

THESIS

INVASIVE SPECIES MANAGEMENT: AN ANIMAL ETHICS PERSPECTIVE

Submitted by

Joseph A. Tuminello, III

Department of Philosophy

In partial fulfillment of the requirements

For the Degree of Master of Arts

Colorado State University

Fort Collins, Colorado

Spring 2012

Master's Committee:

Advisor: Bernard Rollin

Katie McShane

Shawn Archibeque

ABSTRACT

INVASIVE SPECIES MANAGEMENT: AN ANIMAL ETHICS PERSPECTIVE

In the scholarly literature on invasive species management, there exists a tendency to neglect the moral relevance of sentience when determining best possible management strategies regarding sentient members of invasive species. In addition, there is also a negative bias against invasive species, where such species are viewed as inherently “bad.” Because of this negative bias, many wildlife managers, conservation biologists, and ecologists share the default view that invasive species are nuisances and must be gotten rid of, using the most cost-effective and efficient means possible. The neglect or omission of sentience within the literature often carries over into the implementation of invasive species management techniques, where sentient members of invasive species are often not treated as humanely as possible.

In this thesis, I defend Bernard Rollin’s animal ethic, where sentient beings are those capable of having *interests*, and which are also capable of self-valuation, which is necessary for possessing intrinsic value (on Rollin’s view). Because such beings are capable of having interests which can be fulfilled or thwarted, they are objects of moral concern on this view. While I defend Rollin’s view, any moral theory which considers sentience morally relevant at all will be compatible with the majority of my arguments regarding our treatment of sentient members of invasive species. If sentience is a morally relevant criterion, I argue that it continues to be so even when sentient beings are members of species which are considered to be “invasive.” This claim is strongly supported by the large-scale vagueness and disagreement over terms such as “invasive,” “native,” and “exotic” within the literature.

Because sentience is a morally relevant criterion when determining best possible management practices regarding invasive species, members of such species should be treated as humanely and in accordance with their respective *telos* as much as possible. Typically, this will entail prioritizing nonlethal and preventive methods of control over lethal methods. However, even when lethal control is deemed to be the best possible type of management strategy in a given situation, it should be implemented as humanely as possible.

In addition to arguing for sentience as a morally relevant criterion when determining best possible management strategies regarding invasive species, I also argue that the negative bias against invasive species as inherently “bad” is ultimately unfounded. I support this claim by providing evidence of a variety of potential negative, positive, and neutral aspects of invasive species. Because invasive species are not inherently “bad” or “good,” I argue that our attitudes toward and management of members of such species should be developed on a case-by-case basis.

It is also important that the assessment of invasive species on a case-by-case basis be combined with the moral relevance of sentience. The bias against invasive species may serve to perpetuate the omission of sentience as a morally relevant criterion of invasive species management. The omission of sentience may also perpetuate the negative bias against invasive species. Understanding the moral relevance of sentience may help to diminish the negative bias against invasive species, and vice versa.

After considering and responding to several objections to my arguments, I provide an overview of different sorts of lethal, nonlethal, and preventive methods of invasive species management, and discuss how each of these can be implemented in a more humane fashion, in

order to present ways in which my arguments and view can be successfully applied in a variety of real-world scenarios.

TABLE OF CONTENTS

ABSTRACT	ii
INTRODUCTION	1
CHAPTER 1: DISTINGUISHING SENTIENT FROM NON-SENTIENT MEMBERS OF INVASIVE SPECIES	3
What is an Invasive Species? The Vagueness of Key Terms in the Literature	4
Contextualizing Invasive Species Ethics	12
Animals as Objects of Moral Concern	17
Environmental Ethics and Rollin’s Animal Ethic	23
For a Morally Relevant Distinction between Sentient and Non-Sentient Members of Invasive Species	26
CHAPTER 2: AGAINST THE INHERENT “BADNESS” OR “GOODNESS” OF INVASIVE SPECIES.....	32
Potential Negative Aspects of Invasive Species	33
Some Remarks on Negative Aspects of Invasive Species	39
Potential Positive/Neutral Aspects of Invasive Species	42
Conclusion	53
CHAPTER 3: COUNTER-ARGUMENTS, CONTROL METHODS, AND CONCLUSIONS ..	56
Provision of Original Arguments	56
Counter-arguments and Objections	63

Methods of Control and Prevention	74
Lethal Control Methods	74
Nonlethal Control Methods.....	77
Preventive Methods	79
CONCLUSION.....	82

INTRODUCTION

Sentience is largely neglected as a morally relevant criterion by wildlife managers, conservation biologists, and ecologists when determining best possible management strategies. Further, there is also a negative bias against invasive species, where members of such species are viewed as inherently “bad,” which encourages the view that they need to be gotten rid of in as efficient and cost-effective a manner as possible.

In this thesis, I argue in opposition to this view. In chapter 1, I first present evidence that many of the key terms regarding invasive species management suffer from a high degree of vagueness and disagreement within the literature. While the scientific community fails to agree on what exactly makes a species “invasive,” this term continues to be employed, and carries a negative connotation with it, where many members of a species which carries the label are destroyed as a result. I also defend Rollin’s animal ethic, which argues that sentience is a morally relevant criterion. I apply this to issues within the ethics of invasive species management, where sentience continues to be morally relevant regarding sentient members of invasive species. Taking this into consideration, sentient members of invasive species should be treated as humanely as possible, and in accordance with their respective *telos*. Often, this appears to entail reserving lethal methods of control as a last resort, while employing nonlethal and preventive methods as much as possible. However, even when lethal control is deemed to be the best possible type of management strategy, it should still be carried out as humanely as possible.

In chapter 2, I argue that the negative bias against invasive species, where invasive species are viewed as inherently “bad,” is unfounded. I first discuss the potential negative

effects of invasive species, which are heavily documented and cited throughout the literature, such as the propensity of invasive species for decreasing biodiversity and causing large amounts of economic and ecological damage on a global scale. I then present evidence of the potential positive and neutral effects of invasive species. For example, invasive species can often increase species richness in a given area, and can also have no discernible impact in native populations. Further, it has even been argued that biological invasions are necessary for life to persist on earth, at least in some cases. After presenting a sufficient amount of evidence, I argue that this undermines the foundation for the bias against invasive species as inherently “bad” (or “good,” for that matter). Consequently, our attitudes toward and management of invasive species should be developed on a case-by-case basis, while also taking into account the relevance of sentience.

In chapter 3, I stress the importance of combining the assessment of invasive species on a case-by-case basis with the moral relevance of sentience. The bias against invasive species may serve to perpetuate the omission of sentience as a morally relevant criterion of invasive species management. The omission of sentience may also perpetuate the negative bias against invasive species. Understanding the moral relevance of sentience may help to diminish the negative bias against invasive species, and vice versa. I also address a number of objections to my arguments, dealing in particular with the cost-effectiveness of alternative management strategies and the importance of public awareness and support regarding the humane treatment of sentient members of invasive species. I close this thesis by discussing some lethal and nonlethal control methods, and how these can be implemented more humanely. I also present some preventive methods, and look at this as an area where animal ethics advocates and wildlife managers can work together, as it will be beneficial for all parties involved if we can prevent invasive species from becoming an issue in the first place.

CHAPTER 1: DISTINGUISHING SENTIENT FROM NON-SENTIENT MEMBERS OF INVASIVE SPECIES

In the scholarly literature on invasive species, there is a tendency to lump both sentient and non-sentient members of invasive species together under the general category of “invasive species.” The failure to make this distinction carries over into discussions of potential management techniques regarding invasive species, where sentience is typically not taken into account as a relevant factor when deciding on the best possible method of management for a given situation.

In this chapter, I argue that a distinction must be made between sentient and non-sentient members of invasive species, particularly when possible management methods are being considered. “Sentient” is used here to refer to beings which have some sort of conscious awareness, which gives rise to their having *interests* (e.g. avoidance of suffering). Interests here are a kind of need, the fulfillment of which matters to those beings who possess them (where “mattering” is dependent upon conscious awareness). These interests are in accord with a being’s *telos*, or nature. Because sentient beings have interests which can be fulfilled or thwarted by moral agents, they are objects of moral concern. This distinguishes sentient from non-sentient entities, such as plants, species, and ecosystems, which, to the best of our knowledge, do not possess such conscious awareness. Hence, while non-sentient living beings have needs, lack of conscious awareness precludes them from having interests. These differences continue to be relevant and applicable regarding invasive species, and should be taken into account when discussing potential management strategies. Because “sentience” applies to individual members of a species, I argue for the accommodation of the interests of

individual members of sentient invasive species, as opposed to arguing for the rights of species as species. Subsequently, management decisions regarding sentient invasive species should take into account the relevance of interests of the individual animals in question; hence, lethal control of invasive species should only be implemented as a last resort, in particularly dire situations, though preferably not at all. Nonlethal control methods, as well as preventive measures, should be opted for when possible, and any sort of lethal control should be carried out in the most humane way possible.

What is an Invasive Species? The Vagueness of Key Terms in the Literature

It is important to be aware of the vagueness of some key terms employed throughout invasion biology and environmental ethics (which subsequently will also be used within this thesis). This includes the concept of “nativity,” and how to differentiate native from non-native (or exotic) species, as well as how to determine whether or not a species is “invasive.” Despite these vagaries, these terms are still used and will undoubtedly continue to be used, and I must recognize this in order to employ the above terminology in any meaningful sense throughout the rest of this thesis. With this in mind, I discuss a variety of different ways in which these terms have been cashed out, and I attempt to provide a synthesis of these views in order to approximate as closely as possible what is being conveyed in their usage. However, it is still essential to be aware that issues regarding the ascription of terms like “nativity” and “invasiveness” are far from being black and white.

In a leaflet on invasive species from the Wildlife Habitat Council (WHC), a distinction is made between native species, exotic species, and invasive species. A native species is defined as one that “...historically occurred or currently occurs in a particular ecosystem (other than as a result of an introduction). Native species have adapted over thousands of years to their

surrounding plant and animal communities and local climate and soil conditions.”¹ It is mentioned here that a species cannot be native if it has been “introduced” into its current environment. In *The Great Reshuffling: Human Dimensions of Invasive Alien Species*, edited by Jeffrey McNeely, “introduction” is defined as “the movement, by human agency, of a species, subspecies, or lower taxon (including any part, gametes, seeds, eggs or propagule that might survive and subsequently reproduce) outside its natural range (past or present). This movement can be either within a country or between countries.”² So, according to McNeely, the concept of introduction includes a necessary anthropogenic element; humans must be involved with the transportation of an invasive species in order for the act of transportation to be properly understood as an introduction.

“Exotic species,” which is synonymous with “alien” and “nonnative” species, is defined by the WHC as “a species, including its seeds, eggs, spores, or other biological material capable of propagating it, that is not native to a particular ecosystem.”³ This is essentially saying, in a somewhat circular fashion, that a nonnative species is one that is not native to its current habitat. An “invasive species” is defined as one which is dominating and causing harm to a particular economy or environment.⁴ The difficulty in determining what constitutes “harm” or “harm to an environment” will be mentioned shortly in this chapter. According to the WHC leaflet, an invasive species does not have to be exotic, but can also be native. It is, however, necessary for a species to cause harm to an economy or environment for the term “invasive” to be appropriately applied to it. It is generally agreed upon in the literature that invasive species are

¹ Wildlife Habitat Council, “Invasive Species,” in *Fish and Wildlife Habitat Management Leaflet*, No. 39 (2006), 1.

² Jeffrey A. McNeely, ed. *The Great Reshuffling: Human Dimensions of Alien Invasive Species* (Cambridge: IUCN – The World Conservation Union, 2001), 3.

³ Wildlife Habitat Council, “Invasive Species,” in *Fish and Wildlife Habitat Management Leaflet*, No. 39 (2006), 1.

⁴ Ibid.

almost always nonnative. This makes the task of effectively distinguishing between native and exotic species especially important, as being considered “exotic” usually plays a role in a species’ being considered “invasive.”

These definitions begin to shed light on the vagueness and circularity of what it means for an organism to be “native” to a particular environment. On this definition of “native,” a species may have adapted to a particular ecological niche over thousands of years, but if it was introduced into that environment via human agency, then it technically should be considered non-native. If these definitions are to be taken literally (and there is no indication that they should be taken in any other way), this matter is further complicated when considering the possibility of a species that is considered invasive, but was not introduced into its current habitat by humans.

Peretti raises the issue that scientists often determine the nativity of a species by referring to natural history records which are incomplete.⁵ In South Africa, the origin of 10% of the alleged “alien” species is in doubt: “If the natural history record is incomplete, there is no reliable ecological or biological method that can distinguish between aliens and natives.”⁶

Another illustration of the vagueness of the concept of nativity is the lack of clarity regarding how long a species must live in a particular area before it can be considered native: “Is a species ‘naturalised’ in 100 years, 1,000 years, or 10,000 years? The distinctions are arbitrary and unscientific.”⁷ Different criteria are used by different people in determining the nativity of species, because people disagree about what the term “native” means. Regarding animal species

⁵ Peretti, Jonah, “Nativism and Nature: Rethinking Biological Invasion” in *Environmental Values*, Vol. 7, No. 2 (1998), 185.

⁶ Ibid.

⁷ Ibid.

in Britain, Yalden argues that a species is native "...if it was present before Britain was cut off by rising sea levels about nine thousand years ago."⁸ Others are more concerned with the recent history of a species in order to determine whether it is native or exotic.⁹

In their paper "Strangers in a Strange Land: The Problem of Exotic Species," Woods and Moriarty list 5 main criteria for determining whether a species is native or exotic.¹⁰ This is simply a collection of different criteria which have been posited by various people doing work on the subject. According to the first criterion, the "Human Introduction Criterion," a species is native if humans were not involved in the introduction of that species to the area in which it has become invasive. One problem with this view is that, due to the far-reaching effects of humans on the environment, species which are native may only be those which lived in a particular area before the existence of human beings.¹¹

Woods' and Moriarty's second criterion is "The Evolutionary Criterion," where a species must have "originally evolved" in a certain area to be considered native.¹² One problem with this view is that species themselves are also ill-defined, with boundaries between species often being quite blurry. Also, this criterion can also lead the concept of nativity into absurdity, as demonstrated by Stephen Spurr. Spurr argues that "all plants and animals are exotic...except at the very point in space where the particular gene combination was constructed."¹³ This seems to

⁸ Quoted in Aitken, Gill, *A New Approach to Conservation: The Importance of the Individual Through Wildlife Rehabilitation* (Vermont: Ashgate, 2004), 35.

⁹ Woods, Mark and Paul Moriarty. "Strangers in a Strange Land: The Problem of Exotic Species," in *Environmental Values*, Vol. 10, No. 2 (2001), 168.

¹⁰ Ibid.

¹¹ Ibid., 165.

¹² Ibid., 167.

¹³ Spurr, Stephen, "Wilderness Concepts", in *Ohio Law Review*, Vol. 16 (1980), 441.

be an extreme view of the native/exotic distinction, at least somewhat removed from how nativity is typically understood.

The “Historical Range” criterion states that a species is exotic if it lives outside of its native range, where “native range” generally means the area where a species has existed in the past. Here, human agency does not necessarily play a part in determining whether a species is native or exotic.¹⁴ A problem with this view is the difficulty in determining a species’ native range in space and time. In fact, the way in which native ranges are demarcated is often somewhat vague. For example, in field guides, native ranges are often shaded areas of a map, which are not exact by any means, and could potentially include locations where that species has never existed.¹⁵

According to the “Degradation Criterion,” the essential foundation for considering a species to be exotic is whether it has a detrimental impact on the ecosystem in which it exists.¹⁶ This view has been advanced by Robert Devine, who argues that invasive species are a subcategory of exotic species.¹⁷ This is argued on the grounds that nearly all invasive species are nonnative. At the same time, Devine still allows for the possibility that an exotic species may not be invasive. While this criterion seems to capture an essential intuition regarding invasive species (i.e. that they are detrimental to the ecosystem), it leaves open the question of defining harm or degradation to an ecosystem. This is further complicated by the observation that a

¹⁴ Woods, Mark and Paul Moriarty. “Strangers in a Strange Land: The Problem of Exotic Species,” in *Environmental Values*, Vol. 10, No. 2 (2001), 168.

¹⁵ *Ibid.*, 169

¹⁶ *Ibid.*, 170

¹⁷ Devine, Robert, *Alien Invasion: America’s Battle with Non-native Animals and Plants* (Washington, DC: National Geographic Society, 1998).

number of exotic species can have both positive and negative effects on their habitats.¹⁸ The second chapter of this thesis focuses on demonstrating that exotic or invasive species are not inherently bad or good, so decisions regarding them should be taken on a case-by-case basis.

As mentioned in the above criterion, there is difficulty and disagreement regarding how to determine the point at which a species should be considered to be harmful. According to the WHC leaflet (as well as the Degradation Criterion), “harm” is the most relevant criterion used to designate the invasiveness of a species. If a species is harming the environment or economy, according to the WHC, it is to be considered invasive (whether native or non-native). However, how does one determine when harm to the environment has occurred, and what caused it? There is an ongoing debate on this issue within the literature. For instance, Mark Sagoff argues that “harm to the environment” is both “nebulous and undefined” within the literature.¹⁹ Sagoff has serious doubts as to whether an adequate, non-tautologous definition of “harm” can be given where non-native species are more likely to be harmful than native species.²⁰

Opposing this view, Daniel Simberloff first grants that talk of non-native species harming or potentially harming the environment is “vague and imprecise,” especially in publications written for lay audiences as opposed to professional journals.²¹ However, Simberloff then argues that this does not detract from the many clear-cut cases of environmental harm caused by non-native species. He also makes it clear that there is an overwhelming consensus among ecologists

¹⁸ Woods, Mark and Paul Moriarty. “Strangers in a Strange Land: The Problem of Exotic Species,” in *Environmental Values*, Vol. 10, No. 2 (2001), 171.

¹⁹ Sagoff, Mark, “Do Non-Native Species Threaten the Natural Environment?” in *Journal of Agricultural and Environmental Ethics*, Vol. 18, No. 3 (2005), 215.

²⁰ *Ibid.*, 218-219

²¹ Simberloff, Daniel, “Non-Native Species *Do* Threaten the Natural Environment!” in *Journal of Agricultural and Environmental Ethics*, Vol. 18, No. 6 (2005), 596.

and other experts that non-native species are one of the most significant factors (second only to habitat destruction) in relation to endangerment and extinction of other species.²²

Woods and Moriarty's final criterion for determining nativity is the "Community Membership Criterion," where a species is native if it is "integrated" in an ecological community. According to this criterion, a species which is not detrimental to an ecological community could still be exotic if it is not integrated.²³ A problem with this criterion, as pointed out by Jared Diamond, lies in determining which species are to be considered integrated natives.²⁴

By applying case studies to these criteria, Woods and Moriarty demonstrate that species are sometimes considered exotic according to some criteria, and native according to others. They further assert that "...there is no 'bright line' which separates native species from exotic species" and that none of these criteria are necessary or sufficient conditions for classifying a species as native or exotic.²⁵

There is at least as much debate over how to properly characterize a species as "invasive." In addition to the WHC's definition quoted above, Colautti and MacIsaac list several different definitions which have been supplied by various ecologists:

- (1) a synonym for 'nonindigenous'...
- (2) an adjective for native or nonindigenous species (NIS) that have colonized natural areas...
- (3) discrimination of NIS established in cultivated habitats... from those established in natural habitats...
- (4)

²² Ibid., 596-597.

²³ Woods, Mark and Paul Moriarty. "Strangers in a Strange Land: The Problem of Exotic Species," in *Environmental Values*, Vol. 10, No. 2 (2001), 171-172.

²⁴ Diamond, Jared, "Reflections on goals and the relationship between theory and practice", in *Restoration ecology: A synthetic approach to ecological research*, eds. William Jordan, Michael Gilpin, and John Aber (Cambridge: Cambridge University Press, 1987), 331.

²⁵ Woods, Mark and Paul Moriarty. "Strangers in a Strange Land: The Problem of Exotic Species," in *Environmental Values*, Vol. 10, No. 2 (2001), 174

NIS that are widespread... or (5) widespread NIS that have adverse effects on the invaded habitat.²⁶

Colautti and MacIsaac explain further that “[p]roblems with invasion terminology reflect a more general dilemma in ecology: the ‘non-operational’ or casual use of important terms and concepts.”²⁷ In other words, this terminology is being used too loosely. This can lead to people talking past one another, due to their conflicting understandings of the terminology. In accord with this sentiment, Carlton has mentioned the restricted usefulness of the concept of ecological invasion outside of the scientific sphere, writing that “[i]t has utilitarian value for...the public, the press, the politicians, the government world, and in that context, operates I think in a very powerful way. It’s not a scientific concept at the moment and that’s a caution for everyone.”²⁸

The relevance of discussing the vagueness of and disagreements over this terminology lies in the fact that literal life and death decisions are made and/or recommended by wildlife managers, ecologists, and environmental ethicists based on these problematic criteria and unclear concepts. There is no clear line of demarcation between “native” and “exotic” species, and no obvious way of determining whether or not a species is “invasive.” Yet, these terms come to bear on living beings (and on sentient beings in particular, for the purpose of this thesis). As I will argue later in this chapter, great care should be taken when utilizing this terminology to make real-world decisions.

While the above information should serve as sufficient evidence of the vagueness and lack of agreement in the scholarly community about terms such as “native”, “exotic”, and

²⁶ Colautti, Robert and Hugh MacIsaac, “A neutral terminology to define ‘invasive’ species,” in *Diversity and Distributions*, Vol. 10, No. 2 (2004), 136.

²⁷ Ibid.

²⁸ Carlton, J, “Invasions in the World's Oceans: How much do we know, and what does the future hold?” Lecture delivered at the March 2004 meeting of the American Institute of Biological Sciences.

“invasive”, as well as the difficulty with defining such words in the first place, these terms are nevertheless still employed throughout the literature. Hence, I must continue to employ them within this thesis. With this in mind, I will attempt to provide a basic idea of what is meant when these terms are used, particularly the term “invasive.”

From what I have gathered from research on this subject, a species that is invasive is often considered exotic to the area which it currently inhabits, although this is not necessarily the case. It is also considered to be a “detriment” in some form or fashion, whether this is cashed out in terms of its harm to an ecosystem, to other individual species, to the economy, or to humans and human interests.²⁹ It was difficult to find an agreed-upon distinction between “exotic” and “native” species, as is evidenced by the above discussion of Woods and Moriarty’s criteria. Quite generally, a species is considered native if it has existed in a given area for an extended period of time, and/or if it has undergone significant evolutionary changes in this given area, over a given period of time. “Exotic” and “non-native” are simply antonyms for “native,” so the negation of the criteria for nativity would apply to exotic species.

Next, it is essential to place issues of invasive species and animal ethics within the greater context of debates within environmental ethics.

Contextualizing Invasive Species Ethics

Ethics is the branch of philosophy which addresses questions regarding how we should live our lives. Are some actions right and others wrong? If so, how do we determine whether a particular action is right or wrong? What guiding principle should be employed when determining the rightness or wrongness of actions? *Is there a single guiding principle for determining moral truths, or is there an irreducible plurality of principles? What is goodness, and*

²⁹ This criterion of invasive species as “detrimental” should also be taken with a grain of salt; I present evidence later in this thesis that species which are considered “invasive” can have positive impacts as well.

what does it mean for something to be “good”? All of these issues fall under the general purview of ethics.³⁰

Environmental ethics is a subfield of ethics which deals particularly with humanity’s moral relationship with non-human nature (including sentient and non-sentient entities). In the early 1970s, a number of philosophers articulated an inadequacy in previous ethical theories regarding this relationship, and so aimed to correct this oversight within their own ethical theories.³¹ It was argued that this bias stems from an anthropocentric conception of morality, where “...human beings and/or their interests matter morally in their own right while everything else matters morally only insofar as it affects human beings and/or their interests.”³² Early theorists, such as Richard Routley, argued that this sort of view precludes humans from having moral obligations to non-human nature which are not tied to humans and their interests.³³ Routley, as well as other early proponents of the environmental ethics movement, expressed that a system of ethics was needed which recognizes that “...the natural world has value that is independent of humans and/or their interests and that our moral obligations regarding the natural world aren’t just a matter of what we owe to our fellow humans.”³⁴

This new system of ethics took as necessary the need to ascribe “intrinsic value” to at least part of the natural world, independent from humans. Intrinsic value, in one sense, is taken

³⁰ Audi, Robert, ed. *The Cambridge Dictionary of Philosophy* (Cambridge: Cambridge University Press, 1995), 244.

³¹ See Routley, Richard, “Is there a need for a new, an environmental ethic?” in *Proceedings of the XV World Conference of Philosophy* (1973), 205-10. See also Rolston, Holmes, III, “Is there an Ecological Ethic?” in *Ethics*, Vol. 85 (1975), 93-109.

³² McShane, Katie, “Environmental Ethics: An Overview” in *Philosophy Compass*, Vol. 4, No. 3 (2009), 407.

³³ *Ibid.*

³⁴ *Ibid.*, 408

to mean that X has intrinsic value if X is valuable “in and for itself” or “for its own sake.”³⁵ According to environmental ethicists, at least some part of non-human nature has value for its own sake, not merely because it is instrumentally valuable to humans. Instrumental value is another kind of value, where “...we may say that X has instrumental value if and only if it is a means to, or causally contributes to, something that is intrinsically valuable.”³⁶ So, according to early environmental ethicists, the anthropocentric moral theories which acted as the impetus for environmental ethics generally held that non-human nature, including both sentient and non-sentient beings, has instrumental value insofar as it pertains to humanity or the fulfilling of human interests. Intrinsic value was strictly tied to humans and their interests. Environmental ethics originally sought to extend intrinsic value to encompass at least some members of nonhuman nature. Different ways of cashing out intrinsic and instrumental value have been proposed within the literature. There are ongoing debates regarding whether the existence of something that is intrinsically valuable is necessary for there to be instrumental value, whether value requires a *valuer*, and what sorts of things should be counted as “valuers.”³⁷ For instance, Holmes Rolston, III argues that value does require a valuer, but further argues to broaden the meaning of “valuing” to include all behavior directed towards a goal. Therefore, all living things are valuers, and have intrinsic value, on Rolston’s view.³⁸

Most relevant for the purpose of this thesis is the debate between individualism and holism. Proponents of holism argue that “wholes”, as opposed to individuals, are primarily morally significant. Different flavors of holism ascribe moral significance to wholes such as

³⁵ Audi, Robert, ed. *The Cambridge Dictionary of Philosophy* (Cambridge: Cambridge University Press, 1995), 829.

³⁶ *Ibid.*

³⁷ McShane, Katie, “Environmental Ethics: An Overview” in *Philosophy Compass*, Vol. 4, No. 3 (2009), 409-10.

³⁸ Rolston, Holmes, III, “The Value of Nature and the Nature of Value,” in *Philosophy and the Natural Environment*, eds. Robin Attfield and Andrew Belsey (Cambridge: Cambridge University Press, 1994), 13-30.

species or ecosystems. Ecocentrism is a type of holism where "...ecosystems matter in their own right, and individuals have value in virtue of the contribution they make to ecosystemic functioning."³⁹

Proponents of individualism argue that moral significance is primarily ascribed to individuals (e.g. persons, animals, plants). There are different kinds of individualism, based on different notions regarding which sorts of individuals are taken to be morally significant. One individualist view is biocentrism, which is "...the view that each living thing matters morally in its own right."⁴⁰ On this view, regardless of sentience, each individual living organism has intrinsic value. Another sort of individualist view, which the position that I defend in this thesis broadly falls under, is known as "animal ethics." On animal ethics views, moral significance is ascribed primarily to some or all animals.

One relevant critique that defenders of holism have leveled against defenders of individualism is that, on a general individualist view, "...members of destructive invasive species have as much value as the members of the native species that they threaten."⁴¹ Holists generally find this to be problematic, because invasive species are typically taken to be detrimental to other species and to the greater ecosystem which they occupy. Because these are the entities which are primarily morally significant on holist views, there is in some sense a moral obligation to employ some sort of management strategy in regards to members of invasive species. Because sentience is not a relevant criterion for moral significance on this view (or at least not prioritized above the moral significance of "wholes"), generic holism involves little or no qualms about taking action against individuals which pose a threat to another species or

³⁹ McShane, Katie, "Environmental Ethics: An Overview" in *Philosophy Compass*, Vol. 4, No. 3 (2009), 411.

⁴⁰ Ibid.

⁴¹ Ibid.

ecosystem (which returns to the problem of the vagueness of defining “harm” to an ecosystem or species). In fact, it could even be argued that there is value in eliminating such individuals, because their removal would contribute to greater ecosystemic functioning.

It is important to note here that general conceptions of both biocentrism and ecocentrism do not count sentience as a factor for determining moral significance, or at least rank sentience far below criteria which are met by all living beings, sentient and non-sentient. In this way, sentient and non-sentient beings (or the species or ecosystems of which they are members) are considered equal candidates for moral concern.

In my view, which I will describe and defend below, this is quite unfortunate, because it allows for (and even advocates) situations where the interests of sentient beings are ignored or neglected due to the purported moral status of plants, species (of which the ontological status is highly contestable), or other non-sentient entities. I argue that this neglect of the interests of sentient beings has at least some bearing on the lack of distinction made between sentient and non-sentient invasive species. This, in turn, bears on the lack of concern with management strategies for invasive species which take into consideration the sentience of the members of the invasive species (when they are in fact sentient).

My view consists of a defense of Bernard Rollin’s animal ethics, as well as an extension of his view which brings it to bear on problems regarding the ethics of invasive species and invasive species management. I begin this section by describing his view, as articulated in the book *Animal Rights & Human Morality*. I then present an application of this view which critiques environmental ethics (where it does not ascribe moral significance based on sentience). One such criticism consists in a re-examination of intrinsic value. I defend Rollin’s view that a proper understanding of intrinsic value necessitates that it can only be ascribed to sentient

beings, beings that have interests. This is not an anthropocentric view, though it is centered on sentience as being in some way necessary for value.

Animals as Objects of Moral Concern

Rollin provides a discussion of both Kantian ethics and utilitarianism, highlighting the useful and relevant features of each view, as well as those features which are considered to be problematic, before describing how these favorable elements work in accordance with his own ethical view.

Briefly put, Kant argues that moral laws are principles which we have in virtue of rationality that "...we, as rational beings, give to ourselves and that regulate our conduct insofar as we engage each other's rational nature."⁴² These laws are applicable to, and should be followed by, all rational beings. Hence, according to Kantian ethics, a moral agent must be a rational being. Rollin describes the essence of rationality as "...the ability to universalize and transcend particulars."⁴³ This is basically the ability to grasp and wield concepts. On this view, moral agency requires rationality, rationality requires the use of concepts, and the use of concepts requires language. Animals lack language, therefore they cannot be moral agents.

This view of moral agency is more or less agreeable. There are some issues regarding parts of this argument, such as anecdotal evidence of non-human animals (simply "animals" for the remainder of this thesis) acting as moral agents. Also, there is great difficulty in defining precisely what should be counted as a language, not to mention the evidence of some non-human primates which are able to learn and employ basic sign language. Animals may also be able to employ basic concepts which are non-linguistic. For the most part, however, this is an

⁴² Audi, Robert, ed. *The Cambridge Dictionary of Philosophy* (Cambridge: Cambridge University Press, 1995), 246.

⁴³ Rollin, Bernard, *Animal Rights & Human Morality* (New York: Prometheus Books, 2006), 65.

acceptable view of what constitutes a moral agent. We know, at least, that normally functioning humans have the capacity for moral agency.

What is more problematic, and not acceptable, about Kant's view is his way of delineating objects of moral concern. The exact criterion (i.e. rationality) which is necessary and sufficient for moral agency is also necessary and sufficient for a being to be considered an object of moral concern. Essentially, what seems problematic about the Kantian notion of an object of moral concern is that it runs counter to the intuitions that people generally have about what sorts of things should be objects of moral concern. Rollin puts this point thus: If we accept Kant's account of the criteria for something to be an object of moral concern, "...why do we extend our moral concern, attention, deliberation, and consideration beyond the strictly rational aspects of human life and activity? Why do we concern ourselves morally with human activities that have nothing to do with our rational side?"⁴⁴ None of these interests would be morally relevant on Kant's view.

Also, while Kant's view may see those who are potentially rational agents as objects of moral concern (e.g. infants), Kantian ethics certainly precludes people who are irreversibly and severely mental ill and/or mentally handicapped (to the point where they would not be considered moral agents) from being objects of moral concern. So, not only animals, but also "marginal humans" are outside of the scope of moral concern on this view. This is counter-intuitive, even on anthropocentric assumptions about morality, because we, as rational moral agents, typically care and are concerned with such people and their interests. Summarily, Kant's view of moral agency as pertaining to rational beings is acceptable, but his view of objects of moral concern is lacking, so we must look for a more satisfying set of criteria for something to be counted as an object of moral concern. While moral theories can sometimes change our

⁴⁴ Rollin, Bernard, *Animal Rights & Human Morality* (New York: Prometheus Books, 2006), 73.

intuitions, "...the Kantian theory flies in the face of far too many intuitions and excludes far too much of what we take to be central to morality."⁴⁵ For instance, we often consider the capacity for pleasure and pain to trump rationality in terms of moral concern.

With this in mind, Rollin examines the moral theory of utilitarianism. As articulated by Jeremy Bentham in *Principles of Morals and Legislation*, Bentham argues that the rightness of an action depends on whether it maximizes pleasure (and/or minimizes pain) for the greatest number. This refers to the greatest number of all beings who are capable of feeling pleasure and pain, so this theory takes animals into account, as well as people, in determining what sorts of beings are objects of moral concern. This seems to capture more of our intuitions about objects of moral concern.⁴⁶ Such a view will at least include the "higher" animals (i.e. animals more closely related to humans), who are more obviously capable of feeling pain and pleasure, within its scope of moral concern.⁴⁷

However, there still seems to be something missing, even when utilitarianism is broadened to encompass suffering and happiness more generally, instead of simply pleasure and pain. Basically, there are actions which do not involve utilitarian criteria which nonetheless seem to be within the scope of moral concern. For instance, we generally take actions which impede self-fulfillment to be wrong actions, even if the being in question is not suffering as a result. Rollin uses an example from Aldous Huxley's *Brave New World*, "...where people are kept in a state of happy idiocy by the use of drugs. Even if they are not suffering and are indeed feeling considerable pleasure, we still find such a society to be immoral and monstrous."⁴⁸ Other

⁴⁵ Ibid., 74.

⁴⁶ For a more recent argument for taking animals to be objects of moral concern based on their capacity to feel pleasure and pain, see Peter Singer's *Animal Liberation* (New York: Avon Books, 1975).

⁴⁷ Rollin, Bernard, *Animal Rights & Human Morality* (New York: Prometheus Books, 2006), 76.

examples of these kinds of actions also include lying to and manipulating others without their being aware of these occurrences. There are also examples of this sort which are applicable to animals. For instance, it appears wrong to take an animal which, by its very nature, lives and roams within vast open spaces, and to put this animal in a very small cage for the rest of its life. Even if there was something in place which led to the animal feeling a great amount of pleasure in the cage, this does not seem to be morally acceptable.⁴⁹ This is because such an action is in violation of the animal's nature.

So far, an adequate moral theory seems to consist partially of rational capacity for beings to be moral agents and capacity for pleasure and pain/suffering for beings to be objects of moral concern. To determine what is missing from this picture of morality, Rollin suggests a thought experiment. In a situation where a group of people have a genetic mutation which renders them incapable of feeling pain, pleasure and suffering, it still does not seem right to do whatever we wish with them, for example, starving them to death.⁵⁰ Rollin proposes another thought experiment, where there is an omnipotent being, completely independent from others and unable to be affected by them, and who lacks any sort of desires, needs, interests, or goals. Rollin argues that such a being would not enter the scope of moral concern, because anything that we did to it would not, and *could* not, matter to it.⁵¹ Rollin uses these thought experiments to suggest that, instead of rationality or merely the ability to feel pain or pleasure (which is one among many interests that sentient beings can have), "...what makes something fall within the scope of moral concern of a [moral agent] is the presence of needs, desires, goals, aims, wants,

⁴⁸ Ibid., 75.

⁴⁹ Rollin, Bernard. *Animal Rights & Human Morality* (New York: Prometheus Books, 2006), 94.

⁵⁰ Ibid, 95.

⁵¹ Ibid., 94.

or, more generally, *interests*, which that being has and which the being capable of moral action can help, ignore, or hinder.”⁵² So, for something to be an object of moral concern, it must have interests, which moral agents can attempt to fulfill or thwart.

This naturally leads to the issue of how to adequately define an interest. Rollin makes an important distinction between “needs” and “interests.” To aid in clarifying this distinction, I will introduce Rollin’s concept of *telos*. The *telos* of something – which is a term borrowed from Aristotle – is its nature or function. For example, the *telos* of a spider is, non-specifically, its “living spiderness.”⁵³ *Telos* is the source of a being’s activities and of the needs that it strives to fulfill. This brings the discussion back to Rollin’s distinction between needs and desires. Needs, as stated above, stem from the nature of the being in question, and consist of activities which that being is genetically and evolutionarily programmed⁵⁴ to partake in, to fulfill its needs. Interests, in turn, are kinds of needs, where interests are needs that matter to the being which possesses said interests: “In some sense, the animal must be capable of being aware that the thwarting of the need is a state to be avoided, something undesirable.”⁵⁵

So, in order for something to be an object of moral concern, it must not only have needs, but these needs must be interests (i.e. they must “matter” to the possessor of the needs). Further, in order for something to have interests, that thing must have some sort of conscious awareness, or sentience, which gives rise to the capacity for things to “matter” to that being. So, for something to be an object of moral concern, on Rollin’s view, the being in question must have

⁵² Ibid., 95.

⁵³ Ibid., 100.

⁵⁴ This is, of course, in the case of living organisms. It may be argued that inanimate objects can have a *telos* and needs, e.g. “a car needs gasoline to run.” See Bernard Rollin, *Animal Rights & Human Morality* (New York: Prometheus Books, 2006), 100-101.

⁵⁵ Rollin, Bernard, *Animal Rights & Human Morality* (New York: Prometheus Books, 2006), 101-102.

conscious awareness. This does not mean that the being in question must be able to express its interests linguistically, or even to verbalize them. Rollin details a number of ways to observe evidence of interests (i.e. neurophysiological evidence, biochemical evidence, behavioral evidence, the presence of sense organs, and all of these cited within the context of evolutionary theory).⁵⁶

It is also important to make note here of Rollin's view of intrinsic value. Something has intrinsic value, on this view, if what happens to it matters to it. Hence, intrinsic value can only be possessed by beings with conscious awareness, beings that have the capacity for self-valuation. I will begin to show how Rollin's view conflicts with traditional views in environmental ethics by expounding upon his idea of intrinsic value.

In his book *The Frankenstein Syndrome: Ethical and Social Issues in the Genetic Engineering of Animals*, Rollin argues that there are two separate senses in which the phrase "intrinsic value" is used in ordinary and philosophical language:

- a. To apply to that which is worth doing or having by an agent for its own sake, rather than for some other result (i.e., noninstrumental).
- b. To apply to that which is not dependent on a relationship with anyone else to create value. (Only conscious beings can have value *intrinsic* to them in this sense, since only conscious beings are self-valuing).⁵⁷

Rollin argues that sense (a) of intrinsic value lacks the moral dimension of sense (b), and sense (b) can only apply to beings that have conscious awareness. Only sentient beings possess the capacity for things to matter to them, the capacity to *care* about things, hence the capacity to have interests. This capacity for having interests gives rise to the capacity to have interests in regard to oneself, or the capacity for self-valuation. In Rollin's view, this is what it is for

⁵⁶ Ibid., 102.

⁵⁷ Rollin, Bernard, *The Frankenstein Syndrome: Ethical and Social Issues in the Genetic Engineering of Animals* (Cambridge: Cambridge University Press, 1995), 53-54.

something to have intrinsic value. As stated above, something has instrumental value (for Rollin as well as traditionally) if and only if "...it is a means to, or causally contributes to, something that is intrinsically valuable."⁵⁸ So, coupled with Rollin's view of intrinsic value, something is instrumentally valuable if it has value for intrinsically valuable beings. On this view, intrinsic value is self-directed instrumental value. Things which are capable of possessing only instrumental value are those things which are not capable of self-valuation. Hence, things which can only be instrumentally valuable are those things which do not have conscious awareness. These things can have needs, but not interests.

Environmental Ethics and Rollin's Animal Ethic

What should be made of environmental ethics in relation to Rollin's view? First of all, there is an important similarity regarding environmental ethics and Rollin's animal ethics. These moral theories share a common goal of extending the notions of intrinsic value and moral consideration to cover entities besides humans. The major difference is that this view of animal ethics extends intrinsic value and moral consideration beyond humanity, but still restricts these notions to sentient beings. Environmental ethics, on the other hand, is generally concerned with ascribing intrinsic value and moral consideration to non-human beings more broadly construed, such as plants, and often to entities which are collections of beings, such as species and ecosystems.

If Rollin's view is correct, then many attempts by environmental ethicists (and anyone else) to ascribe intrinsic value to non-sentient nature are essentially mis-ascriptions of instrumental value. For instance, if it is argued that nature has intrinsic value "[b]ecause we apprehend beauty or other aesthetic experiences when we interact with nature," as Rolston

⁵⁸ Audi, Robert, ed. *The Cambridge Dictionary of Philosophy* (Cambridge: Cambridge University Press, 1995), 829.

argues throughout his work⁵⁹ (though this is by no means his only method of arguing for the intrinsic value of non-sentient nature), this is really an attribution of aesthetic instrumental value to nature, rather than intrinsic value.⁶⁰

In fact, Rollin's view allows for the possibility of a well-founded environmental ethic, based on the importance, hence the instrumental value, of non-sentient nature for sentient beings: "Concern for wilderness areas, mountains, deserts, and so on would arise from their survival value for sentient animals as well as from their aesthetic value for humans."⁶¹ It is vital to emphasize here that instrumental value is in no sense *worse* than intrinsic value. It is simply the sort of value which it may make the most sense to ascribe to non-sentient beings. On Rollin's view, there certainly should be concern for the environment, because it has a direct impact on the interests of sentient beings (not just humans), to whom things matter.

A concern that I have regarding environmental ethical theories which ascribe intrinsic value to non-sentient entities (e.g. plant life, species, ecosystems, etc.) is that such views can influence people to neglect the interests of sentient beings, particularly when there may not be sufficient reason to do so. I find this to be the case regarding the management of sentient invasive species.

Because of the emphasis on biodiversity, protection of native species, and ecosystem health, a bias has emerged against exotic and invasive species within invasion biology and environmental ethics (in the second chapter of this thesis, I argue explicitly that this inherent bias

⁵⁹ Rolston, Holmes, III, "Are Values in Nature Subjective or Objective," in *Philosophy Gone Wild* (Buffalo: Prometheus Books, 1989), 44.

⁶⁰ Rollin, Bernard, *The Frankenstein Syndrome: Ethical and Social Issues in the Genetic Engineering of Animals* (Cambridge University Press: Cambridge, 1995), 52.

⁶¹ *Ibid.*, 60.

is ultimately unfounded).⁶² This negative bias carries over into discussions of potential management techniques. Also, there is virtually no distinction made between sentient and non-sentient invasive species when discussing best possible management strategies. I take this to be, at least in part, due to this distinction not being made when ascribing intrinsic value. This can cause environmental ethicists and invasion biologists alike to commit themselves to counterintuitive views regarding value and life. This is, for instance, the case with Rolston's view of environmental ethics.

In Rolston's view, a species is a type of organism. That is, a species is a "superorganism," composed of other organisms. It follows, then, that destroying a species is an act of "superkilling," and this should not be done without some sort of "superjustification."⁶³ On this view, preservation of the species, regardless of whether the species is composed of sentient or non-sentient beings, trumps the preservation of individual members of a species, even if these members are sentient beings. While Rolston's concern seems to be with according legal rights to species, and especially to endangered species, this view commits him to advocating a rather counterintuitive position. An example of this is recounted by Rollin, where Rolston expresses this position in a debate between the two:

I asked [Rolston] to consider an imaginary case, one in which the endangered plant was threatened...by teenage trail bikers who persisted in driving over it. "Shoot them as well," he replied instantly. "There are plenty of them." This, of course, reveals quite clearly how far removed the intrinsic value position, at least in Rolston's version, is from common consensus morality, a point I consider devastating to the theory but that does not disturb Rolston.⁶⁴

⁶² See Jason Evans, Ann Wilkie, and Jeffrey Burkhardt, "Adaptive Management of Nonnative Species: Moving Beyond the 'Either-Or' Through Experimental Pluralism" in *Journal of Agricultural and Environmental Ethics*, Vol. 21, No. 6 (2008), 521-539, and James Brown and Dov Sax, "An Essay on Some Topics Concerning Invasive Species" in *Austral Ecology*, Vol. 29, No. 5 (2004), 530-536.

⁶³ Rolston, Holmes, III, "Duties to Endangered Species," in *Philosophy Gone Wild* (Buffalo: Prometheus Books, 1989), 213.

As stated above, moral theories can change our moral intuitions. However, theories which take the defense of non-sentient life over sentient life to such an extreme seem to be so far removed from our moral intuitions that they are difficult to accept. Note, in contrast, that Rolston is perfectly willing to bite the bullet regarding the destruction of sentient life in favor of non-sentient life. In fact, he doesn't seem to think that there is much of a bullet to bite in the first place, because of the priority that Rolston's ethical theory places on the amount of existing members of a given species.

For a Morally Relevant Distinction between Sentient and Non-Sentient Members of Invasive Species

To give an example concerning a real-life scenario where Rolston is committed to the above position, in his book *Philosophy Gone Wild*, Rolston discusses the shooting of feral goats and rabbits in order to save endangered plants.⁶⁵ According to Rolston's view, as explained above, there is a moral obligation to do whatever is necessary to preserve a species, whether it consists of sentient or non-sentient members. It also should not matter whether or not the individuals threatening the species are sentient or non-sentient. If they pose a risk of destroying a species, some action must be taken against them.

Such a view lends itself to the position which I am arguing against here; namely, the failure to make a morally relevant distinction between sentient and non-sentient members of invasive species, particularly in terms of determining management strategies. In my view, Rollin's animal ethics position is easily applicable to the ethics of invasive species. Sentient

⁶⁴ Rollin, Bernard, *The Frankenstein Syndrome: Ethical and Social Issues in the Genetic Engineering of Animals* (Cambridge: Cambridge University Press, 1995), 60-61.

⁶⁵ Rolston, Holmes, III, "Duties to Endangered Species," in *Philosophy Gone Wild* (Buffalo: Prometheus Books, 1989), 211.

members of invasive species, by the very nature of the term “sentient,” have some sort of conscious awareness. This awareness allows for these beings to be concerned with the fulfillment of their needs, hence it allows for members of sentient invasive species to have interests. The source of these interests is the *telos*, or nature, of the sentient beings. So, respecting the interests of sentient beings consists in treating them in accordance with their *telos* as much as possible. Because sentient members of invasive species are capable of self-valuation, they can be said to have intrinsic value (on Rollin’s view of intrinsic value).

It is important to note here that I am not arguing that no action should ever be taken regarding damage caused by species which are considered to be “invasive.” A thorough examination of different methods for weighing out competing interests is beyond the scope of this thesis. However, it is completely plausible for there to be a scenario where members of a sentient invasive species are having a large negative impact (or posing the potential to have such an impact) on other sentient beings, or on aspects of the environment which are instrumentally valuable to sentient beings, to such an extent that it is determined that some action must be taken to stop or diminish this negative impact.

The focus of my argument here is in regards to the question, “If it is determined that some sort of action must be taken against sentient invasive species, what sort of action should be taken?” I take the stance that if sentience is a relevant criterion (perhaps *the* relevant criterion) for something to be an object of moral concern regarding sentient members of species which are not considered to be invasive, then it remains a relevant criterion regarding sentient members of species which *are* considered to be invasive. To put this point another way, “invasiveness” does not automatically compromise the moral relevance of a being’s sentience. There could be particular scenarios where a being’s interests are judged to be outweighed by other interests (e.g.

the survival of many more sentient beings). But even in such scenarios, the sentience of the members of the invasive species in question is still a morally relevant factor in determining the best possible action to take.

In order to accommodate the *telos* of sentient members of invasive species as much as possible, lethal forms of control of such beings should only be employed as a last resort, if at all. Instead, there are forms of non-lethal control which can be both feasible and effective. There also exists the potential for development of more control methods along these lines. So, non-lethal control should be opted for instead of lethal control, barring particularly dire circumstances. There are also various preventive methods which should be employed, and which have the potential to make both lethal and non-lethal control methods unnecessary in particular situations. This is also an area where both ecologists and advocates for the humane treatment of animals can agree. If a preventive method is successful, it prevents the issue of how to deal with a particular invasive species from arising in the first place.

Later in this thesis, I explore various specific forms of non-lethal and preventive methods of dealing with invasive species. Granting that there will undoubtedly be situations where some form of lethal control is deemed to be the best management strategy, I also explore more and less humane forms of lethal control. In my view, even if lethal control is determined to be the best possible management strategy in a given situation, it should be conducted in the most humane manner possible. In encouraging this view, I will present a case of what can go wrong (based on what *has* gone wrong) when lethal control is conducted irresponsibly, resulting in unnecessary suffering for the members of a given invasive species.

It should be noted that the arguments which I make and support here are not applicable to non-sentient members of invasive species, or to invasive species *as* species (or to non-invasive

species as species, for that matter). In my view, which is an extension of Rollin's animal ethic, while plants, for example, have needs, the fulfillment of which is in accord with their *telos*, plants do not seem capable of having interests. This is because plants do not, as far as can be observed and studied, have conscious awareness, which is necessary for things to matter to them, hence they cannot be said to have interests. Because things cannot matter to plants, Rollin's view precludes them from having intrinsic value. This remains to be the case when members of a plant species are considered to be invasive. Therefore, there is no *a priori* reason to argue against lethal control of non-sentient members of invasive species. There could be a situation, for instance, where non-lethal control of non-sentient members of invasive species is preferable over lethal control for other reasons (e.g. the reliance of sentient beings on non-sentient beings), but not because these individuals are objects of moral concern with intrinsic value.

Thus, my argument calls for a distinction to be made between management strategies regarding sentient members of invasive species and management strategies regarding non-sentient members of invasive species, where, because sentient members of invasive species are objects of moral concern with conscious awareness and interests, their *telos* should be accommodated as much as possible, even in cases where lethal control is deemed the best possible type of management strategy.

In arguing for the employment of the most humane possible form of lethal control, as well as opting for non-lethal and preventive measures over lethal control, I am seeking a middle ground between environmental ethics, which generally prioritizes species and ecosystems over individuals in terms of moral concern (or takes a biocentric view of individualism, where all living things are objects of moral concern, regardless of sentience), and animal ethics, which generally prioritizes individual sentient beings over non-sentient beings and non-sentient holistic

entities. Even someone who disagrees with my views on morality, and prioritizes ecosystems, species, and/or being alive above sentience in terms of criteria that determine whether something is an object of moral concern, can agree that, if the unnecessary suffering of a sentient member of an invasive species can be avoided, especially through employing an efficient control method and at little extra cost, then it *should* be avoided. Whether or not someone holds sentience in high moral regard, she can still recognize when there is a distinct possibility that suffering, the compromising of the interest of a sentient being, will occur unless alternative action is taken. If this can be done in a realistic and sensible manner, then this is a good reason to undertake alternative management methods. This conclusion is at least a *prima facie* reason for undertaking preventive measures, non-lethal control, or perhaps a more humane form of lethal control, unless someone's moral theory has no room at all for sentience as a criterion for determining whether something is an object of moral concern.

In this chapter, I have demonstrated the vagueness and disagreement over the terms “native,” “exotic,” and “invasive,” while also providing as close an approximation as possible to what is typically conveyed by these terms. I have placed my argument for a morally relevant distinction between sentient and non-sentient members of invasive species within the greater context of debates within environmental ethics, particularly between holist and individualist ethical views. I have supported and defended Bernard Rollin's animal ethics view against general environmental ethical theory, and have extended Rollin's arguments to apply to issues in the ethics of invasive species management. Finally, I have proposed a middle ground between animal rights and environmental ethics, where some concern for sentient members of invasive species can still be had, even if someone does not completely agree with my moral theory, and

places other criteria above sentience in determining whether something is an object of moral concern.

CHAPTER 2: AGAINST THE INHERENT “BADNESS” OR “GOODNESS” OF INVASIVE SPECIES

In this chapter, I argue that the current bias against invasive or nonindigenous species (the terms are often used interchangeably, as previously mentioned) is largely unfounded, and that invasive species are not inherently bad or good.

In order to support this claim, I will provide an overview of potential negative *and* positive or neutral aspects of invasive species. Emphasis however, is placed on discussion of positive and neutral aspects, as these appear to be understated and underemphasized within the current scholarly literature on invasive species. While invasive species are generally considered responsible for widespread ecological and economic damage, I will provide evidence that invasive species are also capable of causing increases in biodiversity (and can also have virtually no effect on biodiversity), that invasive species are not always drivers of ecological change, and that biological invasions may even be essential for the persistence of life on Earth.

It is important to keep in mind here that, due to the vagueness and lack of agreement over terms such as “invasive”, “native”, and “non-native”, as shown in the previous chapter, I will sometimes (but not always) use the term “invasive” in place of terms such as “alien” and “nonindigenous”. This will be done largely to avoid confusion, and also because these terms are often used synonymously in the literature. It is, for instance, not clear where the point is (if there *is* such a point) when a species should no longer be considered merely “alien” or “introduced,” but “invasive.” In some cases, species are considered invasive by virtue of their being alien. On other views, native species can become invasive due to behavioral changes or ecological

disruption. Because the meanings of and distinctions between these terms are so muddled, I will employ the term “invasive” as much as possible in place of the other largely synonymous terms.

Because invasive species are not inherently bad or good, I argue that management of and attitudes regarding invasive species should be considered on a case-by-case basis, with individual attention being given to particular situations. The default scientific attitude towards invasive species is that they are “bad” and that they should be gotten rid of by whatever means necessary. Often, some form of lethal control is deemed the best possible option, and this may very well be the most cost-effective sort of control method in many scenarios. However, as discussed in the previous chapter, sentient invasive species are often evaluated in the same light as non-sentient invasive species: they are all perceived to be detrimental and hence unwanted, and sentience is not considered to be a relevant criterion when determining best possible methods of management and control. I argued in Chapter 1 that sentience is, in fact, a morally relevant criterion for determining our treatment of and attitudes towards invasive species.

In this chapter, I conclude that invasive species should be evaluated on an individual basis in order to determine whether they are “good” or “bad” (if such a clear-cut determination is even possible), and that sentience should be taken into account regardless of the conclusion reached regarding a particular species, even if this still leads to deciding on some form of lethal control as the best possible management strategy. In such cases, there are certainly more and less humane forms of lethal control, as will be discussed in Chapter 3 of this thesis.

Potential Negative Aspects of Invasive Species

In chapter 1, I argued that “invasiveness” is quite a vague concept at best. This makes the frequency with which it is employed to advocate the destruction of living things particularly problematic. However, in trying to tease some clarity out of the concept (in order to continue to

discuss it in a meaningful way), I argued that perhaps the most fundamental criterion for determining whether a species is invasive is based on whether or not it is taken to be “detrimental” in some respect. Here, I ask a further question: What qualities does a species exhibit by virtue of which it is perceived as being detrimental, or harmful? I furnish an answer by appealing to negative aspects of invasive species which are prevalent in the literature.

Virtually all major negative aspects of invasive species are capable of being classified under either “ecological/environmental” or “economic” damage. I will briefly discuss the most ubiquitous cases of these kind of damage, and will also provide some relevant examples involving particular species. In terms of environmental damage, invasive species are notoriously linked with “biodiversity loss.” In a 1997 paper, Walker and Steffen identify “invasion by alien species” as the second leading cause of biodiversity loss, behind change of land use.⁶⁶ Related to this, Simberloff also mentions that, according to “most tallies,” invasive species are the second most significant factor in endangerment and extinction, behind habitat destruction.⁶⁷ Simberloff illustrates the prevalence of invasive species by providing a number of examples, many from ornithology, where there is much available data. For instance, nearly half of all bird species which are threatened by imminent extinction are threatened “wholly or partly by introduced species.”⁶⁸

In their leaflet on invasive species, the Wildlife Habitat Council (WHC) subdivides the category of “ecological impacts” into impacts on terrestrial ecosystems, aquatic ecosystems,

⁶⁶ Walker, Brian and Will Steffen, “An Overview of the Implications of Global Change for Natural and Managed Terrestrial Ecosystems.” in *Conservation Ecology*, Vol. 1, No. 2 (1997), 15.

⁶⁷ Simberloff, Daniel, “Non-Native Species *Do* Threaten The Natural Environment,” in *Journal of Agricultural and Environmental Ethics*, Vol. 18, No. 6 (2005), 597.

⁶⁸ *Ibid.*

natural fire and water regimes, soil composition, and wildlife.⁶⁹ While invasive plants appear to be largely responsible for the first four types of impacts discussed by the WHC, invasive animal species are known for having direct negative impacts on wildlife. Specific ways in which animal invasives can adversely affect native populations include “predation, grazing, competition, and habitat alteration.”⁷⁰ An example used by the WHC, which is also cited in much of the literature, involves the effects of the brown tree snake (*Boiga irregularis*).⁷¹ The brown tree snake is native to Australia and the South Pacific. As a predator in Guam, it has effectively eliminated “...10 native bird species, 6 native lizard species, and 2 native bat species...”⁷² The European starling (*Sturnus vulgaris*) is also known to have contributed to the decline of native bird populations, largely through outcompeting other species for resources and claiming the nest spaces of native birds by contaminating their nests and competing with them physically.⁷³

In addition to the aforementioned ways in which invasive species can inhibit and negatively affect biodiversity, a factsheet from the United States Department of Agriculture (USDA) also includes “shifts in predator-prey dynamics”, “shifts in species niches”, and “reductions in ecosystem complexity.”⁷⁴ The factsheet goes on to argue that the very act of a species invading another region inherently diminishes biodiversity. According to the USDA, this is because the place that is being invaded inevitably becomes similar to the place from which the

⁶⁹ Wildlife Habitat Council, “Invasive Species,” in *Fish and Wildlife Habitat Management Leaflet*, No. 39 (2006), 2-3.

⁷⁰ *Ibid.*, 4.

⁷¹ *Ibid.*

⁷² *Ibid.*

⁷³ *Ibid.*, 7.

⁷⁴ United States Department of Agriculture, “Invasive Species Factsheet.” in *Animal and Plant Health Inspection Service* (1999), 1.

invasive species originally emigrated.⁷⁵ As I will show later in this chapter, this is by no means obviously the case. In fact, the truth of this claim is explicitly contested in the scholarly literature regarding invasive species, where there is evidence suggesting that invasions can increase species richness in certain situations.

Nutria are cited here, and are also discussed with some frequency throughout the literature, as a case study which illustrates the potential that some invasive species have to cause significant environmental damage. Nutria, or coypu (*Myocastor coypus*), is a species of large, semi-aquatic rodent that is indigenous to South America.⁷⁶ In the 1930's, nutria began to be imported into Louisiana in order to yield a profit for the fur farming industry. Soon after, they began to escape into Louisiana's coastal wetlands, and can also be found throughout the Gulf coast, from Texas to Florida. Here, they continue to do extensive damage by feeding on plants in the wetlands, and annually destroy up to 40 square miles of the coastal marshes of Louisiana.⁷⁷

As an aside, the case of the nutria also serves to illustrate the anthropogenic and anthropocentric nature of many issues within the ethics of invasive species. Just as the nutria were brought to the United States for commercial profit, many species "introductions" now occur for reasons which are in some way driven by human interests. It is also worth mentioning here that our determination of a species being "invasive" or "harmful" sometimes appears to depend on whether or not that species is serving the interests of humanity, besides the question of whether or not it is a detriment to a particular ecosystem or native species.

⁷⁵ Ibid.

⁷⁶ Louisiana Department of Wildlife and Fisheries, "Nutria Control Program," accessed 05 May 2011, <http://www.nutria.com>.

⁷⁷ Ibid.

Nutria were touted in the 1940's as a great natural means of getting rid of weeds in the coastal marsh. To promote this success, they were subsequently transported throughout southeast Louisiana, which further spurred a massive population growth for the species. By the mid-50's, there were reportedly 20 million nutria, causing significant damage to the marsh, rice and sugarcane fields, as well as levees.⁷⁸ In 1958, due to the extent of agricultural damage incurred, nutria were removed from the list of protected wildlife.

Until the mid-80's, there was a market for nutria fur in the international fur industry, and in 1965, nutria were briefly returned to the list of protected wildlife. However, once the market began to wane, fur "harvesting" began to decline in response, and so the nutria once again started to rapidly populate the wetlands, and again started to cause major damage, leading the Louisiana Department of Wildlife and Fisheries to advocate lethal control (essentially "bounty hunting," paying people by the amount of nutria that they successfully shot and killed) as the best possible management technique.⁷⁹

In addition to these specific examples of damage, there are also a number of large-scale estimations of damage. For example, the U.S. spends about \$137 billion in annual costs due to damages from and control of invasive species.⁸⁰ Because this thesis focuses on management and control of sentient invasive species, it will also be beneficial to mention the combined costs of just those types of species. The combined damage and control cost of invasive mammals, birds, reptiles, amphibians, and fish in the U.S. is over \$40 billion annually.^{81 82} Globally, damage caused by invasive species is estimated at \$800 billion annually.⁸³

⁷⁸ Ibid.

⁷⁹ Ibid.

⁸⁰ Pimentel, David, Lori Lach, Rodolfo Zuniga, Doug Morrison, "Environmental and Economic Costs of Nonindigenous Species in the United States," in *BioScience*, Vol. 50, No. 1 (2000), 54.

In terms of general economic impacts, the WHC leaflet on invasive species reports that “[i]nvasive species have caused major financial losses in agriculture, forestry, and other economic sectors around the world.”⁸⁴ These financial losses largely come in the way of damages to crops and also to the health of livestock which are raised for slaughter or for their produce. These types of losses occur in addition to the costs of quarantine, control, and eradication of invasive species, contributing to a much larger total economic cost.⁸⁵ There are a number of invasive insects, for instance, such as the glassy-winged sharpshooter (*Homalodisca vitripennis*) and red fire ants (genus *Solenopsis*), which have caused hundreds of millions of dollars in losses to sources of agricultural profit ranging from California grapes to poultry chickens.⁸⁶ The European starling, mentioned earlier in this chapter, is a bird species which is native to North Africa and Eurasia, and was introduced to the U.S. in the late 19th century. It has cost hundreds of millions of dollars in agricultural damage annually, damaging fruit crops as well as consuming and contaminating feed for livestock.⁸⁷ In fact, it has been estimated that farmers and ranchers lose \$13 billion annually because of invasive plant species alone.⁸⁸

⁸¹ Ibid.

⁸² This estimate excludes arthropods and mollusks. While there is growing concern over the potential sentience of insects, even this somewhat conservative estimate for damage caused by sentient invasive species is quite large.

⁸³ Kirby, Alex, “Alien species ‘cost Africa billions’,” in *BBC News World Edition* (5 February, 2003), accessed February 10, 2012, <http://news.bbc.co.uk/2/hi/science/nature/2730693.stm>.

⁸⁴ Wildlife Habitat Council, “Invasive Species,” in *Fish and Wildlife Habitat Management Leaflet*, No. 39 (2006), 4.

⁸⁵ Ibid.

⁸⁶ Ibid.

⁸⁷ Ibid., 7.

⁸⁸ Federal Interagency Committee for the Management of Noxious and Exotic Weeds and Randy Westbrooks, “Invasive Plants: Changing the Landscape of America (Paper 490),” in *Utah Regional Depository* (1998), accessed February 10, 2012, <http://digitalcommons.usu.edu/govdocs/490>.

The Formosan subterranean termite (*Coptotermes formosanus*), possibly originating in southern China, was transported throughout the world for hundreds of years, from the 17th-20th century. These termites are known for foraging up to 300 feet in soil. As a result, they carry the potential for causing large-scale structural damage. In the U.S., these termites are found throughout the south (particularly in the Gulf coast) as well as Hawaii and California.⁸⁹ According to the National Invasive Species Council (NISC), the Formosan termite has been estimated to cause \$300 million in annual damage. This estimate only takes into account damages in the city of New Orleans, and there is likely more damage occurring in the many other locations occupied by these termites.⁹⁰

Some Remarks on Negative Aspects of Invasive Species

Before discussing the potential positive aspects of invasive species, a few remarks should be made concerning the negative. The damage, both ecological and economic, which is caused by species which are considered to be “invasive” is well documented and widely reported. I have included some choice statistics and examples here, and I believe that these can be taken to make as strong a case as possible for those who have a negative bias against invasive species. While some of the above mentioned species may very well accurately fit the criteria that people take to be constitutive of an “invasive” species, it is important to keep in mind the overwhelming vagueness of the concept of “invasiveness,” as argued in detail in the first chapter of this thesis.

In accord with the general vagueness of the concept, there is widespread disagreement over what the necessary and sufficient conditions are for a species to accurately be characterized

⁸⁹ Su, Nan-Yao and Rudolf Scheffrahn, “Formosan Subterranean Termite” (2010), accessed February 10, 2012, http://entomology.ifas.ufl.edu/creatures/urban/termites/formosan_termite.htm

⁹⁰ National Invasive Species Council (NISC). “Meeting the invasive species challenge: national invasive species plan” (2001), accessed February 10, 2012, https://www.denix.osd.mil/denix/Public/News/OSD/NIWAW/Invasive_Species/cover.html#toc.

as “invasive.” If empirical and statistical data are to be collected regarding invasive species, then it appears inevitable that this disagreement will carry over into the data. Lacking a universally agreed upon system of classifying invasive species, different collectors of data may differ in their beliefs about how the concept of “invasiveness” should be cashed out. This could feasibly lead to two major kinds of results which would significantly impact the integrity of any data presented regarding the total (e.g. global or national) amount of damages and costs incurred due to invasive species. First, it is possible that some species may exhibit characteristics which some people would take to be indicative of their being invasive. Disagreeing over what characteristics properly constitute invasiveness, other people (perhaps the people collecting the scientific and statistical data) may not consider this same species to be invasive. For example, white-tailed deer (*Odocoileus virginianus*) are generally considered to be “native” (another overwhelmingly vague term) to the United States, while also possessing qualities that could merit their being considered “invasive” on some views. Large populations of deer can lead to forest degradation and increased rates of automobile collisions involving deer. However, even while many people may agree that deer populations need to be controlled in some way (often through the advocacy of hunting), they may not be generally considered invasive because of their nativity. Depending on one’s characterization of invasiveness (there are multiple), deer may or may not count as invasive species.

While it may seem agreeable that the concepts of “invasiveness” and “nativity” are mutually exclusive, it is important to keep in mind that this is just one way of cashing out these concepts, and it is not obviously the correct way of doing so. It will be helpful here to recall a quote from the WHC’s leaflet on invasive species: “Invasive species can be native or exotic. Native species can become invasive if environmental conditions change substantially and the

balance of the ecosystem is disrupted.”⁹¹ This is not obviously the correct way of cashing out the concepts either, but serves to illustrate that there is legitimate disagreement over this issue. This disagreement could lead to an underestimation of the total costs and damages incurred due to invasive species, as some particularly detrimental species may not be considered invasive by those who are collecting the data regarding this.

There is another potential result of the disagreement over the concept of invasiveness which could also lead to a lack of integrity regarding the data. It is possible that some species may be included and discussed as “invasive” when they should not be placed within this category. For example, a species may be considered to be invasive strictly because it is non-native. Further, such species may cause only minimal damage, but all damage would be considered to be caused by invasive species, due to the species’ foreignness. It is conceivable that this damage could add up, if enough species are mistakenly considered to be invasive. Then, if enough species are considered to be invasive when they are not very harmful, it could appear that invasive species as a whole are much more destructive than they actually are. It is also possible that a foreign species could be construed as causing damage to its current ecosystem *because* it is foreign. In my discussion of potential positive aspects of invasive species, I will mention the view that foreign species are not always the drivers of ecological change in a particular area, but are sometimes passengers “along for the ride.”

This discussion of the relationship between disagreements over “invasiveness” and the integrity of data collected and presented regarding invasive species brings us back to the point that it is nearly *impossible* to use this concept in a way which is genuinely meaningful. Surely, those who abuse the phrase “invasive species” through its casual employment are the farthest from making good sense of its use. Even here, holding this, as well as related terms under close

⁹¹ Wildlife Habitat Council, “Invasive Species,” in *Fish and Wildlife Habitat Management Leaflet*, No. 39 (2006), 1.

scrutiny, I am simply aiming for the best mischaracterization of the concepts involved, and this has proven to be quite difficult in itself.

Finally, granting that there is a meaningful way of classifying a species as “invasive,” humanity is still in error, at least from not taking its arguments against invasive species to their ultimate logical conclusions. For, if any species merit being described as “invasive,” *Homo sapiens sapiens* must fall among them. If being a “detriment” is the most acceptable criterion for whether or not a species should be considered “invasive” (and I have argued in Chapter 1 that this seems to be the case), we are perhaps the ultimate invasive species at this time on Earth. We are not just causing a detriment to other species, but to *ourselves* as well. If one of our utmost environmental concerns should be the management and control of invasive species throughout the world (as many invasion biologists argue), we should perhaps start with a focus on our own invasiveness. Certainly, many of the other invasive species with whom we are deeply concerned do not match the degree of damage caused by humans.

Potential Positive/Neutral Aspects of Invasive Species

While extensive damage is known to have been caused by a number of species who are considered “invasive,” there have also been a number of positive benefits which have been derived from invasive species. Some of these benefits are not only perceived as good for humanity, but also for the environment and ecology of the planet.

The first example is brief, and may also be obvious to some. A number of species which have been introduced to the United States have been so economically, as well as nutritionally, beneficial, that their presence is now ubiquitous in commerce. Because of this, these species do not carry the stigma that other invasive species have. According to Pimentel et al., many U.S. food crops and livestock, such as corn, wheat, rice, cattle, and poultry, which are

“nonindigenous” (the authors clearly avoid the use of the term “invasive” to describe any species which may be beneficial or may somehow serve human interests), now constitute 98% of the U.S. food system.⁹² In fact, according to the U.S. Bureau of the Census, the above mentioned crops and livestock are valued at \$800 billion annually.⁹³

It should be noted here that \$800 billion is the exact estimate which was used for the annual global damage which is incurred due to invasive species. If these estimates are at all accurate, then the global annual cost of all invasive species is approximately equal to the value of just a few different “nonindigenous” species in the U.S. It is also important to keep in mind that these estimates do not take into account the global value of these food crops and livestock species, which are likely non-native to a number of other countries in which they are valuable. It is quite possible, then, that the global value of just a few different invasive species offsets the global damages caused by a far greater number of other, less beneficial invasive species.

The next example presented here addresses the debate over whether or not invasive species are truly “good” or “bad.” In “The good, the bad and the reified,” L.B. Slobodkin argues that when a field operates using reifications, this compromises the scientific integrity of that field. Further, Slobodkin points to a number of instances within ecology where this has occurred, and urges members of the field to drive these reifications out of their research, and to stop generating such reifications as much as possible.⁹⁴

⁹² Pimentel, David, Lori Lach, Rodolfo Zuniga, Doug Morrison, “Environmental and Economic Costs of Nonindigenous Species in the United States,” in *BioScience*, Vol. 50, No. 1 (2000), 53.

⁹³ US Bureau of the Census, *Statistical Abstract of the United States 1996* (Washington, DC: US Government Printing Office, 1998).

⁹⁴ Slobodkin, L.B., “The good, the bad and the reified,” in *Evolutionary Ecology Research*, Vol. 3 (2001), 1.

A reification is an axiom which is taken to be untestable and is given empirical meaning when "...its existence has either never been tested or it has been found empty."⁹⁵ Concepts and processes can become reified when a field of research loses its dynamism.⁹⁶ "Dynamism" refers to the dynamic processes by which scientific fields are often characterized, where any and all claims are empirically tested, and confirmed or disconfirmed. These results are then tested by others, and the new results may or may not corroborate the original results. This way, science alleges to get closer and closer, in an asymptotic fashion, to accurately reporting some aspect of the way things are. This serves to legitimate scientific endeavors, allegedly setting scientific disciplines apart from other ways of seeking knowledge, such as astrology.

When a field of research loses its dynamism, it is possible that hypotheses could be prematurely accepted as valid, leading them to become reified. According to Slobodkin, "[t]o reify consists of assigning to a word, quantity or image an illegitimate ontological status."⁹⁷ On this view, non-native species being "bad" and native species being "good" are reifications generated within ecology. Ecology must purge itself of these and other reifications, as any discipline should do in order to continue meriting its status as "scientific."

For the purposes of this thesis, Slobodkin describes an especially relevant reification that has occurred within ecology: the designation of alien species as "bad" and native species as "good." In fact, Slobodkin argues that this reification is "empty and misleading."⁹⁸ Offering a direct challenge to the outcries in the literature that invasive species are some of the worst culprits in terms of reducing biodiversity, Slobodkin claims that "[w]hile invasive species, in

⁹⁵ Ibid.

⁹⁶ Ibid.

⁹⁷ Ibid., 3.

⁹⁸ Ibid.

some cases, actually do damage native species, the generalization that invaders will reduce species diversity is not well founded.”⁹⁹

Slobodkin makes an interesting observation while examining the rationale behind modern determinations of “good” and “bad” species. Good species are not only those which are native, but those which are less successful at surviving and proliferating their species. Bad species, on the other hand, are those which are more successful, in an evolutionary sense, in addition to being alien.¹⁰⁰

Slobodkin is quick to point out that the reification of invasive species as “bad” and native species as “good” does not imply that “all species are equally pleasant.”¹⁰¹ He does not deny that some species are seen as “bad,” but argues that this can often be chalked up to those species being seen as detrimental to the interests of humans.¹⁰² Slobodkin further argues that we should do something to control certain “bad” species, but adds that “...we must do so on the basis of factual information and with the understanding that the ethical problems are ours and not those of the organisms.”¹⁰³ In other words, while invasive species are sometimes detrimental, it is vital to recognize that members of these species are simply trying to survive, and are not acting as moral agents when causing damage.

As argued in chapter 1, it seems reasonable to conclude that non-human animals are typically not moral agents (obviously, invasive plant species would not be considered moral agents, either). They do not appear capable of being held morally responsible for their actions in

⁹⁹ Ibid.

¹⁰⁰ Ibid., 7.

¹⁰¹ Ibid., 8.

¹⁰² Ibid.

¹⁰³ Ibid.

the same way that humans are.¹⁰⁴ However, even from a “human standpoint,” it is unreasonable to automatically consider all invasive or non-native species to be “detrimental.”¹⁰⁵ In fact, Slobodkin cites some of the mounting evidence against the reification of invasive species as “bad.” For instance, Levine and D’Antonio present studies which indicate that there is a “...consistent positive relationship between exotic species abundance and resident species diversity... [which] suggests that invaders and resident species are more similar than often believed...”¹⁰⁶ Slobodkin adds the observation that such invasive species may fill niches in their new ecosystems which were empty beforehand.¹⁰⁷ Further, Ruiz et al. estimate that “...more than 90% of alien species in estuaries have made no discernible impact on the native species diversity or species abundance distribution.”¹⁰⁸

Discussing Slobodkin’s arguments and case studies is important here, because they do a great deal to support the claim that invasive species are not inherently good or bad. Invasive species can be largely neutral in terms of their effects on biodiversity, and in some cases can even improve species richness in particular areas.

Gido and Brown also present some compelling evidence for the potential for invasive species to increase species diversity in a given area. The authors analyzed data documenting the

¹⁰⁴ This is generally speaking, of course. There are certainly anecdotes of animals acting in ways which appear morally praiseworthy or blameworthy.

¹⁰⁵ Once again, invasive species are sometimes considered “invasive” in virtue of their being detrimental, but this is not always agreed upon.

¹⁰⁶ Levine, J.M. and C.M. D’Antonio, “Elton revisited: a review of evidence linking diversity and invisibility,” in *Oikos*, Vol. 87 (1999), 15.

¹⁰⁷ Slobodkin, L.B, “The good, the bad and the reified,” in *Evolutionary Ecology Research*, Vol. 3 (2001), 8.

¹⁰⁸ Ruiz, Gregory, Paul Fofonoff, Anson Hines, Edwin Grosholz, “Non-Indigenous Species as Stressors in Estuarine and Marine Communities: Assessing Invasion Impacts and Interactions,” in *Limnology and Oceanography*, Vol. 44, No. 3 (1999). Quoted in Slobodkin, L.B, “The good, the bad and the reified,” in *Evolutionary Ecology Research*, Vol. 3 (2001), 8.

colonization patterns of introduced freshwater fishes in 125 North American drainages.¹⁰⁹ They conclude from their analysis that there has been an overall increase in fish species richness in most drainages, as the number of invasive species colonizations is greater than the number of extinctions of native species. While the authors acknowledge that some invasive species do cause negative impacts to both ecosystems and human interests, "...the impacts of introduced fishes on North American communities have not normally included wholesale decreases in species richness."¹¹⁰ In light of the above evidence, the reification of invasive species as "bad" seems especially unwarranted.

Gurevitch and Padilla also provide further evidence and arguments which support Slobodnik's arguments against the reification of invasive species. While granting that there are cases where invasive species are strongly correlated with species extinction (e.g. the brown tree snakes in Guam mentioned earlier in this chapter), Gurevitch and Padilla also present many cases where "...the picture is less clear."¹¹¹ They point out the great difficulty in assessing alien species' contributions to declines in native populations:

Most imperiled species face more than one threat, and it is difficult to disentangle proximate and ultimate causes of decline or interactions between different threats and to evaluate their relative importance. Exotic species might be a primary cause for decline, a contributing factor for a species already in serious trouble, the final nail in the coffin or merely the bouquet at the funeral.¹¹²

In other words, because of the complex relationships between different members of different species within a particular ecosystem, it is very hard to determine precisely what role a particular

¹⁰⁹ Gido, Keith and James Brown, "Invasion of North American drainages by alien fish species," in *Freshwater Biology*, Vol. 42, No. 2 (1999), 387.

¹¹⁰ *Ibid.*, 394.

¹¹¹ Gurevitch, Jessica and Dianna K. Padilla, "Are invasive species a major cause of extinctions?" in *TRENDS in Ecology and Evolution*, Vol. 19, No. 9 (2004), 471.

¹¹² *Ibid.*

invasive species might be playing in terms of its threatening the extinction of other species. Other factors which contribute to extinction that have occurred alongside introduction of an alien species include land development, erosion, shoreline destruction, and urbanization.¹¹³ Some species have also experienced declines prior to the introduction of an alien species, also making unclear the role of the alien species in such a scenario.

This perspective is corroborated in an article by Didham et al. where the authors critique the evidence used in support of the claim that invasive species are a leading direct cause of biodiversity loss. They argue that there is another interpretation besides that of invasive species playing a direct causal role in reducing species richness. On this alternative hypothesis, "...exotic dominance could be the indirect consequence of habitat modification driving native species loss."¹¹⁴ So, in situations where invasive species are deemed to be the main cause of biodiversity loss in a particular ecosystem, it is also possible that there are other occurrences which are causing a reduction in species richness, allowing the invasive species to proliferate in that area. That is to say, invasive species may not always be the "drivers" of ecological change, but could be "passengers" instead, which thrive as a result of factors beyond their control.

For instance, Didham et al. point out that there is a strong covariance between human alteration of habitat and invasion impacts. From this, they suggest that "exotic dominance could have less to do with strong species interactions, such as competitive displacement, than with non-interactive processes, such as relative dispersal ability or altered disturbance regimes that are more limiting for native species than they are for invasive species."¹¹⁵ It is important to note

¹¹³ Ibid.

¹¹⁴ Didham, Raphael, Jason Tylianakis, Melissa Hutchison, Robert Ewers, Neil Gemmell, "Are invasive species the drivers of ecological change?" in *TRENDS in Ecology and Evolution*, Vol. 20, No. 9 (2005), 470.

¹¹⁵ Ibid, 471.

here that the authors do not argue that invasive species are never “drivers” and are always “passengers.” Rather, they argue that the importance of invasive species and habitat disturbance in driving ecological change varies between different species and ecosystems, and that both the passenger and driver models are “extreme cases of a general model incorporating additive or synergistic effects of the two factors.”¹¹⁶ Once again, this serves to support the main argument of this chapter by providing evidence that invasive species are not inherently bad or good.

Gurevitch and Padilla further expand on this point, claiming that the language used in describing the threat posed by invasive species is misleading, and makes it appear as though all invasive species pose the same degree of threat, and that all threatened species are threatened to the same extent. They claim that this is false. For example, marine species have very low risks of extinction, particularly when compared with terrestrial species.¹¹⁷ In the conclusion of their paper, they claim that “...the assumed importance of the invaders in causing widespread extinctions is to date unproven, and is based upon limited observation and inference. Evidence supporting a general and primary role for invasive aliens in extinctions remains limited.”¹¹⁸ This further strengthens the main thrust of this chapter, because it exposes the negative bias against invasive species as a broad generalization at best, and one which is arguably too broad to be meaningfully applied.

Ewel and Putz also expand on these ideas, arguing that alien species can serve important roles in the restoration of ecosystems. The authors characterize many conservationists and other opponents of species introduction as taking “the ‘kill them all, always, everywhere’ perspective,”

¹¹⁶ Ibid, 472.

¹¹⁷ Gurevitch, Jessica and Dianna K. Padilla, “Are invasive species a major cause of extinctions?” in *TRENDS in Ecology and Evolution*, Vol. 19, No. 9 (2004), 473.

¹¹⁸ Ibid, 474.

which illustrates the strong negative bias against invasive species that I am addressing in this chapter.¹¹⁹ They write that “[b]lanket condemnation of alien species in restoration efforts is counterproductive,” arguing that alien species should be tolerated, or even utilized for positive benefits, if possible.¹²⁰ Investing in the eradication or control of invasive species is even construed as a wasted opportunity on this view, because those species may be neutral, or could play a very important role in the ecosystem restoration process.¹²¹

With this in mind, Ewel and Putz present a number of ways in which the use of invasive species may be appropriate. Many of these concern invasive plant species; for the purposes of this thesis, I will consider a relevant use for invasive animal species. Alien predators can be used to consume other alien species, plant or animal. As the authors note, this management technique is implemented often, and is gaining more acceptance as a tool for restoring ecosystems.¹²² Sometimes, control of alien species also occurs without human intervention. Ewel and Putz cite an example from Hawaii, where an alien species of bird consumed an alien species of spider.¹²³

When discussing the widespread negative bias against invasive species, the authors make a very relevant and agreeable point by comparing the compulsion to avoid all risk regarding invasive species with the much less extreme stances that people take regarding other important decisions that we make in our lives:

Concern about alien species has reached such a fever pitch among conservation biologists in wealthy nations...that consideration of their potential utility is often disregarded out of hand, and zero risk is assumed to be the only possible position.

¹¹⁹ Ibid, 354.

¹²⁰ Ewel, John and Francis Putz, “A place for alien species in ecosystem restoration,” in *Frontiers in Ecology and the Environment*, Vol. 2, No. 7 (2004), 354.

¹²¹ Ibid.

¹²² Ibid, 355.

¹²³ Ibid.

We do not take this extreme stance when we choose a mode of transport, when we select among health-care options, or when we invest our retirement nest egg; nor should we take it when considering the use of non-native species in restoration.¹²⁴

When making many different choices in our lives, we weigh out the potential utility with the potential risk of the outcomes of our decisions. Often, we opt for the choice which provides the greatest utility and smallest level of risk. Ewel and Putz argue that this way of decision-making needs to be applied to invasive species as well, where we often do not assess the potential utility of such species at all, even where the utility may be very high.

Because this article illustrates a number of positive uses for invasive species in ecosystem restoration, it may be found especially appealing by conservation biologists and ecologists who may have been in favor of the “categorical rejection of all alien species always and everywhere.”¹²⁵ Many people who take this negative stance may have been doing so for the sake of ecosystem restoration, for example. Ewel and Putz make a credible case that, in many situations, preservation and utilization of invasive species can be better for ecosystem restoration than the destruction of invasive species.

Botkin takes this line of reasoning one step further, arguing that “[b]iological invasions are natural and necessary for the persistence of life on Earth...”¹²⁶ I will not focus on Botkin’s claim that biological invasions are natural, but on his claim that invasions are necessary for life on Earth to persist.¹²⁷ Botkin writes that the view that an ideal ecological system is one that is in

¹²⁴ Ibid, 357.

¹²⁵ Ibid, 359.

¹²⁶ Botkin, Daniel, “The Naturalness of Biological Invasions,” in *Western North American Naturalist*, Vol. 61, No. 3 (2001), 261.

¹²⁷ I do not focus on Botkin’s claim that biological invasions are natural because 1) it has proven to be incredibly difficult to give a satisfactory definition of what it means for something to be “natural” and 2) even if biological invasions are naturally occurring, this does not necessarily imply that they are good, or that they should be allowed

a steady state, relatively unchanging, is misguided, and that late 20th century studies confirm that natural ecological systems are always changing, and that biological invasions are necessary for life to persist on Earth.¹²⁸

Botkin uses salmon as a case study to demonstrate the necessity of invasions. 15% of salmon do not return to spawn in the streams in which they were born, instead finding (or “invading”) new streams in which to spawn. This invasive behavior is necessary for their survival because, with the waxing and waning of glacial ages, some streams that were once suitable for salmon may ice over, and others which were too warm may become cold enough to be habitable. Also, salmon require gravel of a certain size and composition for egg laying, which ultimately requires that salmon streams “must become temporarily clogged with gravel and therefore temporarily unusable for salmon to survive.”¹²⁹ This requires salmon to “invade” new streams as previously used streams are rendered unusable. Botkin also points to the Cattle Egret as an example of a massively invasive species whose century-long expansion from Africa to all areas of the Earth with a tropical/temperate climate has been benign, perhaps because the species fills a previously empty niche in the invaded areas.¹³⁰ While Botkin acknowledges that some invasive species have been detrimental, he also writes: “...I am aware of no evidence to support the generalization that all invasiveness is always negative.”¹³¹ This further underscores the case which I am making in this chapter, as it is directly in line with the view that the negative bias

or encouraged. The naturalistic fallacy of deriving an “ought” from an “is” has long been recognized as problematic by many philosophers.

¹²⁸ Botkin, Daniel, “The Naturalness of Biological Invasions,” in *Western North American Naturalist*, Vol. 61, No. 3 (2001), 261.

¹²⁹ Ibid.

¹³⁰ Ibid, 262.

¹³¹ Ibid, 264.

against invasive species is too general to be meaningful, and that they are not inherently bad or good. Further, it is important to keep in mind that at least some biological invasions are necessary for life to persist, and that nature is constantly changing. The general attitude against invasive species is certainly linked to the assumption that we should try to guard against changes in nature, but it is possible that nature is largely characterized by such changes, which may even be necessary (at least in some cases) for life to persist on Earth. It may be very useful for conservation biologists and ecologists to keep the nature of nature in mind when determining best possible management strategies.

Conclusion

In this chapter I have provided a discussion of common traits that lead to particular species being characterized as “invasive,” in an attempt to shed some light on the reasoning behind the overwhelmingly negative bias which is held against invasive species within the scientific community, particular conservation and invasion biology and ecology. Some of these traits include causing a loss of biodiversity, extensive property and natural damage, as well as widespread global economic damage. I then discuss potential conceptual problems with the collection and reports of data on invasive species which may arise due to the vagueness and disagreement over what properly constitutes “invasiveness.”

Next, I outline some of the most relevant arguments, case studies, and data which demonstrate that the view that invasive species are inherently bad is flawed and ultimately unfounded. Briefly, some reasons which oppose the negative bias against invasive species are: some invasive species have great economic and nutritional value, invasive species have been unfairly reified as being “bad,” they can increase species richness, they are not always the drivers of ecological change, the correlation between invasions and native species decline is often

unclear, invasive species can serve important positive roles in ecosystem restoration, and invasions may be necessary for the persistence of life on Earth, as nature may be best characterized by its constant change. In my view, the arguments and evidence presented by the articles which support these claims complement one another in removing the foundation of the view that invasive species are inherently bad, and that they should always be done away with. If invasive species are not inherently bad or good, then it does not make sense to have default valuations of invasive species. Hence, we must take the attitudes towards and management of invasive species on a case-by-case basis. We should also be careful about characterizing species as “invasive,” which itself has a negative connotation.

There could very well be (as has been well documented in its occurrence) some invasive species which are quite detrimental and it may be reasonable to say that something should be done about them. However, it should not be assumed that this is the case, as there are also many occasions where invasive species do not pose a great threat (or much of a threat at all), and can even have positive benefits. Bringing in the conclusion from my argument in Chapter 1, when sentient beings are determined to be invasive, and it is deemed that something should be done about them, then lethal control should be a last resort, and should be conducted as humanely as possible if chosen. Nonlethal control and preventive methods should be prioritized above lethal control for sentient species, and many animal ethics advocates *and* conservation and invasion biologists can agree on preventive methods, where it may be best if detrimental invasive species did not become an issue in the first place.

There are a number of possible reasons for the scientific bias against invasive species apart from the potential detrimental effects of invasive species. For example, invasion biology

has recently come under much criticism for allegedly using fear tactics to promote its agenda.¹³² Also, it has been argued that xenophobia largely undergirds the negative bias against invasive species, equating the removal of invasive species with “purification” and the return of ecosystems to their pure, untainted states.¹³³ This is also shown to be evident in much of the language employed in invasion biology (even in the term “invasive” itself). Speciesism is undoubtedly also a factor in this bias, which may also explain why we are resistant in applying the term “invasive species” to our own species, even if it is logical to do so.

In the next chapter, I provide a recapitulation of my argument thus far, consider and respond to counter-arguments and objections, and discuss various sorts of lethal and nonlethal control methods, as well as preventive methods to deter the introduction of invasive species.

¹³² For further discussion, see Brendon Larson, “The war of the roses: demilitarizing invasion biology,” in *Frontiers in Ecology and the Environment*, Vol. 3, No. 9 (2005), 495-500.

¹³³ *Ibid.*

CHAPTER 3: COUNTER-ARGUMENTS, CONTROL METHODS, AND CONCLUSIONS

In this chapter, I provide a number of counter-arguments and objections to the arguments made within the first two chapters of this thesis. I then respond to each of these in defense of my original arguments. After this, I give an overview of various lethal and nonlethal control methods used in invasive species management, explaining some potential problems regarding the humane implementation of these techniques, and how they can be employed as humanely as possible.

Next, I present methods of preventing the introduction and proliferation of invasive species, and argue that the support of preventive management methods is a solid middle ground on which invasion biologists/ecologists and defenders of animal ethics can stand together, as it will be agreeable for both sides if the issue of how best to deal with a particular invasive species does not become an issue in the first place. Finally, I will conclude the chapter and this thesis by summarizing my arguments in light of objections and existing control methods, and providing reflection on the utilization of these arguments in real-world situations.

Provision of Original Arguments

Before launching into counter-arguments and objections to my original arguments, it will be important and helpful to recapitulate my original arguments and to demonstrate how the main arguments from each of the first two chapters are unified in making an overarching argument regarding our treatment of sentient members of invasive species.

My arguments thus far serve as responses to two vital and interconnected issues which arise within invasion biology, ecology and environmental ethics: the lack of distinction made between sentient and non-sentient invasive species when determining best possible management

strategies, and the large-scale negative bias of invasive species as “bad,” which has become the default view shared among many professionals within the aforementioned disciplines. When invasive species come to be seen as inherently bad, and native species are seen as inherently benign, this serves as the foundation for the development of a prejudice against invasive species “always and everywhere.” This prejudice then enforces the view that invasive species need to be removed from the area which is being invaded, and that this should be done in as efficient and productive a manner as possible. Timeliness and cost-effectiveness often become top priorities as a result of this attitude, and in many cases the most cost-effective method of removing an invasive species from an area is to kill the members of that species, perhaps by calling on volunteer hunters and/or trappers to facilitate this goal. Because the distinction between sentient and non-sentient invasive species is not made in a morally relevant way, the sentience of members of an invasive species often does not become a factor in determining best possible management strategies. This can have the consequence of large-scale neglect of sentience when implementing various control methods, resulting in much unnecessary suffering of sentient members of invasive species which could largely be eschewed even if some form of lethal control were deemed to be the best possible management strategy.

The first chapter of this thesis argues for sentience as a morally relevant criterion when determining best possible management strategies regarding invasive species. Sentient beings have some sort of conscious awareness which bestows upon them the capacity for self-valuation, or the ability to care about what happens to them. This provides a demarcation between an organism’s having *interests* versus only having *needs*, where needs can be had by any living organism, whereas sentience is required for an organism to have interests. An interest here is a kind of need, the fulfilling or thwarting of which matters to the organisms in possession of it.

This gives rise to Rollin's view of intrinsic value which is endorsed in this thesis, where an organism has intrinsic value if what happens to it matters to it, which entails that such an organism must first have the capacity to *care*. Intrinsic value here can also be understood as self-directed instrumental value.

The interests of a particular organism, or set of organisms, arise from the *telos*, or nature, of those organisms: the "pigness of the pig," so to speak. Such interests consist in the fulfillment and expression of the natural behaviors of that particular organism; for example, the *telos* of a pig partially consists of rooting in the ground and bathing in mud, while the *telos* of a chicken partially consists of stretching and flapping its wings, and occupying a position in the social hierarchy (or "pecking order") of a relatively small group of other chickens. While many sentient beings may not be considered moral agents due to their lack of rationality and inability to be held morally responsible for their actions (at least in the same way in which rational beings hold one another morally responsible), their capacity for having their interests fulfilled or thwarted seems to be a valid reason for viewing such beings as moral patients, or objects of moral concern. As moral agents who can become aware of the interests of other sentient beings, we can have quite a large amount of control over whether such interests are fulfilled or thwarted.

The capacity for sentient beings to have interests sets them apart from non-sentient beings (and other non-sentient entities, such as species and ecosystems) in a way that is seen, on this view, as morally relevant. While non-sentient entities, such as plants, have needs, the fulfillment of which is required in order for them to survive and thrive, their lack of conscious awareness precludes them from taking interest in the fulfillment of these needs. Sentience appears to be necessary in order for something to have the capacity to care, and such a capacity is in turn necessary for the possibility of self-valuation. Hence, non-sentient beings are arguably

incapable of caring about what happens to them, and so are unable to possess intrinsic value as it is understood here. It is quite possible, and probably necessary in many cases, that non-sentient beings are instrumentally valuable. Both sentient and non-sentient beings are deeply embedded together in the world, and the existence and fulfillment of the interests of sentient beings may depend on non-sentient beings in many ways. However, the lack of capacity for having interests appears to prevent non-sentient beings and entities from being valuable in and for themselves.

For the purposes of this thesis, this difference between sentient and non-sentient beings continues to be morally relevant when members of such species are deemed to be “invasive.” In other words, just because sentient beings are deemed to be members of an invasive species, this does not simply outstrip the capacity for such beings to have interests, the fulfillment of which matters to those beings. If we are to develop management strategies which take this into account, then those strategies must consist in accommodating the *telos* of sentient beings as much as possible. Even if a lethal method of control is deemed to be the best possible management strategy for sentient members of an invasive species in a given situation, the implementation of this method should *at least* take into account the most fundamental interests of those sentient beings, i.e. their capacity for suffering and their interest in avoiding suffering. This entails that lethal control should be considered as a last resort in most cases, in order to accommodate the *telos* of sentient members of invasive species as much as possible. However, even when lethal control is implemented, it should still be carried out in the most humane way possible, taking the suffering of the invasive sentient beings into account. This is further amplified by the fact that many biological invasions are now anthropogenic, and the members of the invasive species in question, lacking moral agency, are not *deciding* to be invasive, but attempting to survive, proliferate, and fulfill their *telos*. It just so happens that sometimes these

activities occur in places where it may be detrimental, or at least perceived as detrimental in some respect. Further, the inherent vagueness of terms like “invasive” and “native” (which is emphasized throughout this thesis) indicates that we should be as cautious as possible when ascribing these terms to living things, particularly when such an ascription often entails that we take action against them. Even those who largely disagree with the moral theory that I provide as a foundation for the accommodation of the *telos* of sentient members of invasive species can still agree that their *telos* should be accommodated in some way, unless their own moral theory completely fails to take account of sentience and the capacity to suffer as morally relevant in any way. I think that this recognition in itself could lead to great changes in our current attitudes and behavior towards sentient members of invasive species, given the very negative position towards them at present.

It is this exceedingly negative bias against invasive species that is examined and critiqued in the second chapter of this thesis. The information regarding negative aspects of invasive species is very well-known and well-cited throughout the literature on the subject. Invasive species are known for causing large-scale ecological and economic damage; they are reported as being the second leading cause of biodiversity loss, and are also held responsible for many cases of environmental disruption, such as land erosion, while invasive species are estimated to cause \$800 billion in annual global damages. I discuss a number of case studies of species in the second chapter which appear as exemplars of these kinds of negative effects, such as the European starling, brown tree snake, and nutria.

However, it is important to keep in mind here the vagueness of and disagreement over the term “invasive,” as well as the criteria that should be used to evaluate and classify a species as falling under that category. Because of this difficulty, there may be a further challenge in

examining data regarding the overall effects of the whole category of invasive species. It seems important that we agree over what the proper criteria are for a species to be considered invasive, if we are to provide an accurate account of which species *are* and *are not* invasive. Considering the in-depth disagreement over this which is emphasized in Chapter 1 of this thesis, this may be harder to do than many people imagine. As a result, we should consider the real possibility of presenting less-than-accurate large-scale data on invasive species. Due to potential disagreements over which species should be considered invasive and why, it is possible that the total damage caused by invasive species may be under- or over-represented in the data. This is not to say that such data are always misleading, but perhaps that they should be examined with the awareness that we are not quite sure just what makes an invasive species “invasive.”

Aside from the plethora of data recounting the very damaging effects of some invasive species, there is a growing body of scholarly work which examines the potential positive and neutral effects for which invasive species are also known, such as: economic and nutritional value, increasing biodiversity, not always being the drivers of ecological change in a given area, an often unclear correlation which exists between invasive species and the decline of native species, the number of positive roles which invasive species can play in ecosystem restoration, and the occurrence of biological invasions in general as necessary for life on Earth to persist. These examples alone, which are discussed in greater detail in Chapter 2, may be sufficient in deterring some from simply accepting what appears to be the default position in invasion biology and ecology: that invasive species have been reified as inherently “bad” and that we need to rid ourselves of them in the cheapest, fastest, most efficient manner possible, which usually entails killing them, often by hunting or trapping, with very little or no concern for implementing management strategies which recognize and accommodate the *telos* of the beings in question.

Because invasive species can have positive, negative, and neutral effects on the environment, economy, and other species, our attitudes toward and management of invasive species should be shaped on a case-by-case basis. It is important not to assess situations regarding invasive species with a negative (or positive, for that matter) bias in mind, as this could skew what is viewed as the proper action to take regarding such species.

This brings us to the importance of taking the arguments from Chapters 1 and 2 in combination with one another. Briefly, I argue that a) there is a morally relevant distinction to be made between sentient and non-sentient invasive species which is largely neglected in literature and practice, and b) that the bias towards invasive species as inherently “bad” is ultimately unfounded, with the effects of invasive species being wide-ranging, as well as very context-dependent. It is important to argue for each of these conclusions, because the bias towards invasive species as being inherently bad often blinds people to the moral relevance of the sentience of members of invasive species (when they are, in fact, sentient).

Even if a particular sentient invasive species is highly detrimental and immediate (perhaps lethal) action needs to be taken regarding members of this species, viewing the species without an inherent negative bias in mind may allow for the moral relevance of sentience to become more apparent, as opposed to being neglected or dismissed. Even lethal control of invasive species can be performed in such a way that there is at least minimal accommodation of the animals’ *telos*, e.g. reducing suffering as much as possible while still killing. Conversely, another advantage of assessing a situation regarding invasive species without an *a priori* negative basis in mind is that, given the data presented in Chapter 2, it is quite possible that some sentient invasive species are actually very beneficial to their inhabited area, or at least leave it

largely undisturbed. Invasive species sometimes fill empty niches in ecosystems, and can even be important for the thriving of native species.

Being mindful of the morally relevant distinction between sentient and non-sentient members of invasive species may also serve to diminish the negative bias towards invasive species, and allow people to view members of these species for what they are: living beings which are now often thrown into situations over which they have no choice (given the largely anthropogenic nature of many current invasive species introductions), where sentient beings are still objects of moral concern even if they are not moral agents, and which are trying merely to survive and to fulfill their *telos* in an area where they may not be “native,” where doing so may or may not be seen as detrimental. With these arguments and reflections in mind, I will now address a number of relevant counter-arguments and objections.

Counter-arguments and Objections

The first counter-argument that I examine could be considered a pragmatic argument for the retention of the bias against invasive species. I have argued in this thesis that the bias and reification of invasive species as “bad” (as well as the bias and reification of native species as “good”) is unfounded, and that attitudes towards and management of invasive species should be formed on a case-by-case basis rather than assessing a new situation with a negative bias.

An opponent of this view could grant that the reification of invasive species as inherently bad is obviously misguided; given the data presented in this thesis, it is hard to deny that there is significant evidence to the contrary. Certainly, invasive species can be advantageous, or at least neutral in some situations. However, an opponent of my view could further argue that, granting all of this, some negative bias against invasive species should still be adopted because it has proven to be useful. Sure, members of an invasive species are not *inherently* bad, but is it not

still reasonable to adopt the bias that invasive species are *generally* bad? And should this not shape our view of invasive species in a way which is largely agreeable?

In response to this argument, I think it is helpful to draw attention to the relative ease with which one could slide from a healthy skepticism about the effects of an invasive species to an illegitimate negative bias against them. Certainly, given the negative connotation of a label like “invasive species,” one should not begin assessing a situation with any unfounded positive expectations, either. There could be a very good reason why a species has received such a label. However, it is equally important to keep in mind that a species could also receive this label for potentially more trivial reasons.

Given the vagueness of and disagreement over the term “invasive,” it is easily conceivable that a species would receive this label merely in virtue of the fact that it is non-native, or exotic. In other words, depending on one’s view of “invasiveness,” a species need not exhibit overt destructive tendencies in order to receive such a label. In these and similar situations, it does not appear to be very helpful to begin assessing the scenario with a negative bias (or any bias) regarding invasive species, as this could very well enforce and perpetuate the negative stereotype linked with labeling a species as “invasive.” Further, it may be difficult or impossible to tell what sort of situation one will be encountering beforehand; a species may exhibit some invasive tendencies, while providing positive benefits to its new eco-niche, or it may be very destructive, regardless of whether it is native or exotic (as native species can also be considered invasive on some views, such as that held by the WHC).

For these reasons, it seems that the best possible action and attitude to take regarding a potentially invasive species is to withhold all judgment, positive and negative, as much as possible while assessing the facts over the actual behavior of members of the species.

Sometimes, this may be easier said than done. For instance, scientists may have limited time and resources which may be put towards making an accurate assessment, and it is conceivable that an attitude could be adopted where it is “better to be safe than sorry.” That is to say, it could be seen as better to take action against a species which is exotic and potentially invasive, than to leave it alone and give it the opportunity to exhibit destructive behavior in the future.

It seems to me that, while such an attitude could be seen as potentially useful, this returns to the problem of entering a new situation with a negative bias. It can be very difficult to predict the invasiveness of a species, and it may be worse to “err on the side of caution” and destroy members of a non-native species which could be potentially valuable, or at least benign. Further, having a negative bias against a species could also deter one from seeking the most humane form of control in situations where some form of management *is* the best option. Given the potential for an invasive species to have positive and neutral aspects, as well as negative, it seems that assessing a situation with any sort of bias will ultimately be more detrimental than helpful.

An opponent of the arguments in this thesis could further assert that, taken as a whole, my overall argument presents contradictory recommendations regarding the management of invasive species. I argue that we should develop attitudes towards invasive species on a case-by-case basis. However, I also argue that sentience is a morally relevant factor that should be recognized whether or not members of a species are deemed to be invasive. I argue that this entails reserving the endorsement of lethal control methods as a last resort, and first looking into nonlethal control, or preventive methods, if the situation allows for this. Does it make sense to determine our attitudes toward and management of invasive species on a case-by-case basis while having an *a priori* hierarchy of preferred control methods?

First, it is important to point out that my arguing for lethal control as a last resort, as well as the importance of exploring nonlethal and preventive measures as much as possible, are simply extensions of the view that, in accommodating the *telos* of sentient members of invasive species as much as possible, we should always take the most humane action possible regarding them. So, this could be viewed as a sort of tentative hierarchy which is subject to change based on individual situations, and which should be open to such changes. It is possible that the hierarchy will not reflect the most humane strategies in particular situations.

For instance, there could be a situation where killing sentient members of an invasive species is the most humane management strategy. Nonlethal control methods, such as destruction of nests, may not reduce the overall population of a species to a significant extent. If this is the main management strategy for a given species, this could allow for a growth in population over time. This could mean that a greater number of sentient beings may have to be killed later, as opposed to killing fewer in the present rather than allowing the population to grow. In this, as well as other potential situations, lethal control may very well be the most humane possible option, in order to avoid further suffering in the future.

However, even if this were the case, lethal control should still be carried out in as humane a manner as possible. This entails accommodating the *telos* of the particular animal as much as possible, even if this is only at a foundational level. At the very least, lethal control should be performed in such a way that it is as painless as possible, as a fundamental interest which appears to be shared by sentient species (and by which they may be successfully characterized) is an avoidance of suffering. After addressing some more objections, I will provide an overview of various forms of invasive species management, with recommendations on how these can be carried out in the most humane possible fashion.

So, the reservation of lethal control methods as a last resort option, with deference to nonlethal and preventive methods, should remain flexible in regards to the context and details of particular situations and species. Ideally, the most humane management option should be the one opted for, and this could very well be subject to change. However, given the feasibility of some nonlethal methods of control, it is also possible that the reservation of lethal control as a last resort *will* hold up in many situations.

The next objection that I will consider is one which is faced by any view which defends sentience as a morally relevant criterion. While such a defense may make a lot of sense theoretically, when applied to real-world situations, there could be a large amount of gray area where the sentience of a given organism is ambiguous, or suspect. When faced with these sorts of conditions, where should we draw the line in assessing whether or not a creature is sentient? For instance, there are a number of insect species which are considered to be invasive, as well as species of fish and crustaceans.

Providing sophisticated criteria for assessing a being's sentience is beyond the scope of this thesis, and could perhaps be another thesis in itself. In many borderline situations, it could be useful to bring in empirical evidence regarding the cognition of a particular species. There has been some very recent work done regarding whether or not fish feel pain, for instance, and there is also ongoing work within entomology and philosophy of science on the possibility of insect pain, and the obscuration of the existence of such pain by replacing "pain" with terms such as "nociception."¹³⁴ This may be indicative of a scientific bias against the possibility of insect pain. While I understand that my view will certainly not be shared by many within various

¹³⁴ See Victoria Braithwaite, *Do Fish Feel Pain?* (Oxford: Oxford University Press, 2010). Also see V.B. Wigglesworth, "Do insects feel pain?" in *Antenna*, No. 1 (1980), 8-9.

scientific disciplines, I am inclined to give some species the benefit of the doubt.¹³⁵ It may be fairly apparent that members of some species actively attempt to put themselves in situations where they are not suffering. However, it could also be argued that, at some point, this is largely a reflexive tendency, not necessarily characterized by conscious awareness.

While there will undoubtedly be borderline cases where more thought should be put into the assessment of a species' potential sentience, it is also important to keep in mind that there are also quite a number of situations where it is more or less obvious that the members of some species are sentient. In fact, many of the case studies employed in this thesis involve beings whose sentience is hardly questionable, even though it may have been neglected when determining best possible management strategies. Hopefully, in such situations, the arguments in this thesis will aid in encouraging people to take the moral relevance of sentience into account, and will reduce the potential amount of suffering experienced by sentient members of invasive species.

The next objection is essentially a criticism of my portrayal of intrinsic value in this thesis. I defend Rollin's conception of intrinsic value, where something is intrinsically valuable if what happens to it matters to it. As said earlier, this could also be understood as a kind of self-directed instrumental value, where the capacity for self-valuation would be necessary for something to be intrinsically valuable. This is quite different from the view of intrinsic value which undergirds views such as biocentrism, where all living things possess intrinsic value. In characterizing this sort of view, I retain the assumption, which appears to be shared by at least some philosophers, that the sort of intrinsic value entailed by biocentrism is an egalitarian one, where all individual living things are equally intrinsically valuable.

¹³⁵ Peter Singer also takes this approach in his book *Animal Liberation* (New York: Avon Books, 1975).

However, it may also be possible to have a non-egalitarian sort of intrinsic value, where all individual living things have intrinsic value, but some are more valuable than others. One of my original concerns about the ascription of intrinsic value to both sentient and non-sentient entities was that both kinds of entities would be equal candidates to be objects of moral concern. A non-egalitarian sort of intrinsic value has the potential to avoid this worry, where sentient entities may have more value than non-sentient entities.

One potential concern about the view of intrinsic value that I defend, where intrinsic value is tied solely and directly to an entity's being sentient, is that other non-sentient living entities, such as plants, only have value insofar as they are instrumentally valuable to sentient beings. Taking this into account, a possible advantage of a non-egalitarian ascription of intrinsic value is that plants and other non-sentient entities could still have intrinsic value, while still lacking the amount of intrinsic value held by sentient beings. On such a view, the interests of sentient beings could be protected against being subsumed by the needs of non-sentient beings.

In response to this, I should first reiterate the point made in Chapter 1 that it is possible to agree with much of my argument for the moral relevance of sentience without accepting that sentience is required for value. Indeed, as long as sentience factors into someone's moral theory *at all*, it can be agreed that more should be done to take sentience into account than is currently being done regarding sentient members of invasive species. It is on theories where sentience is very easily trumped by other factors that this can become problematic.

However, there are also some conceptual issues regarding a non-egalitarian distribution of intrinsic value which would need to be spelled out in some detail. One issue is that such a view may at least partially collapse into a view where intrinsic value is ascribed depending on an entity's being sentient. For example, if more intrinsic value is ascribed to sentient beings than

non-sentient beings, it seems to be the case that such an ascription would be at least partially based on sentience. At the same time, this kind of view may still provide some kind of protection for non-sentient beings, so that their being valuable is not solely dependent on being instrumentally valuable for sentient beings.

While this may seem advantageous in some respects, it is also worth questioning whether or not it is such a bad thing for the value of non-sentient beings to depend on their being valuable for sentient beings. This view, which I defend in this thesis, may not diminish the value of non-sentient beings at all, but provide a meaningful way of understanding it. Considering how radically interdependent sentient and non-sentient beings are on one another in the world for their survival and thriving, a view of intrinsic value which is dependent on sentience would still entail very careful, mindful decisions regarding our actions toward members of plant species, for example. Indeed, an interpretation of this view where we can do whatever we want with non-sentient beings is both naïve and short-sighted, as it would entail a failure to realize the dependence on non-sentient beings for the fulfillment of the interests of sentient beings. It is because of this that a satisfactory environmental ethics could be developed based on the dependence on sentience for intrinsic value, where great importance would still be placed on non-sentient nature in terms of its instrumental value. So, while there are other ways of understanding intrinsic value which have their own advantages and disadvantages, I do not see a relevant reason to abandon my current understanding of the necessity of sentience for the possession of intrinsic value, as it provides a meaningful and clear-cut method for understanding the moral relevance of both sentient and non-sentient beings in a way which seems well-representative of how these relationships stand in reality.

The next objection which I consider is perhaps the most difficult for my arguments to overcome when being implemented in real-world scenarios regarding the most humane possible management techniques for sentient members of invasive species. While there are alternative management techniques which are demonstrated to be effective in practice, the major complaint regarding these on behalf of wildlife managers and invasion biologists is that they are not cost-effective. Specifically, one major issue that is raised is that many animal rights activists find considerable faults with the conventional methods of controlling sentient members of invasive species (e.g. killing, often involving hunting and trapping), and have raised much public awareness and disapproval regarding these methods in some cases. At the same time, alternative control methods (i.e. alternatives to lethal control) are often reported to be more expensive to implement, and little or nothing is being done on the part of those activists in terms of raising money to cover the difference between these control methods.¹³⁶ While more humane forms of invasive species management exist (as well as the potential to develop new humane methods), they often cannot be implemented unless money is somehow generated to cover the extra costs involved.

Given that the cost-effectiveness of nonlethal control methods is often less than the cost-effectiveness of some lethal control methods, resolving this issue will undoubtedly require focus on public awareness of the ethics of invasive species management. Often when we consider our treatment towards other animals on a large scale (e.g. in industrial agriculture or the management of invasive species), it is not surprising that the most humane options are often the most costly. In fact, this issue regarding invasive species is analogous in many ways to the issue regarding the humane treatment of farm animals which has been sacrificed in industrial agriculture. People are

¹³⁶ For a discussion of this, see Dan Perry and Gad Perry, “Improving Interactions between Animal Rights Groups and Conservation Biologists,” in *Conservation Biology*, Vol. 22, No. 1, 27-35.

interested in having a large supply of cheap food available, and accomplishing this in industrial agriculture typically involves the cost of subjecting animals to very inhumane treatment and miserable living conditions. For some time, the public was largely unaware of the consequences of their cheap food. Slowly, the tide is turning regarding issues in farm animal welfare, as more and more people become willing to pay a higher price for their groceries in exchange for some sort of assurance that the animals used in the making of this food live better lives, and are able to express their natural behaviors to a larger degree than previously possible.

In my view, it looks as though we should be working towards similar public awareness and support regarding the humane treatment of sentient members of invasive species. Just as there are a multitude of non-profit organizations focused on promoting farm animal welfare issues and raising money to improve the austere conditions imposed by industrial agriculture, there should be organizations working with wildlife managers, ecologists, and invasion biologists to promote more humane forms of invasive species management. However, also like the movement away from industrial agriculture, this movement will be dependent on the backing of the public. While this may appear to be daunting, it puts invasive species management not just in a similar position to farm animal welfare, but any social movement that has a chance of succeeding, so public awareness must be an important long-term goal on which advocates of humane invasive species management practices must focus. It is readily apparent that the scientific community is shifting toward a multi-stakeholder approach when dealing with ecosystem management and invasive species issues. For example, there are a multitude of scientific journal articles which consist of poll results analyzing public attitudes towards many facets of invasive species management, including specific control techniques.¹³⁷ Through public

¹³⁷ For example, see Alison Bremner and Kirsty Park, “Public attitudes to the management of invasive non-native species in Scotland,” in *Biological Conservation*, Vol. 139, No. 3-4 (2007), 306-314.

education on these issues, a large amount of power can be exercised regarding how management practices are implemented in real-world situations.

A final point that I will address in this section is one that has been in the background throughout much of this thesis. If key terminology in invasion biology, such as “native”, “non-native,” and “invasive” are so vague and problematic, why should I continue to employ these terms? Part of the reason is that the attempt to use these words assists in shedding light on terminological issues. I have made some passing comments which illustrate that, depending on the criteria one employs for determining “invasiveness,” some species may or may not count as invasive. Another reason why I continue to use this terminology is precisely because it is the current terminology being used. While a re-evaluation of some of the terms thrown around loosely in invasion biology would be ideal, this doesn’t appear to be underway in the near future. Further, it is likely that any positive change regarding invasive species management is going to happen by working with the people who ultimately make the important decisions in this area, and it will also probably require the use of their terminology, however unwieldy.

In any discipline, it is virtually inevitable that there will be some terminology which is ill-defined and used too casually to be as meaningful as it is taken to be. Sometimes the use of these terms allows the user to develop a certain “family resemblance,” where one can have an idea, however vague, of what sorts of things to which those terms can be usefully applied. However, in the case of invasion biology, the lives and treatment of many sentient beings is dependent upon quite vague terminology. Often, being labeled “invasive” is essentially a death sentence, even though we have only a very loose idea of how to properly classify species under this category.

Methods of Control and Prevention

Before concluding this thesis, I provide an overview of some common forms of lethal and nonlethal control of invasive species, discussing ways in which each of these could be carried out as humanely as possible, and providing some case studies illustrating past forms of implementation. I discuss some methods of preventing the introduction of invasive species, and propose that this is a place where supporters of humane animal treatment and wildlife managers can agree, as it would be beneficial for all parties involved (including the animals) if invasion were not an issue in the first place.

Before going into the humane implementation of these management practices, it is important to emphasize that the humaneness of control methods is always going to be species-specific to a large degree. Because the humane treatment of animals is so dependent on allowing animals to express their *telos* and fulfill their interests, the best ways of allowing for this will inevitably vary from species to species. Though I provide some case studies involving particular species, it is always important to extrapolate these ideas while keeping in mind the details and context of the particular situation within which one is working.

Lethal Control Methods

Wittenberg and Cock distinguish between 3 main kinds of control methods: mechanical, chemical, and biological. Chemical control is characterized by the use of pesticides for invasive species control. For vertebrates, this is often manifested in the form of bait, usually placed in a bait station specifically designed to attract a certain target species.¹³⁸ Biological control typically involves the release of species which are “natural enemies” of the target invasive species into the invaded area, but can also consist of the use of chemicals synthesized by living organisms, and

¹³⁸ Wittenberg, Rudiger and Matthew Cock, eds. *Invasive Alien Species: A Toolkit of Best Prevention and Management Practices* (Wallingford: CAB International, 2001), 147-149.

the release of sterile males which breed with females to prevent the further proliferation of the species in that area (this will be revisited under nonlethal control methods).¹³⁹

The three lethal control methods that I will discuss here are hunting, trapping, and on-site euthanasia. These can all be classified as “mechanical” or “manual” control methods, as they involve the direct removal of individuals from their respective populations.¹⁴⁰ The hunting of invasive species can be implemented in two major ways: the encouragement of recreational hunting, or the employment of professional hunters. An advantage of recreational hunting is that it is generally cost-effective (it essentially involves the recruitment of volunteer hunters), and it can even generate money for use on other management projects.¹⁴¹ However, it also poses the potential to be very disadvantageous in terms of humane treatment of animals, as amateur hunters often lack the skill possessed by professional hunters. In terms of animal welfare, this translates into an increased potential for greater animal suffering. Ideally, if hunting is going to be implemented as a control method for invasive species, professional hunters should be hired in order to get the job done as quickly and painlessly as possible. Particularly, sniping using very accurate weaponry would probably be the ideal form of invasive species control via hunting.

Trapping is a mechanical control method which is mentioned in tandem with hunting.¹⁴² This makes sense, because the trapping of an animal typically requires some other lethal control method once the trapped animal is found. However, it is possible for trapping to be executed in ways that are severely wanting in terms of humane animal treatment. For instance, in the early 1990s, The Nature Conservancy (TNC) set up hundreds of snares in a Hawaiian nature preserve

¹³⁹ Ibid., 149-150.

¹⁴⁰ Ibid., 145-146.

¹⁴¹ Ibid., 146.

¹⁴² Ibid., 146.

in order to trap feral pigs, an invasive species in the area. Upon examination, it was found that animals were left in snares for extended periods of time, often dehydrating, starving, or choking to death.¹⁴³ After PETA launched a campaign against TNC's use of snares, TNC removed the snares and began looking into more humane forms of trapping, such as creating snares which emit a signal after an animal becomes trapped. This aids in minimizing the time that an animal spends trapped.¹⁴⁴

This case study serves to illustrate a major variable of trapping which affects the humane treatment of trapped animals: time spent trapped. It is reasonable to suggest that the longer the time that an animal spends in a trap, the less humane this form of control is. Even if the trap is more humane by design, the state of being trapped is no doubt stressful in itself. Therefore, when trapping is employed as a form of invasive species control, the time that an animal spends between being trapped and killed should be as minimal as possible in order for this control method to be implemented as humanely as possible.

The final lethal control method that I will discuss in this thesis is the euthanizing of animals on-site. This could be implemented alongside trapping as a more humane alternative to shooting trapped animals, or killing them in other, less humane ways. For example, once an animal is trapped, there should be some way to alert those in charge of the management procedure. Once the trapped animal is found, it could be tranquilized and euthanized in the field, or perhaps brought back into a lab setting where it is euthanized, depending upon the particulars of the situation. If lethal control is going to be implemented, something along these lines is probably the best way of going about it in terms of humane treatment of the animals. However,

¹⁴³ Rosenberger, Jack, "Attack of the Feral Pigs," in *E: The Environmental Magazine*, Vol. 5, No. 5 (1994), 22.

¹⁴⁴ Ibid.

this could also face issues regarding cost-effectiveness, as the tools and serums used could become expensive, in addition to the need to hire people to carry out this control method.

Nonlethal Control Methods

The three nonlethal control methods that I will be discussing here are the use of contraception, the introduction of sterile males to breed with a target population, and the implementation of fencing or barrier technology in order to restrict the inhabited area of an invasive species.

The use of immunocontraceptive vaccines has been researched and tested for decades as a potential wildlife control method. Unfortunately, the need for multiple inoculations throughout the lifetime of the animal has complicated the potential effectiveness of this control method.¹⁴⁵ However, a 2002 journal article by Fraker, et al. provides data demonstrating the effectiveness of a single dose of the SpayVac™ immunocontraceptive vaccine.¹⁴⁶ The ability to achieve successful contraception with a single dose makes this control method particularly cost effective, and also minimizes stress and injury to the deer to which it was administered.¹⁴⁷ Using maize, deer were baited into a restricted area, where they were inoculated with the vaccine and released.¹⁴⁸ This process could prove somewhat stressful for the animals involved, but it need be done only once. While much of the research on this control method has been done on deer, it seems entirely plausible that this method could be extrapolated and applied to a wide array of other invasive animal species.

¹⁴⁵ Fraker, Mark, Robert Brown, Geoffrey Gaunt, Jason Kerr, and Bill Pohajdak, “Long-Lasting, Single-Dose Immunocontraception of Feral Fallow Deer in British Columbia,” in *Journal of Wildlife Management*, Vol. 66, No. 4 (2002), 1141.

¹⁴⁶ *Ibid.*, 1141-1147.

¹⁴⁷ *Ibid.*, 1141.

¹⁴⁸ *Ibid.*, 1142.

Another viable nonlethal control method is the release of a large amount of sterile males into a target population, where the males mate with the females in the population and are then unable to produce offspring in the next generation.¹⁴⁹ This method was useful in eradicating Screwworms (*Cochliomyia hominivorax*) from both North America and North Africa. Sterile screwworm flies were raised in a production plant and were then released into the target population, successfully preventing the invasive species from proliferating.¹⁵⁰ While this technique has proved effective, there may be difficulties regarding extrapolating this method to other kinds of invasive species, such as vertebrates. It seems fairly easy to implement this with insects, but may be much more problematic, in terms of feasibility and ethical implications, to raise a number of sterile wild animals in captivity and then release them to breed with other members of their species.

Fencing, or, more broadly, containment, is the final type of nonlethal control method that I examine in this thesis. This entails either “fencing the species in a certain area or fencing off ecologically valuable land.”¹⁵¹ If this method is undertaken, it is important to be sure that the target invasive species is only on one side of the fence (the enclosed side), as otherwise the method has failed.¹⁵² A version of this method was successfully implemented in order to control the invasive brown treesnake (*Boiga irregularis*) in Guam, where a variety of barriers were designed in order to prevent the snakes from spreading. These barrier designs are at least 95% effective in preventing snakes from scaling them, with the most useful designs being 100%

¹⁴⁹ Wittenberg, Rudiger and Matthew Cock, eds. *Invasive Alien Species: A Toolkit of Best Prevention and Management Practices* (Wallingford: CAB International, 2001), 150.

¹⁵⁰ *Ibid.*, 178.

¹⁵¹ *Ibid.*, 147.

¹⁵² *Ibid.*

effective. Perry and Campbell, the authors of the article providing this data, defend the view that “[u]ntil the tools are developed for snake eradication, blocking snakes from entering sensitive areas such as electrical power systems, airports, and conservation areas is likely to be the best strategy.”¹⁵³

In my view, even after effective snake eradication tools are developed, the use of barrier technology and fencing could still be a more humane form of control (depending, of course, on the eradication method). This technology appears to be very effective, and could also plausibly be applied to a wide variety of sentient invasive species. Of course, specific designs may have to be altered to take into account the *telos* of the species for which it is being implemented to control. Some species may be more prone to scaling or attempting to scale a fence (which could result in injury), while others may not. Also, depending on the species and the size of the area to which it is restricted, this could lead to increased stress, and so would have to be weighed out against other control methods which may be more or less humane for that particular species.

Preventive Methods

Methods which are implemented that aim to prevent the introduction of invasive species can serve as a solid middle ground where advocates for the humane treatment of animals can stand together with ecologists and invasion biologists. As Perry and Perry write, the prevention of invasive species introduction should be satisfactory for both sides, because it avoids the possibility of ecological damage caused by invasive species, as well as the likely lethal control of those invasive species.¹⁵⁴ Because of this agreement, it is important for animal ethics and

¹⁵³ Perry, Gad and Earl W. Campbell III, “Managing Island Biotas: Brown Treesnake Control Using Barrier Technology,” in *Proceedings of the 18th Vertebrate Pest Conference*, (1998), 138.

¹⁵⁴ Perry, Dan and Gad Perry, “Improving Interactions between Animal Rights Groups and Conservation Biologists,” in *Conservation Biology*, Vol. 22, No. 1 (2008), 32.

environmental advocates to work together to prevent invasive species from becoming an issue in the first place.

Joining forces in this way would be a pragmatic decision on both sides. Supporters of humane animal treatment may not necessarily take issue with a particular species which is deemed potentially “invasive” (especially given the vagueness and disagreement over the term). But, those same people should also consider that if this species *does* become invasive, many members of the species will likely be killed. Likewise, ecologists and invasion biologists often want to prevent invasions as much as possible, regardless of the way in which those species would probably be controlled if they did become invasive (and regardless of whether or not the members of those species are sentient). While neither side may have a vested interest in working with the other, it could be mutually beneficial to have as many people as possible working towards the prevention of invasive species introductions.

Wittenberg and Cock argue that, rather than targeting individual species, a more comprehensive approach to prevention calls for an identification of the major pathways through which harmful invasions occur.¹⁵⁵ On this view, introductions can either be intentional or accidental, and the authors identify a multitude of particular ways that introductions can occur. Some relevant intentional introductions are the release of birds and mammals for hunting purposes, the release of mammals on islands as food resources, and the escape of animals into the wild from zoos and botanical gardens (after being intentionally introduced into captivity).¹⁵⁶ The pathways of accidental introduction which are discussed here are virtually all related to the introduction of invasive plant species and pathogens, and are also largely related to

¹⁵⁵ Wittenberg, Rudiger and Matthew Cock, eds. *Invasive Alien Species: A Toolkit of Best Prevention and Management Practices* (Wallingford: CAB International, 2001), 51.

¹⁵⁶ *Ibid.*, 52-58.

transportation through travel (e.g. hitchhikers on planes).¹⁵⁷ After being introduced, invasive species can spread through emigration from neighboring countries, human-made structures which enhance the spread of alien species (e.g. canals which grant greater access to lake and river systems), and the human alteration of habitats and changes in agricultural practices.¹⁵⁸

Wittenberg and Cock emphasize the importance of public education and accessibility of information on invasive species as key to preventing introductions.¹⁵⁹ There are a variety of internet databases with lists of and information on invasive species, and it is vital for people to understand the laws and regulations concerning invasive species in their area, and why those regulations are in place.¹⁶⁰

While this is largely pertinent to plant species and pathogens, the authors emphasize that the interception of invasive organisms before introduction, the treatment of goods and packing material which may be contaminated with invasive organisms, and the prohibition of the shipping of some invasive organisms are essential for stopping future invasions.¹⁶¹ So, by identifying the pathways of introduction, establishing and enforcing laws and regulations regarding the introduction of invasive species, and educating people on invasive species and on the laws where they live, all parties involved can work together to prevent future introductions of invasive species.

¹⁵⁷ Ibid., 63.

¹⁵⁸ Ibid., 66-67.

¹⁵⁹ Ibid., 69.

¹⁶⁰ Ibid., 69-70.

¹⁶¹ Ibid., 68.

CONCLUSION

In this thesis, I argue that a morally relevant distinction should be made in the scholarly literature on invasive species between sentient and non-sentient members of invasive species, where sentient members of invasive species are objects of moral concern who have interests and intrinsic value, due to their capacity for self-valuation. Because of this, the management of sentient members of invasive species should consist of the implementation of the most humane possible control methods for a given situation. Typically, this will entail that lethal control methods are reserved as a last resort option, in particularly dire situations. Nonlethal control methods should be emphasized, as they are more accommodating of the *telos* of members of invasive species. Preventive methods should also be encouraged, as the prevention of introductions of invasive species is a goal which can be shared between animal ethics advocates and conservationists. However, even when lethal control is deemed to be the best possible management strategy in a given situation, it should still be carried out as humanely as possible, and in such a way that the members of the invasive species undergo a minimum of suffering.

In addition to arguing for the moral relevance of sentience in invasive species management strategies, I provide evidence that the bias that invasive species are inherently bad is unfounded. While invasive species are infamous for their contribution to biodiversity loss, in addition to much other ecological and economic damage, they can also have many positive and neutral effects, such as increasing biodiversity and often not bearing responsibility for large-scale ecological change in areas that they inhabit. Also, due to the vagueness of and disagreement over terms like “invasive,” “native,” and “non-native,” it is quite possible that available data on invasive species may not be entirely accurate. Further, the vagueness of these terms is further

evidence that we should be very careful in characterizing a species as invasive, as this often leads to the endangerment of the lives of members of those species. Taking this into account, we should develop attitudes towards and management of invasive species on a case-by-case basis, and should not hastily default to lethal control or other forms of discrimination just because a species has been characterized as invasive.

Further, I argue that it is important to consider the moral relevance of sentience in combination with the unfounded bias against invasive species. If invasive species are assessed without this bias, this may encourage the recognition of sentient members of invasive species as objects of moral concern, who are trying to fulfill their interests and express their natural behaviors, and this recognition may in turn lead to improved treatment of them. Conversely, if sentient members of invasive species are recognized as objects of moral concern, this may also aid in dissolving the unfounded negative bias against invasive species.

I address a number of objections and counter-arguments, and provide responses in defense of my thesis, arguing that the bias against invasive species is not useful, and may actually be harmful, even considering the estimated damage caused by invasive species. Further, sentient members of invasive species should be managed in such a way that their *telos* is accommodated as much as possible, and this is not contradictory with assessing invasive species on a case-by-case basis. While there are some gray areas regarding the determination of sentience, there are also many situations where a being's sentience is apparent. While non-egalitarian distribution of intrinsic value may have some advantages, it largely collapses into a view where sentience is still the main determinant of intrinsic value. Because more humane forms of control are often less cost-effective, public awareness and support of the ethics of invasive species management is very important in the actualization of the arguments in this

thesis. Finally, my continuing use of the vague and muddy terminology regarding invasive species allows for the exposure of the problems with its employment, and also allows for communication and cooperation with those who are in charge of implementing invasive species management strategies.

I close this thesis by examining different methods of lethal and nonlethal control, as well as preventive practices. Lethal control can be accomplished more or less humanely. For example, time that animals spend in traps should be held to a minimum, and killing should be as painless as possible, preferably through euthanasia. Nonlethal control, while sometimes being more cost-effective, has the advantage of usually reducing suffering to a larger degree than lethal control. I discuss immunocontraception, introduction of sterile males to a target population, and fencing as nonlethal control methods. Preventive methods emphasize the identification of pathways of introduction and vectors of spreading after introduction has occurred, implementing and enforcing legal controls regarding invasive species introduction, and educating the public on invasive species and the laws and regulations that are in place.

It is my hope that this thesis makes some relevant contribution to the understanding and awareness of the relevance of sentience in determining best possible management strategies regarding invasive species management, as well as awareness of the potential positive and neutral aspects of invasive species, which undercuts any possible foundation for the reification of invasive species as bad. This mistaken reification enforces the default attitude that we need to get rid of invasive species as quickly and efficiently as possible in all cases, regardless of sentience and any potential positive aspects of such species.