence of image schemata, and Johnson [1987] and Lakoff and Johnson [1999] examine their existence more generally.

⁷ I will use small caps to indicate image schema, following the convention in cognitive linguistics.

project this CONTAINER image schema in various ways to understand the world. Lakoff and Johnson [1999] give the example of a bee in a garden:

When we understand a bee as being *in* the garden, we are imposing an imaginative container structure on the garden, with the bee *inside* the container. The cognitive structure imposed on the garden is called *the container image schema*. That cognitive structure plays a *causal role* in bringing about an understanding—a conceptualization of the bee as being *in* something [p. 117].

The CONTAINER image schema is also implicit in how we think about invasive species [Larson, 2008a]. The container exists around a pre-existing native community (or at larger scales, all the way to biogeographic regions and nations), the one present before a novel species arrives. When this species arrives, it crosses the boundary defining the container by entering the native community; in normal parlance, it invades it.

This notion of invading a pre-existent container depends on yet another schema, the PATH schema. This schema derives from our everyday experience of purposeful movement from a source to a goal or objective, and it is projected onto our understanding of the trajectory or path through space taken by invasive species. As explained by Lakoff and Johnson [Lakoff and Johnson, 1999, p. 33], this trajectory is conceptualized “as a linelike ‘trail’ left by an object as it moves and projected forward in the direction of motion.” We thus conceptualize invasive species moving in such a manner, from a source somewhere else towards extant, integrated communities. At this point, our conception resonates strongly with our conception of political invasion and the invasion of our bodies by disease [see Larson, 2008a]. It is in part for this reason, though more intimately because of the nature of the PATH schema, that we often portray invasive species as having a negative *intent* or purpose.

At a relatively unconscious level, the CONTAINER and PATH image schemata together construct how we conceptualize the process of invasion. They thus constitute the field of invasion biology, as revealed by the very fact that our name for the field that studies *invasive* species is *invasion* biology. As with metaphors in general, however, these two schemata highlight some aspects of a relation while at the same time hiding others. A major implication of the CONTAINER schema, for example, is that we can define *inside* here, that is, that there is an enduring inner state that is “native” and which can be contrasted with an external “non-native” state. We see here the enduring, yet problematic boundary between nature and culture that often appears in invasion biology [Milton, 2000; Robbins, 2001]. In contrast, we might recognize that the pre-existing community already contains non-native elements because of the effects humans have had almost everywhere on the planet [Larson, 2008b]. Furthermore, this schema assumes that we can draw a boundary around an integrated community, despite the fact that few ecologists subscribe to the idea that communities are integrated wholes. An integrated community is also one that is implicitly in *balance*.⁸

The performativity of the CONTAINER image schema is instantiated in the case of barrier zones. A barrier zone can be defined as an area at the front of a population where eradication (or suppression) activity is performed in order to prevent or to slow population spread [Sharov and Liebhold, 1998]. As an example, managers cut ash trees in a 10-km wide by 30-km long barrier zone to prevent the spread of EAB, as discussed in the introduction [Muirhead et al., 2006]. The establishment of this barrier zone plays out on the land the boundary between what pre-exists, inside the boundary, and that which impedes on it from the outside. Here we see humans

⁸ “Balance” here derives from yet another image schema, one that cognitive linguists attribute to our familiar sense of bodily balance [Gibbs, R. W., Jr., 1994]. While ecologists generally consider “balance of nature” an out-dated popularization, it has been argued that it still constitutes ecological theories and that it is “much more than an imprecise precursor of the theoretical concept of mathematical equilibrium [Cuddington, 2001, p. 465].” Its bodily basis may be one reason for its entrenchment.

reinforcing the capacity of natural systems to resist the spread of an invasive species, a force we explore next.

2.2 The FORCE dynamic schema

To further develop our understanding of the conceptualization of invasive species, next consider the title of a recent paper published in *Ecology*: “Ecological resistance to biological invasion overwhelmed by propagule pressure [Von Holle and Simberloff, 2005].” There are a number of conceptual elements operating here, and cognitive linguistic analysis of FORCE dynamics helps to unpack them. But first, we need to expand and define some background terms. Communities can resist invasion in two main ways: environmentally, in terms of those abiotic factors affecting the establishment of an invading species, and biotically, defined as “ways in which the resident species repel invaders [Von Holle and Simberloff, 2005, p. 3212].” Communities with low invasibility are able to exert enough pressure to prevent invaders from entering. From the other side, we have propagule pressure, which may be defined as “a composite measure of the number of individuals released into a region to which they are not native [, ... which] incorporates estimates of the absolute number of individuals involved in any one release event (propagule size) and the number of discrete release events (propagule number) [Lockwood et al., 2005, p. 223].”

Even though the father of invasion biology, Charles Elton, is credited with the concept of biotic resistance to invaders, the joint concepts of biotic resistance and propagule pressure have only recently arisen in the literature. According to a search of ISI Web of Knowledge, the first occurrence of the term “propagule pressure” was Williamson and Fitter [1996]. Since then, it has rapidly grown in prominence (Figure 1), with a total of 138 citations from 1996 to 2007 (and

88% of them over the four years 2004-2007). Similarly, the phrase “biotic resistance” first occurred in Lake and Odowd [1991], but it has since grown exponentially (Figure 1), with a total of 97 relevant citations from 1991-2007 (and 77% of them over the three years 2005-2007).

Where do these notions come from? According to cognitive linguists, these embodied conceptions derive from our everyday experience of pressures and resistances as we abut against other objects and people [Johnson, 1987; Lakoff and Johnson, 1999; Talmy, 2000]. Again, the basic idea is that as embodied beings we daily experience pressure, and that this familiar experience may ground metaphorical understanding. Evolutionary biologist Richard Dawkins [cited by Gould, 1997], for example, characterizes natural selection as “the pressure that drives evolution up the slopes of Mount Improbable. Pressure really is a good metaphor. We speak of ‘selection pressure’ and you can almost feel it pushing a species to evolve, shoving it up the gradients of the mountain [p. 1022].” Although Gould wryly comments, “Surely, we can do better” in response to this metaphor, biologists often conceptualize evolution in terms of selection pressure, and pressure recurs throughout biological conceptions [Young, 1993].

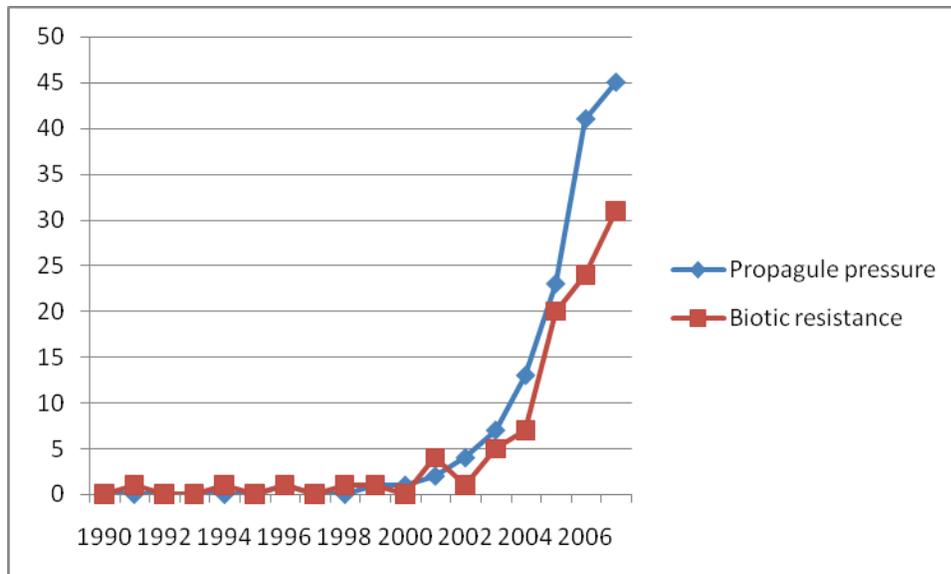


Figure 1. The rise in citations of propagule pressure and biotic resistance, 1990-2007. Figure shows results from search of ISI Web of Knowledge using the keywords (i) "invasi*" and "propagule pressure" and (ii) "invasi*" and "biotic resistance." Only records pertinent to invasion biology have been included in the data presented here, and related terms such as invasion resistance and ecological resistance have not been included.

In the case at hand, we have invasive species exerting propagule pressure on communities from the outside (presumably pressing on their boundary, in the sense discussed above), as represented in Figure 2. The more propagules there are, the greater the external pressure threatening to decompose the pre-existent “native something.” From Newton’s third law (and daily experience), we know that forces always occur in action-reaction pairs, and we do not have far to look for that oppositional force. Unified native communities exert a force outwards, biotic resistance, which opposes this propagule pressure (Figure 2). We can see such conceptions at play most markedly where the two metaphors occur in concert with one another, as in Von Holle and Simberloff [2005], but also in numerous other papers in the recent literature [D’Antonio et al., 2001; Martin and Marks, 2006; Hollebone and Hay, 2007; Perelman et al., 2007]. Regardless of whether these metaphors are made explicit, however, the pressure-resistance pairing is evident

in how a wide range of biologists and environmentalists conceptualize and thus respond to invasive species.

As a further example, consider the phenomenon of invasional meltdown, where “interspecific facilitation leads to an accelerating increase in the number of introduced species and their impact [Simberloff, 2006, p. 912].” Invasional meltdown is now “routinely considered in various explanations by ecologists, conservation biologists, and invasion biologists [and] it has entered the lay literature [p. 916].” But what is it that is melting-down in an invasional meltdown? I would proffer that the meltdown is a loss of pressure within the pre-existing community and hence its ability to resist invaders. Once the community loses this resistance pressure entirely, as the pressure of the introduced species and their impacts accelerate, it ceases to exist. It is deflated and over-run. Note the performativity of this metaphorical extension of pressure-and-resistance, despite the fact that “a full ‘invasional meltdown’ ... has yet to be conclusively demonstrated [p. 912].”

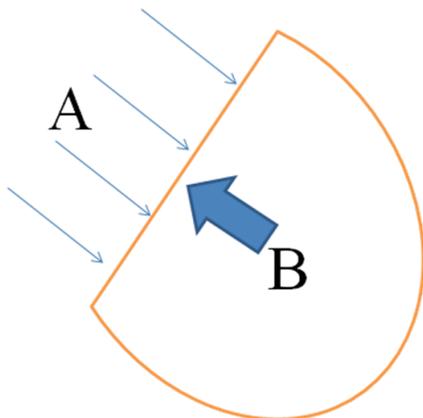


Figure 2. A FORCE dynamic representation of propagule pressure and biotic resistance. The four arrows (A) represent the propagule pressure exerted by a novel invasive species on a pre-existing community, represented by the polygon. The community exerts a force, biotic resistance, which opposes this external pressure.

Interestingly, ISI Web of Knowledge also located 2,576 records for “invasive species” through the end of 2007, of which the first was in 1986.⁹ We have already seen that invasion may be thought of as constitutive within invasion biology. While the terms “biotic resistance” and “propagule pressure” first occurred five and ten years later, respectively, they appear to be an outgrowth of thinking in terms of invasion. For once you have invaders impinging on a container, from the outside, it becomes normal to then think of them in terms of the force they exert, and how this might be opposed by the ecological resistance of the existing community. The coincident rise in these two metaphors occurs in part because thinking in terms of one performatively leads to thinking in terms of the other because of FORCE dynamic conceptualization.

3 Discussion

I began this chapter by inquiring into the reality of invasive species. I then demonstrated that our conception of these species depends on our embodiment, specifically in terms of cognitive schemata such as the CONTAINER and PATH image schemata and FORCE dynamics. Accordingly, the reality of invasive species can only be assessed in terms of how humans understand; it is not unembodied truth. Invasive species may nonetheless appear inevitable in the sense outlined by Hacking [1999] earlier, for we cannot conventionally conceptualize a world without boundaries and pressures. However, is our conception actually “inevitable” and in “the nature of things?” We might approach this question in two ways. First, is this conception universal? Is it common to people regardless of their culture? Second, is it the only option? Is this the only way to conceptualize the movement of these species? If we answer both of these questions in the

⁹ This total is a slight over-estimate since the data have not been combed for hits in ISI Web of Knowledge that do not correspond to invasive species in the sense pertinent to this discussion.

affirmative, we would have a more firm basis for concluding that our conception is effectively inevitable since we cannot realistically know the world in any other way.

Let's begin with the first question. Is this conception universal? While I have presented the cognitive schema of invasion biology as embodied, we have not yet considered the extent to which they may vary depending on cultural context. The importance of this context is contested within cognitive linguistics, but many scholars conclude that image schemata are developmentally and culturally conditioned rather than innate and individualistic [Gibbs, R. W., Jr., 1999; Bono, 2003; Frank et al., 2008]. Thus, it is by no means clear that such schemata are universal, even if we might assume they are relatively constant in the case of Western scientists studying invasion. That said, I have already shown that biologists exhibit variation with regard to their views of invasive species, perhaps *in part* related to variation in the expression of particular image schemata.

The CONTAINER image schema, for example, relates to our conception of self versus other. While we may perceive an obvious boundary distinguishing ourselves from our surroundings—the skin, the question is whether there is any reason to emphasize this boundary rather than the tremendous flux that constantly flows across it [see Brown and Toadvine, 2007]. While those of us raised in Western societies lean towards the former view, anthropologist Geertz [1979] observed that

The Western conception of the person as a bounded, unique, more or less integrated motivational and cognitive universe, a dynamic center of awareness, emotion, judgement, and action organized into a distinctive whole and set contrastively both against other such wholes and against a social and natural background is, however incorrigible it may seem to us, a rather peculiar idea within the context of the world's cultures [p. 59].

In some of these cultures, invasive species may be perceived differently, with less expectation that what is inside should remain isolated and fixed over time. Bono [2003], for example, contrasts containment in Chinese and Western thought and claims that “the boundaries between what is inside and what is outside are differently drawn and, at its most extreme ... the very notion of a ‘boundary’ itself is differently constituted in the two cultures [p. 221].”¹⁰ A key boundary here is the nature-culture boundary implicit within invasion biology, a boundary that tends to be less marked in many non-Western cultures. Thus, while this question is by no means closed, it appears that other cultures may place less emphasis on the crossing of boundaries by invasive species.

Second, we can ask whether there are alternatives to the standard conception of *invasive* species. These alternatives may be hard to find since “invasion” is a constitutive, entrenched metaphor. It leads us to conceptualize these species in a particular way, as entities that cross boundaries and exert pressure on intact communities or ecosystems that oppose them.

Nonetheless, this boundary-laden Newtonian conception may be inadequate for understanding open biological systems whose boundaries may in fact be permeable and interactive. This metaphor has become self-fulfilling, however, in part because it is also performative. It also contributes to an oppositional response to these species, one predicated in part by FORCE dynamics as described above.

Nonetheless, at a trivial level this conception is not inevitable because every metaphor and schema highlights one aspect of a relation while hiding others. As an example, we typically conceptualize arguments as war, as shown by everyday expressions such as “He attacked every weak point in my argument” and “I’ve never won an argument with him” [Lakoff and Johnson,

¹⁰ On a related note, it has been found that people from Asian cultures tend to conceptualize individuality in terms of interdependence more than Americans [e.g., Markus and Kitayama, 1991].

1980, p. 4]. It is possible, however, to view them instead as a dance between two partners, which emphasizes the mutual, perhaps positive exchange of ideas and opinions that can occur, dialogically, as two individuals seek consensus, rather than as a confrontational winner-take-all situation.

We might similarly benefit from the broader perspective provided by reframing invasive species. There are certainly alternatives to our current way of conceiving them [see also Larson, 2007b]. For example, our typical conception reifies “inside” and “outside” rather than emphasizing simple movement of species. Hence, the discussion typically focuses on which particular species are present in a community (*composition*), and on maintaining them in a native/natural state. An alternative is to emphasize questions about whether desired/important *functions* are maintained [Callicott et al., 1999; Hull, 2006], and some of these might be maintained across such boundaries. Other conceptions might weaken the form of spatiality inherent in the CONTAINER image schema, such as ones that better acknowledge the connection between the spread of these species and human globalization and cosmopolitanism.

For alternatives, we may also turn to the two definitions introduced earlier. One of them accents the tendency of these species to spread, to become superabundant. The other accents the harm they cause in relation to human interests. Neither of these so strongly invoke the inside-outside duality implicit in the concept of “invasion.” Similarly, there is no particular reason that either has to attach to non-native as opposed to native species. Recognizing these two dimensions, we might begin to refer to these species as either superabundant or harmful ones, depending on context and intent. Both of these would serve to break down the nature-culture, inside-outside duality that remains as long as we continue to conceptualize these species as invasive ones.

Turning to the broader issues raised in this paper, embodied realism allows us to accept that invasive species are real. We can in that sense be realists about them. At the same time, however, we can see that our conception of them derives from the structured way in which humans have evolved to relate to the world. They are thus constructed. So it seems sensible to accept both views, which may help to further weaken any remaining duality between realism and constructivism.¹¹ Furthermore, whether or not image schemata are universal,¹² biologists (and the general population, more generally) certainly hold varied views on invasive species and their impacts. Embodied realism provides one avenue for a more rich understanding of the reasoning that may underlie these varied perspectives. Ultimately, it thus encourages us to engage in open dialogue about the state of our planet and how we will choose to relate to issues such as invasive species in particular contexts.

In that context, this chapter has focused on the constitution of our *idea* of invasive species, rather than on the related *issue*. The “invasion” metaphor is also performative in terms of the fear-based resonance that it has, which is one reason that people become so adamant about defending landscapes against invasive species. Propagule pressure and biotic resistance are performative too, for when we think in this way, we tend to want to defend the systems that are there. We perhaps relate to the pressure these species exert on intact systems as we feel pressure on our skin. We oppose unpleasant such external pressures on our intact, reified selves; we oppose invasion of our nations as well as the invasion of our bodies by disease. We are thus led to oppose the spread of these species by what I have elsewhere called metaphoric resonance

¹¹ Proctor [2001] sees the relation between these views as one that is fundamentally paradoxical, meaning that the usual attempts to resolve the situation only serve to leave out part of the whole picture.

¹² And this point gives rise to the as yet unmentioned challenge for any deconstructive enterprise: that any statements it makes are no more foundational than any other. Applied here, the science of cognitive linguistics is new enough that I would not want to claim that my hypotheses here about the image schemata of invasion biology are founded in stone.

[Larson, 2006]. This resonance by-passes the naturalistic fallacy. By this means, the idea of invasive species inevitably turns into an issue, while we often neglect how this issue rests on a certain value-set that is not necessarily internally consistent and which is by no means acceptable to all [Rawles, 2004]. Instead, these new species might become objects of involvement for us as embodied beings in the world, and thus objects of concern for various reasons ranging from their aesthetics to their pragmatic uses through to their economic concerns and effects on biodiversity.

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