

An alien approach to invasive species: objectivity and society in invasion biology

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Abstract Several authors have recently argued that invasion biologists should adopt a more objective and dispassionate stance towards invasive species. Brown and Sax (Austral Ecol 29:530–536, 2004; Austral Ecol 30:481–483, 2005) assert that invasion biologists risk their objectivity, “commit the naturalist fallacy” or “embark on a slippery slope” with engaged concern about invasive species. Elsewhere, Colautti and MacIsaac (Divers Distrib 10:135–141, 2004) propose a neutral language for invasion biology, one that insulates scientific from popular discussion about invasive species. While there is certainly hyperbole about the effects of some invasive species, the type of objectivity promoted in these papers may often be inappropriate for invasion biology. It implies a policy of non-action that is inconsistent with the conservation values of many invasion biologists. To engage these values, invasion biologists can adopt deliberative methods for environmental problem-solving that involve stakeholders in their research design and which still promote high standards of scientific rigor.

Keywords Environmental deliberation · Fact-value dichotomy · Objectivity · Science · Society · Values

This dewdrop world
is but a dewdrop world.
And yet ...

Issa, eighteenth century

Introduction

In a recent paper, Brown and Sax (2005, p. 482) asked whether an alien scientist visiting New Zealand and Great Britain would be able to differentiate exotic from native species and demonstrate that the former had caused greater disruption to ecological processes. Presumably their answer to these rhetorical questions would be “No,” since the questions were part of a biogeographical argument that “biological invasions are nothing new” (Brown and Sax 2004, p. 532). Given the ubiquity of invasions through history, Brown and Sax further claimed that invasion biologists should be more objective about exotic species rather than demonstrating such a “strong response” to them (Brown and Sax 2004, p. 530). Perhaps they should aim to be as objective as this alien scientist—the ultimate arbiter of invasive species—rather than so human, so subjective. In this paper, I suggest that their

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alien begs the question of whether we should be less concerned about invasive species, however, because such detachment embodies an ideal of science that does not apply very well to invasion biology.

Brown and Sax are not alone in arguing for greater objectivity in invasion biology (Slobodkin 2001; Colautti and MacIsaac 2004; Vermeij 2005). In fact, their proposal revisits the state of the field at the Asilomar conference on introduced species in 1964, where participants “did not consider conservation implications of species colonizations whatsoever” (Davis 2006, p. 37). Their proposal also overlaps in intriguing ways with recent cultural critiques of invasion biology (Subramaniam 2001; Theodoropoulos 2003; Sagoff 2005). Nonetheless, I will focus on the recent exchange between Brown and Sax (2004, 2005) and Cassey et al. (2005) in *Austral Ecology* because it exemplifies discussion about the form that invasion biology should take. This discussion needs to be continually revisited because invasive species present a complex social and ethical quandary rather than solely a biological one.

Based on their claim about the normalcy of current invasions, Brown and Sax suggest that invasive species are less critical an issue than articles in *Biological Invasions* imply insofar as they recommend that researchers should focus on providing information rather than promoting concern. They clarify their purpose as follows:

[It] is not to argue that exotic species are ‘good’ so that their spread should be fostered. It is not to suggest that modern humans should let nature take its course and elect not to intervene in the dynamics of dispersal and extinction, and the resulting impacts on biodiversity, ecosystem function and the economy. It is to plead for more scientific objectivity and less emotional xenophobia (Brown and Sax 2004, p. 531).

Consequently, they recommend more dispassionate study of invasive species as an interesting biological phenomenon from which we can learn about ecological and evolutionary processes (see also Sax et al. 2005), while simultaneously providing objective information to society. Cassey et al. (2005) counter that current invasions differ

from historical ones in terms of human agency, magnitude, and rate, so they represent a distinct process. They thus conclude that scientists have a responsibility to engage this issue more directly, in part because “we should not confuse scientific objectivity with moral neutrality” (p. 478). However, they neither develop this point nor explain how scientists might become more engaged. Since this debate raises critical issues for the field of invasion biology, it needs to be carefully evaluated and extended.

Invasion biologists specifically need to reflect upon the meaning of scientific objectivity in their field. Brown and Sax neither clarify this concept nor describe in detail how one might be objective, especially in the context of invasion biology. Their presentation generally accords with a caricature of objective ecology contrasted with blatant subjective advocacy (see Killingsworth and Palmer 1992), however, since they do not engage with extensive discussions of advocacy and objectivity in conservation biology elsewhere (Barry and Oelschlaeger 1996; Kaiser 2000; Allen et al. 2001; Bradshaw and Bekoff 2001; Franz 2001; Ludwig et al. 2001; Rykiel 2001; Weber and Word 2001; Lach et al. 2003; Wallington and Moore 2005). They specifically disregard the intrinsic role of values in science, thereby reinforcing the “myth of a ‘value neutral science’” (Norton 1998, p. 355). Here, I will argue that it is possible for invasion biologists to simultaneously embody their biodiversity values and to be objective.

I agree with Brown and Sax that invasive species have often been unduly maligned (Larson 2005), so I am not arguing for excessive advocacy or valuation within invasion biology. Instead, I seek a path between the extremes of objectivity and subjectivity. Most invasion biologists probably entered their field to express their care for biodiversity rather than to study invasions as “unintentional experiments” (Brown and Sax 2004, p. 530), so this impulse needs to be acknowledged rather than denied (see below). To this end, I demonstrate why it is problematic to step back and be ‘objective’ about invasive species, and then suggest a way to reconceptualize the role of invasion biologists in the broader social discussion over invasive species.

Objectivity in invasion biology

Brown and Sax's argument relies on an implicit dichotomy between objectivity and subjectivity, between facts and values. For example, they contrast objectivity with emotional xenophobia (Brown and Sax 2004, p. 531), "scientific" with "ethical" judgement (Brown and Sax 2005, p. 481) and "objective scientific finding" with "subjective value judgement" (Brown and Sax 2005, p. 483), providing a mixed bag of oppositional values. Similarly, Colautti and MacIsaac (2004, pp. 135, 137) propose "objective definitions" for invasion biology to contrast with "subjective interpretation". Both papers strive to eliminate these values for they reveal "individual idiosyncracies" that stand in the way of objective science (for discussion see Daston 1992). As evidence of this subjectivity, Brown and Sax (2005, pp. 482–483) point to how only some people share the view that invasive species are undesirable and how perceptions of whether they are good or bad "varies with the moral beliefs of societies and individuals". To eliminate this subjectivity, they invoke "the principles of unbiased, objective inquiry that are the essence of the scientific method" (p. 483).

While a certain type of objectivity is undoubtedly critical for science, many scholars have trenchantly critiqued the dichotomy between facts and values that underlies the conception described above (Roebuck and Phifer 1999; Putnam 2002). Traditional models of values in science held that contextual values, including social and religious influences, were kept out of science by differing constitutive values that held within science itself (Longino 1990). Unfortunately, it is impossible to draw such a firm line between contextual and constitutive values. A key constitutive value is objectivity, yet even the desire to be objective reflects particular contextual values. Contextual values also influence scientists when they make value judgments in the course of their research (methodological value judgments, see Shrader-Frechette 1994, p. 53), which sometimes extend to more overt forms of research misconduct that lessen scientific objectivity (see Martinson et al. 2005). For these and other reasons, the philosophy on which the

fact-value dichotomy is based has been rejected, mainly because there is no way to isolate our facts from our humanness. In actuality, many values influence objectivity at each stage in the scientific process, from guiding assumptions to methodology through policy (Proctor 1998).

To understand how the often-useful distinction between facts and values tends to become an overblown dichotomy (Putnam 2002), consider the extent to which facts are value-laden and values are fact-laden in the debate in *Austral Ecology*. In their critique, for example, Cassey et al. (2005) demonstrate that the biogeographic facts provided by Brown and Sax are not as solid as they appear. While disagreements of this sort are common in science, they demonstrate that facts do not stand alone and speak for themselves, but are negotiated through particular frames of reference. As a specific example, Brown and Sax emphasize how non-native species increase species richness, while sidelining its effect on evenness and endemism relative to Cassey et al., an emphasis reflecting a particular valuation system.

On the other hand, some of our values about invasive species may be just as 'objective' as our facts. Brown and Sax (2004, p. 530), for instance, point to "something deep in our biological nature, related to xenophobia towards other humans, that colours our view of alien plants and animals". But if this is the case (see Simberloff 2003), might it then qualify as an 'objective' value? Further note that they disregard the inverse possibility that there is something within our biological nature—some would call it biophilia—that "colours our view" the other way, motivating a genuine concern for landscapes affected by invasive species (Kellert and Wilson 1995). Whether or not one accepts the biophilia hypothesis, it would appear that many, if not most, invasion biologists entered their field because of an abiding interest in organisms. Among the 18 prominent ecologists interviewed by sociologists Kinchy and Kleinman (2003, p. 872), for example, "many [...] stated that they felt a desire to 'save the planet' or prevent environmental damage. Often, these ecologists were drawn to their field of study by a concern or love for nature." Brown and Sax (2005, p. 483) show an affinity with this position when they state that "we authors are enthusiastic supporters of

actions and policies to reduce the ongoing loss of global biodiversity and homogenization of the earth's biota". These values may be no less variable among ecologists than agreement about many ecological mechanisms.

Several scholars have underscored the varied cultural values that influence ecological research (Keddy 1989; Keller 1991; Barbour 1995). What cultural influences such as these might operate in the current context? As one example, ecologists publishing in the field of invasion biology have been able to study invasive species largely because of its close association with biodiversity and environmental issues, which has provided extensive public funding for ecology and for related research on invasive species. At another level, Brown and Sax implicitly argue that we should be less concerned about invasive species because species have always moved around the planet, a point that resonates strongly with contemporary globalization and the concomitant devaluation of the local, whether biological or cultural. And this further reflects postmodern denial of any ultimate value system, a view that could serve to undermine contemporary conservation efforts (Soulé and Lease 1995).

Brown and Sax provide another example of the complex interaction between facts and values in their rhetorical appeal to the naturalistic fallacy. They accuse Cassey et al. of coming "dangerously close to committing the naturalist (sic) fallacy", which they claim is a "belief that what is 'natural' should be equated with what is positive, good, or acceptable. A corollary is that there exists a pure 'natural state' that can and should be preserved." Accordingly, those who commit this fallacy would consider exotic species "an unnatural, undesirable component of the biota and environment (Brown and Sax 2005, p. 482)". This characterization misconstrues the naturalistic fallacy, which has a complex history in philosophy. In short, "the so-called naturalistic fallacy is no fallacy at all" (Ridge 2003), but rather a heavily disputed and subtle series of philosophical claims. For example, Brown and Sax claim that arguments in evolutionary psychology are immoral because of the naturalistic fallacy, but this claim has been discounted elsewhere (Wilson et al. 2003). While Cassey et al. may have "committed" the fallacy,

one could argue that Brown and Sax have themselves committed it too—to the extent it can be committed at all—when they argue from a series of biogeographical observations showing that species have always moved around the globe to a plea "for more scientific objectivity and less emotional xenophobia." That is, they implicitly argue that processes as they are (and have been) are the way they ought to be (see also Lodge and Shrader-Frechette 2003, p. 33).

A recent 'neutral' language for invasion biology similarly presumes objectivity only by ignoring its implicit values. Colautti and MacIsaac (2004, p. 137) claim that "universal definitions are unlikely to succeed unless authors forego their individual preferences", and then propose a numerical, stage-based method to operationally define terms in invasion biology based on propagule pressure models. While their proposal helps to break down a simplistic duality between native and non-native species, their proposal has its costs. For example, their claim that "Science progresses best when hypotheses, theories, and concepts are concisely stated and universally understood" (p. 139) ignores the capacities provided by 'ambiguous' terminology (see Adams and Adams 1987), particularly in a young field such as invasion biology that deals with a complex area of study. More importantly, their claim that the use of "subjective criteria" reveals how some terms "may have more to do with human perception than with any inherent ecological characteristics (p. 136)" neglects cognitive scientific insight into the extent to which human perception always helps to constitute "facts" (Maturana and Varela 1998; Lakoff and Johnson 1999). For instance, they note that descriptive adjectives about the model "are intended only to aid in conceptualizing each stage, but should not be used to refer to the stage of interest" (p. 137). To interpret their numbers, however, one *must* refer back to necessarily human descriptions (something they themselves do repeatedly) (see Lakoff and Núñez 2000). No matter what symbols one chooses, the field is influenced by its origin in the concept of invasion from political geography (Moore 2005) and by our conceptualization of the process (Larson 2007a). The science is inseparable from these narrative elements (see Allen et al.

2001). Even in their “recommended protocol”, Colautti and MacIsaac (2004, p. 135) continue to refer to invasive versus non-invasive species.

Why have these recent papers highlighted neutrality and objectivity? Scientists rightly value the attempt to be objective, and consequently, it has tremendous rhetorical value. It especially appeals to other scientists, since few of them would openly admit to being ‘non-objective’ (or, especially, emotional and xenophobic). Stated another way, this language reinforces shared values by differentiating science from ‘non-science’—in this case scientific ecology from activist environmentalism or even fervent invasion biology (Killingsworth and Palmer 1992). While constitutive scientific values may lessen the tendency for bias, however, so that one can carry out one’s research practices more-or-less objectively, they are nonetheless framed by overarching contextual values that influence why one does the research in the first place. If just having these values biased one’s results, then it would be too late for most ecologists and invasion biologists. Thankfully, it is the social character of science that primarily contributes to its value as a way of knowing (Franz 2001; Wallington and Moore 2005). Consequently, while objectivity is important, claims to objectivity may also obscure the values that one actually holds, which can become problematic in a social context.

Invasion biology and society

The dichotomy between facts and values may appear insignificant, but it leads to a restrictive model of science and society. It implies that we can somehow separate these realms, and by association ‘professional’ from ‘private’ domains, and that their separation is desirable (see Brown and Sax 2005, p. 483). This intention follows from the belief that values inhere only when scientists address the public, rather than when they do their research. While there is precedent for this view, it leads to diverse problems because the idea that science stands apart from society, an assumed derivative of its objectivity, actually gives it moral and political authority (see Shapin 1996, p. 164). Scientists effectively exclude themselves from

moral culpability when they demote the role of values in science. This belief becomes risky to the extent that scientists forget that they never speak without values, and can only do their best to lessen them within a particular micro-scale empirical context. Even objectivity and “a non-judgemental, dispassionate tone” (Brown and Sax 2004, p. 535) convey a particular value system; recommendations flowing from them need to be scrutinized like any other.

Invasion biologists need to balance claims to value-freedom and utility since social values heavily influence the availability of research funding (Kinchy and Kleinman 2003). In this context, Brown and Sax’s claims about the need for objectivity in invasion biology may be understood as ‘boundary-work’ intended to influence both how biologists relate to invasive species and how biologists function in society (Gieryn 1999). Colautti and MacIsaac (2004) begin their abstract with a nod towards the broader “management” implications of the language of invasion biology, for example, yet focus on issues that impede the “progress of objective scientific theory”. In both cases, the authors give less weight to the social side of their proposals. This is curious given that their research on invasive species relies at least in part on public funding. An artificial distinction between science and society effectively operates as a form of political action, or more specifically in this case, non-action towards invasive species.

Brown and Sax’s private/professional split reflects a fairly common ‘separatist’ model of the role of science in decision-making: scientists provide information, others make decisions based on this information (Lach et al. 2003). To maintain their credibility, scientists should provide information rather than advocate for particular outcomes. To the extent possible, they should also distinguish their beliefs about reality from their personal values (Rykiel 2001). This popular ‘two-hat’ model is useful in principle, but Kinchy and Kleinman (2003, p. 891) found that it reflects “deeply taken-for-granted attitudes” rather than conscious reflection. The two-hat model may not apply in all cases, and it is crucial to recognize where it breaks down.

Social research has found that people actually prefer an emerging, more integrated role for

scientists in society. Lach et al. (2003), for example, surveyed scientists, managers, interests groups, and members of the “attentive public” in the Pacific Northwest, particularly people associated with the H. J. Andrews Experimental Forest LTER. Their research evaluated respondents’ preferences for five potential roles of research scientists in natural resource decision-making: (1) *reporting*; (2) reporting and *interpreting*; (3) working with managers and *integrating* research results into decisions; (4) actively *advocating* for preferred decisions; and (5) *making decisions* themselves. While the scientists slightly preferred the interpretive role, the other groups tended to prefer an integrative role for scientists (with the other three options generally much less popular). In short, all groups would “like to see the research scientists involved in interpreting and helping to integrate the results of their science into policy decisions” (Lach et al. 2003, p. 174), but not to advocate for specific options. While these results could be case-specific, they nonetheless reiterate that there is a continuum between idealized objectivity and blatant advocacy.

The separatist model also makes assumptions about what people value about science. Brown and Sax (2005, p. 483) claim that “the principles of unbiased, objective inquiry that are the essence of the scientific method ... [are] the primary reason why society should support and pay attention to scientists”. However, Lach et al. (2003) demonstrate that non-scientists do not evaluate credibility in the same way that scientists do (e.g., in terms of quality of methods and data generated, quality and quantity of publications, and their reputation). In fact, non-scientists were more likely to evaluate credibility in terms of the “ability to deliver research results that managers and others can use” and the “ability to communicate with other groups” (see also Bocking 2004, pp. 172–173). To the extent that research is conducted for the public, scientists need to attend to what people actually want rather than their ideal of how science should be.

As an example, consider Colautti and MacIsaac’s (2004) proposal to lessen the conceptual baggage of invasion biology to promote

research. While they acknowledge that the use of “ordinary words” and “simple terms” in ecology has “allowed rapid dissemination of novel ideas” (p. 135), they diminish the significance of this public aspect relative to its consequences for scientific progress. They specifically seek a “neutral terminology” to replace the “problematic” terminology currently in use. In contrast, a key paper by Norton (1998) reasons that the desire to jettison values from communication will make ecological knowledge ineffective in the policy process, “virtually ensur[ing] that long-term ecologically-based values will not be protected” (p. 351). In sharp contradistinction to Colautti and MacIsaac, he argues that for ecological discourse to be applied to policy it must be “frankly value-laden” (p. 353). Similarly, Hull et al. (2003, p. 1) recommend that environmental scientists “embrace and make explicit [the] ambiguous and evaluative qualities [of terms for environmental quality] rather than ignore and disguise them”. Colautti and MacIsaac (2004, p. 351) also oppose the “subconscious associations with preconceived terms, particularly emotive ones”, but again these may be unavoidable elements in the broader public understanding of ecology (Trudgill 2001; Weber and Word 2001).

The universal knowledge promoted by Brown and Sax (2004, 2005) and Colautti and MacIsaac (2004) may also be at odds with the local knowledge that most people value. It is often this knowledge that we most need for policy discussions in specific places. Furthermore, presumed objectivity may be misinterpreted by non-scientists, who perhaps more clearly understand that one cannot escape one’s values (Rykiel 2001; Weber and Word 2001). Claims to objectivity and universality imply a hierarchy where scientists have a more central role in environmental decision-making than other stakeholders. However, it is not necessarily true that “knowledge that can be ‘generalized’ and applied to any situation is always of higher value than the specific, local knowledge of citizens” (Bocking 2004, p. 173). This attitude creates fundamental barriers to engagement with non-scientists. As Norton (1998, p. 358) explains in the context of wetlands policy:

Simply studying what they find ‘ecologically interesting,’ without engaging in dialogue regarding what is important in a larger management and public context, has left academic ecologists on the sidelines, providing almost no guidance as to what information and what studies are essential ...

If scientists want to contribute to social policy about invasive species, they cannot simply present the facts, but need to interact with non-scientists both in the design of their research as well as in its application to particular problems.

In short, these papers rehearse a fairly standard, conservative model of science and society, one that is markedly different from more democratic models that have recently been proposed and explored in diverse contexts (Lee 1993; Fischer 2000; Robertson and Hull 2003; Bocking 2004). Instead of a hierarchy where scientists are distinct from society providing facts from their research (or the reverse, where society decrees what scientists do), this new vision conceptualizes scientists as part of society, working with others—though using special tools to do so, to help solve problems. These ideas have been developed in numerous ways, but a common theme is that scientists need to interact with non-scientists to conduct research that is of value to society. Though these proposals do not exclude the possibility of ‘basic’ research, they unanimously acclaim that to the extent that scientists want to contribute to solving social problems they need to better engage with society rather than artificially separate themselves from it. For example, deliberative methods for environmental decision-making have been developed to more explicitly involve numerous stakeholders—including scientists. Decision-making requires explicit discussion of facts and values, as well as the trade-offs among them, and consequently, scientists can only contribute to policy to the extent they participate in these deliberations (Dietz and Stern 1998).

These alternatives help to dissolve some issues raised by Brown and Sax. For example, they state that “it is up to humankind as a whole to decide whether [manipulations of biodiversity are] good or bad, and hence what actions should be taken”

(Brown and Sax 2004, p. 535). They elsewhere raise a concern that “When scientists go further and try to impose *their own* ethical and moral imperatives on society *as a whole*, they embark on a slippery slope (Brown and Sax 2005, p. 483, italics added).” In both cases, these issues of representativity arise squarely from the implied conception of science and society. On the one hand, aren’t scientists part of this “whole?” Shouldn’t their voices be included? Don’t their values matter? On the other hand, is it even reasonable to think that scientists have a univocal “ethical and moral imperative?” How could they possibly impose it on society in any case? Does relegation to an undefined “whole” of humankind equate to nobody? While an alternative to imposition is to be disinterested and objective, scientists could also seek to better understand which “objective” information they need to provide for society.

Conclusion

Invasive species provide biologists with an opportunity to critically examine the adequacy of their working assumptions about science, society and values. Several conservation biologists, for example, have recently encouraged their colleagues to explicitly acknowledge their “biodiversity values” since they may understand the global changes caused by humans as well as anyone (Bazzaz et al. 1998; Lubchenco 1998). Concerns about invasive species reflect such values, and it follows that many biologists recommend direct engagement with invasive species (Mack et al. 2000; Lodge and Shrader-Frechette 2003). The opening editorial in *Biological Invasions*, for example, states that “it is imperative that vigorous action be taken (Carlton 1999)”. This may be the appropriate course, even if there are valid doubts about whether invasive species are really so bad (Gurevitch and Padilla 2004; Didham et al. 2005). In this context, is it wise to simply view invasions as “unintentional experiments”, when they are experiments that might have very dire effects for our species (and for other species as well)? We can be concerned about invasive

species without having to adamantly believe they are “bad”. There may be excessive emotion about invasive species in some cases, but that in itself does not justify recourse to excessive objectivity.

The recent papers discussed herein curiously ignore the value of the emotions, which is particularly misleading given that feeling and rationality are inextricable (Damasio 1999). As one biologist remarked, “That creatures with an innate sense of passion for life should attempt to suppress this passion in an attempt to be completely objective is the real lurking inconsistency [in conservation biology]” (Trombulak 2000, p. 1203). What is the evidence that passion always impedes conservation science? The desire to be dispassionate could simply be a way to avoid the pain and the losses of our contemporary world or even our doubts about how to act with regard to a complex issue such as invasive species.

With their emphasis on objectivity, Brown and Sax undervalue another striking point in their papers: Invasive species have tremendous effects on the daily lives of many people. Their experience is discounted by an objective invasion biology that ignores the need for science that addresses human needs. We most require ecological knowledge in cases where invasive species are actually causing a problem, and solving these problems will require engagement with people in particular places.

In order to be socially engaged, yet careful researchers, biologists with an interest in invasive species may benefit from reconsidering their role in society (see Bradshaw and Bekoff 2001). Ecology, for example, might be viewed as a “bridge between science and society” (Odum 1997) rather than simply a natural science. De Laplante (2004) contends that the orthodox conception of ecology as a unified natural science, distinct from the social sciences, needs to be expanded. This proposal acknowledges that humans are natural organisms, which necessitates that ecological economics, ecological psychology and related fields be considered legitimate sub-disciplines of ecology as a more general science. One consequence is that ecology would be more directly involved in environmental problem solving since it bears “directly on fundamental questions of human-environment relations” (De Laplante 2004, p. 268).

If invasion biologists want to address these fundamental questions they will need to engage their highest moral faculties. When we decide whether or not to cull an invasive herbivore population, for example, “there is a real choice of evils” (Midgley 2003, p. 158). With a cull, we are taking lives; without a cull, we may contribute to the demise of a population or species, and different values are implied in each case. Hence, we cannot fall back on absolutist positions, but instead must operate within a larger democratic process of decision making about invasive species (Woods and Moriarty 2001). While we might resort to either vigorous activism or dispassionate objectivity to solve the problem, it may be that we need to remain with the complexities, moral dilemmas, and paradoxes of invasive species a little longer, rather than swinging to extreme viewpoints (see Proctor 2001). Environmental economist Schumacher (1973) describes problems of this sort as ‘divergent’ ones, which can only be dealt with by living them in their particularity, rather than ‘convergent’ ones for which science can provide definitive or universal answers. As a species, we still seek ways of relating to the problem of invasive species (Larson 2007b), something we have brought upon ourselves.

An alien scientist visiting our planet would likely notice how we relate to the world around us long before it would assess the effects of exotic species. It would likely strike this alien that our attitude towards our home planet may have created the problems we face, with ‘objectivity’ itself being a significant causal factor. If the alien is instead truly alien, and cannot take this empathic view towards the human condition, then its perspective is largely irrelevant to perceiving invasive species. We are embodied, place-based creatures who conduct science that is imbued with particular cultural and human values. Our place is the earth, and as biologists we have a responsibility to share our care for the earth and its organisms, despite our doubts and the very real burden of this responsibility.

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