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Aldo Leopold’s Land Ethic and the Great Lakes: 
A Paradigm for Understanding the Morality of Aquatic Invasive Species Management

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Abstract: This essay explores what obligations we have to protect the Great Lakes ecosystem from the threat of aquatic invasive species within the context of Aldo Leopold’s seminal essay in environmental philosophy The Land Ethic. In this essay I argue that Leopold’s land ethic provides a consistent and dynamic paradigm for how we perceive and protect the natural environment. The land ethic is summarized in what I call Leopold’s Edict which directs us to preserve the health and beauty of the natural environment. The land ethic implies that people interested in conservation must develop a firm understanding of what is necessary by experience with nature. The experience of venturing out into the natural world allows us to enter into a relationship with the land and thereby develop sound judgment in our ecological decision-making. This judgment, the judgment that a craftsman may have is more finely tuned due to the experience. The best way to come to this level of judgment is both through an understanding of the scientific and natural history but it is also vital that an understanding of the natural aesthetics be present as we make conservation decisions. Not all invasive species will pose substantial threats and possible response will vary because ecosystems are dynamic not static. New solutions will need to be discovered, but it seems as though Leopold’s land ethic can provide a versatile framework within which to determine the best solutions. Versatility does not mean that it is adaptable to whatever moral winds seem to be blowing at the time, but rather that it will help us to discover the mean between two extremes and therefore give us a virtuous response to each new threat.

Introduction

A lot of attention has been given to the problem of aquatic invasive species within the Great Lakes basin in recent years. Many of these invasive species have been introduced into the Great Lakes accidently by commercial shipping practices such as ballast water discharge and the use of locks and canals which previously did not exist. When we examine the cost both monetary and in ecological damage to the Great Lakes ecosystem of the more than 140 species of invasive plants and animals that are present in the lakes at this time we are faced with many ethical questions. These questions and the answers we decide upon as solutions are vitally important because four of the Great Lakes contain an international boundary which means that two nations have a controlling interest in them. The Great Lakes themselves are approximately 20% of the
world’s surface fresh water supply and therefore are vital to the lives of approximately 33 million people. This is about 10% of the US population and 25% of the population of Canada. Nearly all of these people obtain their drinking water from the Great Lakes. The five Great Lakes comprise approximately 95 thousand square miles of surface area, while the entire watershed for the Great Lakes Basin is over 195 thousand square miles. Much of the industry in both the US and Canada relies upon the Great Lakes, and a seven billion dollar a year fishing industry demand their health.

In this essay I will explore the questions of what obligations we may have to protect the Great Lakes ecosystem within the context of Aldo Leopold’s seminal essay in environmental philosophy *The Land Ethic*. This essay is the capstone of his posthumously published *A Sand County Almanac*, in which he contends that we should change our relationship to the land and view the land as part of our community. In this essay I will argue that Leopold’s land ethic provides a consistent and dynamic paradigm for how we perceive and protect the natural environment. The land ethic implies that people interested in conservation as well as conservation leaders must develop a firm understanding of what is necessary by becoming immersed in a relationship with nature. I will begin by summarizing and analyzing the content of *The Land Ethic*, next I will explore what I call Leopold’s Edict. His edict asks us to understand what it means to “preserve… the integrity, stability, and beauty” of the natural environment. (Leopold 262) The final portion of this essay will be focused on ways in which the land ethic paradigm can be applied to aquatic invasive species control and management within the Great Lakes. There are times in which the best action with regard to invasive species management and control may be no action at all.
A Summary of *The Land Ethic*

Charles Starkey suggests that Leopold’s land ethic is at its root a call for a shift in thinking about the natural world. Starkey’s recent essay highlights two ubiquitous interpretations of the land ethic. He suggests that the first view sees the land ethic as expanding rather than challenging a solely economic perspective on the environment. Those who hold a solely economic perspective on the land this view the land or natural environment as something to be used for the benefit of humanity without consideration of any value the land itself may possess. Critics of the economic perspective of Leopold’s land ethic see it as ineffectual in promoting genuine public policy change, due to its focus on economic considerations alone. While the land ethic sees economic concerns as important they are; according to Leopold, only part of the criteria for deciding what actions we should take in our use and conservation of natural ecosystems. However economics cannot stand alone, it is not the only value we should consider within the decision-making process of ecosystem management. Leopold plainly states that “a land ethic cannot… prevent the alteration, management and use of [natural] ‘resources,’ but it does affirm their right to continued existence.” (Leopold 240) Viewing Leopold as someone who wishes to perpetuate economic misuse of the land is based upon a misunderstanding of the land ethic. Leopold wanted us to change our thinking and provided us with a framework for discovering how environmental protection can coexist with economic use of the land.

The second view is that the land ethic goes too far and not only ignores the economic interests but also “subordinates the welfare of humans to the good of the ecological whole… [and] is incompatible with human rights.” (Starkey 150) This view seems to have originated with Tom Regan, who called the land ethic “environmental fascism.” Regan sees the land ethic as problematic because of the difficulty of “reconciling the individualistic nature of moral rights
with the more holistic view of nature.” (Regan 361) Regan fails to take into account that a healthy environment is an important human right, and therefore it would seem that a holistic view of nature is quite compatible with individual moral rights. Leopold’s essay taken as a whole suggests that the natural environment be considered, however the land is not given a trump in the decision making process. It does not subjugate human interests to the interests of the land, rather it asks us to recognize human dependence on the land and value it for what it provides us. Put another way it asks us to consider our actions and attempt, as rational human beings, to act in a way which will provide for the continued health and existence of the land.

Charles Starkey suggests that we understand the land ethic, not as “the evolutionary development of new psychological module or capacity,” but rather as a change “in moral perspective… which evolve[s] in the sense that culture evolves.” (Starkey 160) The land ethic is dependent on our moral perspective, on what we recognize as being morally considerable. This understanding of ethics is consistent with Leopold’s suggestion that we begin to see the land as part of our moral community. It demands no evolutionary change to the structure of our brain but rather that we “recognize interdependency and internalize standards of conduct accordingly.” (Starkey 160)

Change to our perspective which would lead to a better understanding of the natural environments moral value requires a catalyst. Leopold implies throughout A Sand County Almanac that this catalyst will come through our experience with the land. This experience with the natural environment seems to be essential to developing an ethical relationship with the land. An essential component of developing an ethical relation to the land for Leopold is that we learn to love and respect the land, he writes: “It is inconceivable… that an ethical relation to the land can exist without love, respect, and admiration for the land, and a high regard for its value.”
This concept of respect and admiration for the natural environment is critical to understanding how Leopold’s land ethic is actualized. It seems obvious that our experience with the natural environment is essential to developing a deep respect for the land. It is our interaction with the land which will foster an intuitive sense of the necessity and value of the natural environment. This essentially means that we internalize standards of conduct toward the natural environment.

The internalizing of standards of conduct is analogous to becoming a master craftsman which seems to be what the ancient philosophers Plato and Aristotle saw as the way to become moral people. In Aristotle’s virtue ethics we find what seems to relate to Leopold’s view of the proper way to interact with the land. The art of acting ethically toward the land is in fact something which for Leopold actually requires development and consistent practice of interaction with the land. For Aristotle a physician must learn to understand health in order to be aware of the ideal good in his craft. Leopold seems to imply the same thing with regard to understanding the natural environment and how to maintain the health of it. Practice, study, and persistence are required to interact morally with the land, and this must be learned in the same way any craft is learned. In the crafts, the difference between an apprentice and a master is that the apprentice must consistently refer to the rules of the craft in order in order to successfully complete tasks. As an example, the rules for an apprentice physician include following of a strict diagnostic protocol. The physician uses the symptoms described to rule out commonly occurring illness and disease first. This allows an apprentice physician to treat the patient through the use of guidelines. In contrast, the master physician has so successfully and consistently internalized the guidelines and diagnostic protocol he has developed a level of judgment so keen the rules no longer concern him. The master physician begins to intuitively know the particular illness or
disease from which the patient suffers because experience has informed him certain signs are always present when the particular disease is present. The rules become intuitive to his performance of the craft and he develops an ability to project his knowledge, thought, and analysis in the practice of the craft. The rules for the master take on another role and can be considered secondary to the correct performance of the duties of the craft. The craftsman would judge when the correct action to take involves a bending, breaking or reconceptualization of the rules. For the master following a rigid set of rules which are thought to be ethical cannot lead to truly ethical behavior. For the apprentice ethical conduct begins with learning and following the rules; however in order to truly conduct oneself in an ethical manner it must become intuitive and be a natural tendency to act rightly.

Rules set the framework for developing character and judgment when we have not yet developed this character and judgment. Through the interaction with the natural environment Leopold suggests we are lead to the shift in moral perspective which Starkey argues is the thrust of Leopold’s land ethic. This shift in our moral perspective occurs because of our experience with the land. Familiarity with anything leads to a type of valuation of that object or entity. This is a common human experience, when we learn about and experience another culture or activity our perceptions often change. Someone may say they do not like Asian food until they taste Kung Pau Chicken or a spring roll. A person may say they do not like sailing, until they take an excursion cruise on Lake Huron and their perception changes. Aristotle’s ethics describe a concept of the mean, which is an action which is between excessive and deficient action, for Leopold this type of action can only occur with experience of the land which allows us to know the difference between actions which are excessive or deficient. Bill Shaw has pointed out that

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1 It should be understood that experiencing something may not lead to liking it. It could also be an affirmation of dislike, but for our purposes a positive view is sufficient.
“virtues are not the same as rules, and the person of virtue is not a mere rule follower living in blind obedience to a fixed position.” (Shaw 61) Leopold’s land ethic should not be thought of as a rigid rule which can be applied universally. Instead we should think of it as a paradigm for developing a virtuous approach to protecting the natural environment. This involves the development of a good judgment in conservation and resource management and is incumbent upon the agent interacting with the land. When we learn about and begin to understand the natural world we can no longer be apathetic toward the needs of an individual or environment.

An Analysis of Leopold’s Edict

Near the end of Leopold’s essay The Land Ethic he proffers a summary of the land ethic which highlights the important aspects of the actions that must be taken in the field of conservation. He writes, “A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.” (Leopold 262) It could be said that these two sentences are the most often quoted passage in the field of environmental philosophy. For this reason it is safe to say that Leopold is one of the most influential thinkers in conservation. A central reason for this is the edict above, which provides a paradigm within which conservation management of the natural environment can operate. Leopold’s edict directs us to preserve the integrity, stability and beauty of the natural environment. It is important to begin by understanding the terms which Leopold uses in his edict. The first term we need to understand is Leopold use of the word preservation. Environmental philosophers have argued that preservation is a somewhat misleading and unfortunate word to use in this edict because Leopold is understood to be a conservation ecologist, rather than a preservation ecologist. It seems appropriate to begin by discussing the difference between conservation and preservation
philosophies. I will then discuss in turn each of the three characteristics of the natural environment which Leopold encourages us to preserve, the integrity, stability and beauty.

Leopold’s use of the word preserve in his edict has been a source of much debate in environmental philosophy. The primary reason for this is that philosophers, naturalists and ecologist generally conceive of preservation in the sense of preserving an ecosystem in a pristine state and unchanged. This approach has often been seen as faulty because it implies a hands-off approach to resource management. News reports a number of years ago condemned such an approach when it was used in the Yellowstone National Park and hundreds of thousands of acres burned because of a hands-off fire policy. This type of preservation ecology is not found in A Sand County Almanac, instead Leopold acknowledges humanity’s right to use the land and asks that our use preserve the integrity, stability and beauty of that land. Leopold’s view is considered by many to be a conservation view that included the preservation of certain wilderness areas. He clearly seems to understand that hunting, fishing and other outdoor activities are important to the human experience, but irresponsible use of natural resources by such actions as clear cutting a forest or mountaintop removal mining would have been opposed by Leopold.

Leopold writes of a profound change which occurred in his thinking in the essay Thinking Like a Mountain. This change in his thinking moved him toward a preservation view, but most importantly it changed the way he perceived the role of human beings in relation to that land. He remained a conservationist but he no longer viewed the human relation to the land as “conqueror of the land-community [but instead as a] member and plain citizen of it.” (Leopold 240) Early in his career Leopold had been involved in a predator extermination program with the forest service in the American southwest. At the time he justified the killing of wolves, mountain lions, and bears by thinking that “fewer wolves meant more deer.” (Leopold 138) But there came a time
when he had a profound experience which made him question the correctness of the predator extermination program. He describes this profound life-changing event in the same essay. He and other forest service workers were eating lunch on a mountain when they looked down and below the rimrock saw a wolf come out of a creek and be greeted by her pups. The men then all opened up with their rifles and when they had emptied them they hiked down to the wolf Leopold describes his revelation. “We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes – something known only to her and the mountain.” (Leopold 138) He would later regret the killing of wolves because without the wolves the deer populations increased and destroyed every bit of edible foliage on trees as high as the deer could reach. Leopold would always be a sportsman enjoying the outdoors, angling and hunting, but his views changed from a completely anthropocentric utilitarian philosophy of conservation toward a view that considered the needs of other parts of the biotic community. The contrast between conservation and preservation must be stressed because Leopold chose the word preserve in his edict. However it seems clear that Leopold’s views were closer to a conservationist view.

The next aspect of Leopold’s land ethic which we must examine is the concept of integrity. Integrity can be thought of as relating to the whole. The whole may be weakened by removing a portion or part of it, but this does not necessarily happen with every loss. For example, I still have physical integrity if I get a haircut. The fact that my barber removed my hair does not in any way change the integrity of the physical me; however certain things on my body if they are removed or damaged can profoundly affect my physical integrity. For example about three years ago I broke my leg in three places in a roller skating accident and this very much weakened my physical integrity. Many of the things which I had always taken for granted
became extremely difficult or impossible to do. In the case of the natural environment I would like to suggest that we think in terms of static and dynamic integrity.

We could see integrity as being what I will call static integrity. A house may be seen as an integrated system of walls and floors, but if certain walls such as a load bearing wall are removed the entire structure may collapse. External forces in nature can alter the integrity, such as a hurricane or tornado which weakens or destroys the house. But normal interaction with the wind and rain will only produce small changes, these small changes do not alter nor do they normally have the potential to alter radically the physical integrity of the structure. Static integrity seems to relate most directly to nonliving things and therefore we see it primarily in relation to man-made objects or nonliving entities in the natural environment such as rocks.

Our conceptualization of integrity within the processes of the natural environment can be through what I call dynamic integrity. Ecosystems are continually involved in geological as well as biological changes. Because ecosystems are constantly in a state of change, the preservation of the system becomes complicated because as Callicott puts it, “conservation must aim at a moving target.” (Callicott 369, 1996) He suggests, rightly I think, that the very idea of conservation when applied to commonly accepted understandings of the terms integrity and stability actually seem to suggest “arresting change.” (Callicott 369, 1996) Arresting change is a complex issue in a dynamic ecosystem and requires an understanding that some change is necessary and our attempts to arrest change must allow natural and normal change and prevent harmful changes. Dynamic integrity can be protected by recognizing that changes occur within an acceptable range. Changes from evolutionary forces and the processes of natural selection constantly affect a natural ecosystem, but these changes are most often small and take place

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2 Static integrity seems to be rather complicated when it relates to the natural environment. Geological changes may also alter the integrity of an ecosystem. But insofar as a primary concern in environmental ethics seems to be with protecting plant and animal life I make the distinction, understanding it may not be a perfect division.
slowly. The problem arises when human agents introduce radical changes through the use of technological advances and machinery. As Leopold points out “man’s invention of tools has enabled him to make changes of unprecedented violence, rapidity and scope.” (Leopold 254)

Integrity may be seen as strength with cohesiveness, the ability to hold together to remain strong. Dynamic integrity requires that the cohesiveness of an ecosystem be maintained while recognizing that certain changes will and must occur. These minute changes are part of the cohesiveness of the system.

Like integrity, stability also relates to the health of an ecosystem, because both have a correlation to strength. Stability and integrity seem to be synonymous and this complicates an analysis of Leopold’s thought. However I think that we can conceptualize stability as being strength with persistence, the ability to maintain strength in the face of challenges. Stability is directly related to the health of an ecosystem, as is integrity, but because change occurs naturally within ecosystems it is necessary to view stability as being dynamic as well. Sven Ove Hansson and Gert Helgesson, who conducted an extensive review of literature relating to the concept of stability, discovered that stability is usually used to mean constancy, robustness, and/or resilience. I would like to use this paradigm of common usage of the word stability to frame our discussion of stability as it relates to Leopold’s edict, with one minor change. They define constancy as a “lack of change during some period of time.” (Hansson-Helgesson 223) However if we define stability as constancy, I think that we will have a difficult time applying it to ecosystem conservation, because preserving constancy seems to fly in the face of what conservation is attempting to accomplish in dynamic ecosystems. Therefore I propose that we change constancy to equilibrium and understand stability as equilibrium, robustness, and resilience. Equilibrium within an ecosystem can be understood as being dynamic processes
which maintain a sort of balance. This balance does not necessarily require that individual parts of the ecosystem be maintained, they are parts of the process but do not need to remain unchanged themselves. Hansson and Helgesson suggest later in their essay that stability and equilibrium can be understood to mean nearly the same thing and suggest that equilibrium is a balance between opposing forces. Equilibrium means for the purposes of understanding our obligation to protect the Great Lakes ecosystem, that we understand and maintain the balance of the system within acceptable limits.

Robustness, as it pertains to the health of a particular ecosystem means its ability to remain healthy in the face of assault by outside forces. In the Great Lakes these assaults could be from aquatic invasive species such as Asian Carp and the Sea Lamprey. While it is true that these two invasive species may only affect the fauna of the Great Lakes it is possible that their feeding habits may ultimately have a detrimental effect on the robustness of the ecosystem itself. If this occurs it would make the ecosystem less capable of fending off assaults from future threats. Therefore an important component of preserving the stability of an ecosystem seems to be the protection of the system’s ability to protect itself from external assaults. If we think in terms of our own physical bodies we can understand robustness as the ability to resist disease. We are daily exposed to numerous germs and viruses for which our bodies have built up immunity and because of this we do not become sick. This ability to be exposed to a certain virus and avoid infection is the very picture of robustness. Healthcare workers are often substantially better at staying healthy when viruses are going around because in their employment they encounter many different viruses and the body builds antibodies to counter these, thus building immunity.

Resilience within an ecosystem means that the ecosystem can recover from damage caused by assaults and return to a stable state. In some respects this seems difficult to separate
from the robustness component of stability preservation and in fact may rely very much upon the robustness within an ecosystem. Resilience can be illustrated by thinking of a floating toy that a child may play with in a swimming pool. The toy is buoyant and naturally floats but the child takes hold of it, pushes it under water, and stands on it. The toy however struggles toward the surface and at the first sign of weakness or inattentiveness in the child it rapidly rebounds and returns to the surface. This concept can also be illustrated through the use of the human body. As I discussed with robustness above, resilience relates to health as well; however in the case of resilience the body is exposed to a virus it has no immunity to and because the body is healthy it quickly recovers. This is the aspect of stability we will call resilience. Stability requires that equilibrium, robustness and resilience be understood and preserved in a conservation paradigm.

The third thing we are to attend to in Leopold’s edict is the preservation of beauty. Leopold certainly understood that the aesthetic pleasure of the natural environment was of immeasurable value. He even prefaced his famous edict by suggesting that each question regarding how we ought to act toward the environment should be weighed by its rightness ethically as well as aesthetically. Leopold’s natural aesthetics are described and collated by J. Baird Callicott in his essay The Land Aesthetic. In this essay Callicott makes two distinctions in regard to aesthetics, that there are natural aesthetics and artifactual aesthetics. The artifactual aesthetics are those that Western Philosophy clearly emphasizes, while natural aesthetics seem to be almost overlooked. Callicott points out that while reading A Sand County Almanac you will be confronted with many instances where Leopold comments about the beauty of nature or how it is significant to the human experience: Stephen Kellert has this to say about why we ought to understand beauty in nature:
A recognition of beauty in nature… can engender an enhanced awareness and understanding of harmony, balance, and grace. People discern unity and order in certain natural features, and in the process, these aesthetic expressions inspire and instruct. Natural beauty and symmetry functions like a quasi-design model, where grasping the prototype people capture analogous potential for excellence and refinement in their own lives. (Kellert 10)

Kellert concludes the portion of his essay which deals with the aesthetic in a manner with which I think that Leopold would agree, by positing that the aesthetic affinity for nature gives birth to wonder which can be the catalyst for encouraging human exploration and study of the natural world. This wonder and the understanding of the natural world through the relationship we are able to develop with the land through outdoor activities are important for learning how to interact ethically with the environment. The application of Leopold’s land ethic to the environmental problems is, I think, an effective way to find solutions. Understanding how the health and beauty of an ecosystem relate to its continued ability to support both the human species and the numerous species of flora and fauna which inhabit our natural environment is important. The integrity, stability and beauty are where we need to look to aid us in discovering the right action.

Aquatic Invasive Species Management and Control

The control and management of aquatic invasive species on the Great Lakes raises complex moral problems. Some of these stem from the knowledge we have of the Great Lakes themselves, we simply are not completely aware of what has been here from the end of the last Ice Age and what has been introduced since that time. Because the Great Lakes are only about 10,000 years old, it may be that all species could be classified as non-native. There are some species that we are aware of being introduced after colonization by Western Europeans. For example the Sea Lamprey, a parasitic fish, was native to Lake Ontario and the eastern seaboard
before it was introduced into the upper Great Lakes following the opening of the Welland Canal between Lake Ontario and Lake Erie. The Sea lamprey has had a devastating effect on the integrity and stability of the game fish populations since its introduction into the upper Great Lakes. Commercial lake trout fisheries were destroyed by the Sea Lamprey and have never recovered. They are one of the reasons cited that the Lake Trout has not successfully recovered directly altering the stability and integrity that Leopold saw as so important in ecology. When the Lake Trout populations became depleted it allowed the Burbot, a freshwater codfish to increase in population. Some scientists are concerned that a significant factor in the difficulty in reestablishing breeding populations of Lake Trout is that the Burbot has taken over the spawning grounds of the Lake Trout in the Grey’s Reef area and the Beaver Island archipelago in Northern Lake Michigan.

In order to effectively respond to threats to the integrity, stability and beauty of the Great Lakes ecosystem we must have an appropriate and effective paradigm within which we can work. Leopold’s land ethic provides us with advice on the management of invasive species and our response, which is done within the boundaries of preserving the health and beauty of the natural environment. It is clear that he recognized that non-native flora and fauna could pose a threat:

In the world-wide pooling of faunas and floras, some species get out of bounds as pests and diseases, others are extinguished. Such effects are seldom intended or foreseen; they represent unpredicted and often untraceable readjustments in the structure. (Leopold 254)

As Leopold points out the readjustments are often untraceable and this results in a sort of tail chasing model in invasive species control and management. In spite of the difficulties involved in aquatic invasive species management and control, Leopold asks us to consider two
questions: (1) “Can the [ecosystem] adjust itself to the new order?” (2) “Can the desired alterations be accomplished with less violence?” These questions must be asked within the context of Leopold’s edict, when we take action against invasive species, will our actions preserve the health and beauty of the ecosystem. If the actions we propose will not tend to preserve the health and beauty we have to ask if other actions may be more appropriate. In attempting to manage or control aquatic invasive species we must understand that this pertain to both the conservation of an ecosystem, as well as efforts to restore an ecosystem, such as the stocking of Lake Trout in an effort to restore the system. But any action taken can have other effects some of which may take years to materialize. And there may actually be cases where the non-native species should not be considered a threat at all.

There are a couple of ways to understand this first, that it may be the case that ecologists really cannot know from the outset what an invasive species will do to the present populations of native species. And second we cannot actually know whether or not any supposed or projected effect is actually going to be a bad thing. Mark Sagoff uses an analogy to human immigration and points out that a person may be “no good and an immigrant [but] it does not follow that he or she is no good because an immigrant.” (Sagoff 98) Leopold also points out that change, such as the change from invasive or nonnative species “does not necessarily obstruct” the natural processes of an ecosystem. (254) According to Leopold some species may have a natural resistance to perturbations. Therefore it seems relevant to note that nonnative species may simply establish themselves and live average lives in their new home range. In much the same manner as human immigrants often move into a neighborhood and assimilate into that environment without radically altering the norms of the community. The same can be said for nonnative flora and fauna, which in fact provides much of the North American agriculture and
aquaculture needs. It may be that some species do not pose quite the threat to the integrity and stability of the ecosystem that we may think. Some of our reaction may be emotional rather than rational. This seems to be happening in the case of the Asian Carp.

The story of the arrival of the Asian Carp into the Mississippi River basin has been told by fish biologist Zeb Hogan: “A fish farmer imported bighead and silver carp from China in the early 1970s. He gave them to researchers who stocked them in sewage lagoons to see if the carp would eat the algae and keep the lagoons clear.” (Flying Carp) The Asian Carp have multiplied rapidly since their unintentional release into the Mississippi River system during the 1993 floods. Dr. Alan Steinman, Director of Grand Valley State University’s Annis Water Resources Institute said in a recent interview with WOOD TV-8, a local West Michigan NBC affiliate, that the Asian Carp are getting the media attention “because [they are] big, people can see [them]. And… it jumps. So it’s got charisma in that sense.” (Steinman) In spite of the media sensationalism the most significant thing we have to realize from an ethical standpoint is that scientists do not know exactly what the Asian Carp will do if it enters the Great Lakes. There is some evidence which indicates the threat they pose may be far less than the media has suggested. In 2009 it was reported that in the Missouri River system, Silver Carp were starving due to decreases in zooplankton. (Wade) This seems to indicate that something which is vitally important to the survival of the Asian Carp, namely food, may threaten their ability to survive within the Great Lakes ecosystem. The Asian Carp is a filter feeder and this method of gaining nutrients for their bodies requires that nutrient levels in their environment are capable of supporting large population of plankton. It is important to note that Limnologists classify lakes and rivers based on the body of water’s nutrient level. The Great Lakes are classified as
oligotrophic\(^3\); because of this they cannot support the levels of plankton which would be needed to supply food for the Asian Carp. The Missouri, Mississippi and Illinois Rivers are eutrophic and if the Silver Carp in the Missouri River were so numerous that they were starving because they have attained their highest possible population levels and have depleted there food source to such a degree I question whether the threat posed by Asian Carp is acute or if the seriousness of the threat has been overblown. It is interesting to note that the current nutrient levels in the Great Lakes are lower due to other aquatic invasive species which are also filter feeders, namely the Zebra and Quagga Mussels. These invasive mussels may have actually contributed to the creation of an environment which does not have the required nutrients to provide a viable source of food for the Asian Carp. The nutrient level of the Great Lakes relates to their robustness in that they may not provide a hospitable environment for the Asian Carp and therefore may ward off the threat.

The Asian Carp are not the only aquatic invasive species which threaten the Great Lakes ecosystem. There are numerous other invasive species that are already established in the Great Lakes ecosystem. Each of these is established and successfully reproducing, in addition to not being present in the Great Lakes before the beginning of the 19\(^{th}\) Century. The invasive species present in the Great Lakes ecosystem come from eight different geographic regions of the world with the most prevalent being from Europe, Asia and the Atlantic Coast. (Mills ET. Al. & GLIN) Some of these species have had more of an impact than others and it may be that as Sagoff suggested there is no real need for alarm. Certainly Zebra and Quagga Mussels have been costly, fouling cooling water intakes of power plants and the hulls of recreational and commercial

\(^3\) Limnologists use oligotrophic, mesotrophic and eutrophic to classify bodies of water by their nutrient level. Oligotrophic lakes and rivers are low in nutrient levels, mesotrophic are medium nutrient levels, and eutrophic lakes and rivers are high in nutrient levels. These classifications are determined by clarity of the water when a Secchia disk is lowered into the water.
vessels. Oddly however the Zebra and Quagga Mussels were instrumental in the recovery of Lake Erie during the last four decades, as filter feeders they helped restore Lake Erie to an oligotrophic state which has resulted in increased healthy populations of popular game fish in Lake Erie. And, as I mentioned above, also may be instrumental in preventing the establishment of Asian Carp within the Great Lakes.

The Sea Lamprey, a parasitic fish native to the Atlantic, also effects native lake trout and whitefish populations in the Great Lakes. Sea Lamprey entered the Great Lakes through the St. Lawrence River and they were found in Lake Ontario in the 1830’s. With the opening of the Welland Canal connecting Lake Ontario to Lake Erie they were able to migrate to the upper Great Lakes. Prior to that Niagara Falls had served as a natural barrier to their migration. The Great Lakes Fishery Commission is currently involved in Sea Lamprey control on the Great Lakes. Control methods include the use of lampricide to kill Sea Lamprey larvae in their spawn stream. The lampricide has little or no affect on other fish species and is considered to be safe. Other methods that have proved effective in controlling Sea Lamprey have been barriers in spawning streams, releasing sterile males, and trapping. “Sea Lamprey control in the Great Lakes has been tremendously successful. Ongoing control efforts have resulted in a 90% reduction of Sea Lamprey populations in most areas, creating a healthy environment for fish survival and spawning.” (Sea Lamprey) Between five to ten million dollars are spent every year to control Sea Lamprey and stock Lake Trout in the Great Lakes.

While the issue of invasive species control is complex – it does seem to be something we can understand through the paradigm of Leopold’s land ethic. The land ethic asks us to consider the possible changes that an invasive or non-native species may make to the environment. But it also seems show us a way to approach it rationally. If the possibility exists that a non-native
species will not be able to become established in a particular ecosystem then our response can be minimal or nonexistent. Asking ourselves questions like the ones Leopold suggests aids in our discovery of priorities. Can the ecosystem adjust itself to the presence of this species? Can it do so without detrimental effects to other biota within the system? Will the health and beauty of the system be affected? It is important for us to understand that Leopold’s land ethic provides a framework within which we can decide upon the best conservation actions. Basic virtues, public policy issues and economic realities play a part in our conservation decisions, but it can also help to understand that ecosystems can be admitted into our moral community. With that it will also benefit us to realize that sometimes the health and beauty of the ecosystem may not be threatened. As with anything else, one tool is useful but it cannot complete the entire project. Leopold’s land ethic can thus be compared to a blueprint, you cannot build a house with a blueprint alone other tools will have to be employed. The land ethic is simply a plan a way to frame the problem and determine the appropriate action to take.

**Conclusion**

Unfortunately there are no easy answers to the threats facing the Great Lakes from aquatic invasive species, but we do need a paradigm for evaluating the morality of the conservation actions we take. The Great Lakes are certainly an ecosystem worth preserving, because of their value to the economic lives of much of the population of two nations, as well as their aesthetic value to many people. But the clear and concise answers as to the best ways to accomplish that preservation or conservation still seem to be lacking. Because ecosystems are dynamic and one change can have affects which we do not see or understand for years to come our actions must always be carefully considered. In this essay I have considered the ever-changing nature of the Great Lakes ecosystem and have highlighted that this dynamic factor of
the Great Lakes ecosystem is something which complicates the processes and planning in conservation management. The land ethic seems to provide the best answer to the problems faced by conservationists, naturalists, and ecologists in trying to preserve this vital resource. The land ethic suggests the development of a judgment concerning the proper actions to take in our conservation management efforts. This judgment seems to be developed through interaction and relationship with the natural environment.

It is certain that at least one portion of Leopold’s land ethic should be very helpful to us and that is his insistence on personal experience and knowledge in the natural environment. Once an individual has developed an understanding of the natural environment in a scientific and ecological sense, and developed an appreciation for its natural history it seems that it will be easier for them to make appropriate decisions regarding the preservation of the integrity, stability and beauty of natural ecosystems. The experience of venturing out into the natural world allows us to enter into a relationship with the land and thereby develop sound judgment in our ecological decisions making. This judgment, the judgment that a craftsman may have is more finely tuned due to the experience. The best way to come to this level of judgment is both through an understanding of the scientific and natural history but it is also vital that an understanding of the natural aesthetics be present as we make conservation decisions. Answers to the questions we face in an effort to protect the Great Lakes are always going to be difficult to discover and it seems at times that the solutions we propose are not acceptable. The potential threat posed by some invasive species will likely present us with serious dilemmas in the future, and it will be necessary to evaluate each threat to the Great Lakes individually. New solutions will need to be discovered, but it seems as though Leopold’s land ethic can provide a versatile framework within which to determine the best solutions. Versatility does not mean that it is
adaptable to whatever moral winds seem to be blowing at the time, but rather that it will help us to discover the mean between two extremes and therefore give us a virtuous response to each new threat.
Bibliography and Works Cited


