




The Invasive Species Diet: The Ethics of Eating Lionfish as a Wildlife Management Strategy

Samantha Noll^a and Brittany Davis ^b

^aSchool of Politics, Philosophy, and Public Affairs, Washington State University, Pullman, DC, USA;

^bDepartment of Environmental Science, Allegheny College, Meadville, PA, USA

ABSTRACT



This paper explores the ethical dimensions of lionfish removal and provides an argument supporting hunting lionfish for consumption. Lionfish are an invasive species found around the world. Their presence has fueled management strategies that predominantly rely on promoting human predation and consumption. We apply rights-based ethics, utilitarian ethics, and ecocentric environmental ethics to the question of whether hunting and eating lionfish is ethical. After applying these perspectives, we argue that, from a utilitarian perspective, lionfish should be culled. Rights-based ethics, on the other hand, are not applicable in this case, while ecocentric environmental ethics would support lionfish removal.

KEYWORDS

Lionfish; fishing; environmental ethics; animal ethics; wildlife management; fisheries

Throughout the Caribbean and western Atlantic, governments, fishers, and marine resource managers have been on high alert as they waited for and then managed the arrival of two invasive fish, the Red Lionfish (*Pterois volitans*) and Devil Firefish (*Pterois miles*), collectively referred to hereafter as lionfish. Once detected, efforts to remove them began immediately, with an initial focus on eradicating them before they could become established. Unfortunately, such efforts failed for reasons discussed below. Nevertheless, their presence has fueled management strategies which rely heavily on promoting human predation and consumption due to the absence of natural predators in the region. Concerted efforts, such as Florida's statewide annual Lionfish Removal and Awareness Day which began in 2015, are undertaken to promote capturing lionfish, raise awareness about their existence and deleterious effects, and showcase their appetizing qualities, all while removing thousands of lionfish from an area's waters in a day or weekend. While the biological and ecological effects of these removals have been studied, thus far the ethical concerns of targeted lionfish removals and the question of whether these efforts violate the rights of lionfish have gone unexamined.

In this paper, we first provide an overview of the current dilemmas we face due to lionfish. We then explore how utilitarian ethics, rights-based ethics, and ecocentric environmental ethics answer the following question: Is the promotion of hunting and eating invasive species an ethical approach to addressing the problem of lionfish, in particular, and invasive species, in general? We chose these three specific frameworks for

CONTACT Samantha Noll  sam.noll@wsu.edu  School of Politics, Philosophy, and Public Affairs, Washington State University, Pullman, DC, USA

two reasons. First, these perspectives play an increasingly important role in wildlife management, as they capture values that guide discussions concerning what constitutes acceptable animal use (Gamborg et al., 2012). Second, utilitarian and rights-based ethics also play an important role in food ethics (Barnhill et al., 2016; Frey & Pirscher, 2018; Thompson, 2015, 1997). As dietary management strategies will only be successful if people are willing to eat the invasive species, these positions help to flesh out potential problems that may arise concerning consumption. After applying these perspectives, we argue that, from a utilitarian perspective, lionfish should be culled, though we acknowledge that this position largely supports adopting a vegetarian diet in most circumstances other than invasive species management (Singer, 2015). Rights-based ethics, on the other hand, are not applicable in this case, while ecocentric environmental ethics would support lionfish removal. We end by identifying and addressing concerns that should be considered before adopting dietary focused wildlife management strategies. It should be noted that, while we hope that this paper will contribute to the wider discussion concerning dietary focused wildlife management strategies, we do not argue that eating all invasive species is ethical. Our analysis specifically supports lionfish culling, not the adoption of dietary focused policies for all invasive species.

Case Study

Lionfish are native to the Indo-Pacific but were first sighted in the western Atlantic in October 1985 (Schofield, 2009). Despite a popular story that they were released during Hurricane Andrew in 1992, the most likely source of the invasion is an accidental or intentional release from an aquarium later in the decade (Betancur-R et al., 2011; Whitfield et al., 2002). There were sporadic lionfish sightings in the late 1990s in the western Atlantic. However, by 2002, lionfish had spread rapidly and were largely distributed continuously from Miami, Florida to Cape Hatteras, North Carolina on the U.S. Atlantic coast (Schofield, 2009). Lionfish are the first marine fish from the Pacific to be successfully introduced to the western Atlantic and are the first non-native marine fish to become established in the region (Schofield, 2009; Whitfield et al., 2002). They have since spread rapidly via ocean currents and, by 2007, were found in the entire Caribbean and Gulf of Mexico in all major habitat types and from sea level to depths of 300 meters (Albins, 2013; Johnston & Purkis, 2015; Morris, 2012).[1] In May 2014, the first lionfish sighting in Brazil was recorded approximately 5,500 kilometers from the Caribbean (Ferreira et al., 2015). Since being introduced, lionfish are the first marine fish in the region to become invasive (Albins & Hixon, 2013), meaning that they are a species "whose introduction does or is likely to cause economic or environmental harm or harm to human health" (Beck et al. 2008, p. 414).

Several characteristics facilitated the rapid invasion of the western Atlantic, Caribbean, and Gulf of Mexico by lionfish. Lionfish are generalist carnivores with a broad diet primarily consisting of a variety of small crustaceans and small-bodied reef fishes (Morris, 2012; Sancho et al., 2018). They are efficient predators because of the variety and uniqueness of their hunting tactics which are unlike those used by other predators in the region (Albins & Hixon, 2013; Côté & Maljković, 2010; Morris, 2012). They also lack predators to control their population (Whitfield et al., 2002). In addition, lionfish reach sexual maturity in under a year, are capable of nearly continuous reproduction (as often as

every 2–3 days), and release 1,800 to 40,000 eggs per event (Côté et al., 2013; Gardner et al., 2015; Morris, 2012). Rapid reproduction, the absence of predators, and the ability to survive in a broad range of ecological niches are characteristics of an invasive species.

Lionfish present a problem for the estuarine and marine ecosystems of the invasive range. Research shows invasive lionfish have a higher prey consumption rate and grow 1.25 to 2.25 times faster than in their native range (Côté & Maljković, 2010; Pusack et al., 2016). Analysis of their stomach contents in the Bahamas finds that small-bodied reef fishes from 42 species comprised 90% of the prey consumed and that the combined biomass of these species declined by an average of 65% on the studied reefs (Green et al., 2012). Lionfish also cause significantly larger reductions in the abundance of small native fish than similarly sized native predators (Albins, 2013). This diet places them in competition for prey with commercially-important species such as groupers and snappers (Sancho et al., 2018). Thus, their predation has the potential for devastating effects on native fishes, which are already stressed by pollution, climate change, and other factors.

To combat and control their spread, biologists have focused on targeted removals of lionfish, also known as culling. Targeted removal can be both a cost-effective and viable management strategy, particularly with the involvement of recreational and professional scuba divers who go out and spear individual fish (Barbour et al., 2011; Chapman et al., 2016; de León et al., 2013). Studies investigating the efficacy of infrequent culling events find they can significantly reduce lionfish density (Smith et al., 2017) but that such culls may not be effective over longer time spans (Johnston & Purkis, 2015). Research on culling has been used to develop step-by-step frameworks for managers to follow and to remind managers to develop reasonable, measurable goals for lionfish removal (Barbour et al., 2011; Usseglio et al., 2017). Despite these efforts, deepwater refugia, the number of areas where lionfish have become established, the lack of resources for frequent intense culling, and the ability of lionfish to quickly recover make it unlikely that population control through humans will be successful (Smith et al., 2017; Albins & Hixon, 2013; ; Barbour et al., 2011). Albins and Hixon (2013) conclude that successful control of the lionfish invasion will require biotic resistance, such as predation by native species. However, as targeted removal can significantly reduce lionfish density, the promotion of culling could play an important role in managing populations until such biotic resistance can be established. If this cannot be done, then reducing lionfish populations may become a permanent fixture of any long-term management strategy aimed at helping the ecosystem recover.

Concerted efforts to promote lionfish capture exist at the international, national, and state level. A few examples are illustrative. Internationally, the Professional Association of Dive Instructors (PADI) has joined the effort with its Invasive Lionfish Tracker distinctive specialty course, which focuses on teaching divers ‘what action is needed to control the lionfish population’ and ‘practical ways to safely and humanely capture and euthanize these fish’ (PADI, 2019). Belize formalized its lionfish management plan in 2012 and a regional lionfish control strategy for the Mesoamerican Reef, which spans from Mexico to Honduras, was published in 2014 (Chapman et al., 2016; Rodriguez et al., 2014). The Florida Fish and Wildlife Commission offers several programs including the Lionfish Charter Harvest Reimbursement Program, which aims to incentivize dive charter businesses to offer lionfish-focused harvesting trips by reimbursing them USD\$50 per diver, and the Lionfish Incentive Challenge, which offers tiered rewards based on the

number of lionfish caught (Florida Fish and Wildlife Conservation Commission 2019). In 2018, Alabama held its first ever lionfish tournament with a USD\$1000 first place prize (Moseley, 2018).

The abundant supply of lionfish and desire to minimize their effects on native fishes have led to the promotion of lionfish consumption throughout the Caribbean and Gulf of Mexico. Its mild, flaky texture and lack of a 'fishy' taste make it appealing to many (Reef, n. d.) . They require careful preparation as the venomous spines on their dorsal, anal, and pelvic fins (up to 18 in total) are typically removed prior to filleting the fish (Florida Fish and Wildlife Conservation Commission 2019). At lionfish events, attendees are encouraged to sample dishes such as lionfish ceviche or lionfish nuggets. These samples are intended to 'give the public a chance to see how delicious lionfish are and encourage the consumption of lionfish in local restaurants' (REEF, n.d.).

Such efforts to promote lionfish consumption appear to be working. Researchers have noted that restaurants offer lionfish as a conservation-minded option (Albins & Hixon, 2013) and websites such as Lionfish Hunting offer a list of restaurants serving lionfish (<https://lionfish.co/eat-lionfish-here/>).¹ A growing appetite for lionfish fillets has led to a sharp decrease in lionfish sightings in Jamaica (Jamaica Observer, 2014). Similarly, demand for lionfish has exceeded supply in Belize due to initiatives raising people's awareness (Chapman et al., 2016). Consequently, increased desire for lionfish could shift consumption away from other, threatened species, promoting both the population reduction of an invasive species and the conservation of groupers and snappers in the region. Yet, caution is needed with this approach, there are several concerns that need to be considered before adopting dietary focused wildlife management strategies, especially when invasive species become an economic resource (Nunez et al., 2012). For example, development of fisheries targeting lionfish may have the unintended effect of shifting the focus from keeping lionfish populations low to keeping them at the levels needed for harvesting to continue (Andradi-Brown et al., 2017). These will be discussed more fully after applying ethical frameworks to the case.

Ethical Frameworks

We will be utilizing three prominent ethical frameworks in our analysis, with the caveat that we know there are many more. The first two are prominent approaches in both food and animal ethics, or those that guide discussions concerning animal consumption. This is a key component of the analysis, as the success of eating lionfish as a management strategy is dependent on whether people will eat them. In fact, several literatures highlight a clear connection between animal ethics and food choice. According to a study by Hölker et al. (2019), 'the most frequently reported motivations for a meat-reduced or meat-free diet are ethical concerns about animal welfare' (p. 1). The connection between animal ethics and food choice (as catalysts for reducing meat consumption and preference animal husbandry practices, for meat eaters) is well established in the current literature on consumer choice (see Bennett et al., 2002; Napolitano et al., 2008). Frey and Pirscher (2018) go so far as to argue that deontology, utilitarianism, and a mixture of the two approaches play an important role in motivating the willingness to pay more to support higher welfare standards in production systems. Additionally, philosophers such as Thompson (1997) and Lamey (2008), place particular importance on utilitarian and

rights-based approaches in philosophy of food. As such, these two approaches will largely make up the animal ethics position in this paper, though it is important to note that this application is only intended to be the beginning of philosophical work on lionfish. In addition to these individual focused ethics, we will also apply wildlife management strategies grounded in ecocentrism to the question of lionfish consumption, as removals are part of larger regional conservation plans. In this vein, our general goals for the paper include: a) adding to the literature exploring the strengths and weaknesses of these positions in application; b) marshaling ethical theories to provide support for eating lionfish as a management strategy; and c) addressing dietary focused concerns, as both utilitarian and rights-based ethics have been used to support vegetarianism.

In addition, the field of animal ethics primarily focuses on determining what ethical duties we have toward non-human others (Garett 2012). This work can take on several forms, with philosophers providing both indirect and direct theories, or those that deny animals moral status, and yet require humane treatment (indirect theories) and those that place animals firmly in the moral sphere (direct theories). Applying specific ethical frameworks, such as rights-based approaches (Regan, 1985, 1995), Kantianism (Korsgaard, 2018), and utilitarianism (Singer, 2015), to the question of the animal is a popular strategy for philosophers crafting both types of theories (Oliver 2009). Such work, especially in animal liberation and animal rights circles, has been highly influential beyond the academy (Petrus and Wild 2013). In *Ethics of What We Eat: Why Our Food Choices Matter*, Singer and Mason (2007) utilize a utilitarian argument to try to convince readers that adopting a vegetarian lifestyle is the ethical course of action to take. Similarly, Regan in *Empty Cages: Facing the Challenge of Animal Rights* (Regan, 2005) uses graphic case studies and rights-based arguments to the same end. According to Thompson (1997), these pieces and earlier work by Regan and Singer ‘spawned the present philosophical literature on animal welfare, animal rights and animal liberation’ (p. 7) and we would add the current popular work on animal ethics and dietetics. Due to the importance of this work, we begin our analysis by exploring how the animal ethics of Singer and Regan could be applied to the lionfish dilemma above.

Singer’s Animal Ethic

It is not surprising that Singer’s work helped to spark public discourse concerning the moral status of animals (Thompson, 1997), and food choices, more specifically, as he has a talent for galvanizing a wide audience with his arguments. In particular, his work on animal ethics can be understood to include two parts. In the first section of *Animal Liberation*, Singer (2015) provides justification for placing non-human others within the moral sphere. To ignore a species’ suffering based on species membership violates his principle of equality and is, therefore, speciesism, or discrimination based on species membership. If a being suffers, it has an interest to end that suffering. Therefore, Singer contends all beings who suffer have interests and thus we should recognize those interests. Second, he argues that when determining how we should treat other animals, whether cats or lionfish, we should use a utilitarian calculus – that is, follow the principle of utility – to help us weigh the benefits and harms of specific actions in order to determine what constitutes the best action. While this is a simplistic overview of Singer’s work, it illustrates key features of his animal ethic and illustrates how Singer

both crafts a direct theory placing animals in the moral sphere and grounds this theory in utilitarianism. Utilizing this framework, lionfish would be placed in the moral sphere and their interests would be weighed against the like interests of other impacted parties, such as the small reef fishes on which they predate and groupers and snappers with which they compete for food. Thus, it appears that Singer's animal ethic would place the determination of right action firmly in the realm of calculations of costs and benefits or benefits and harms. When we weigh the 65% loss of biomass of small reef fishes which lionfish consume (Green et al., 2012), against the pleasure of the smaller number of lionfish, one could justify culling this invasive species from a utilitarian perspective.

This position is further reinforced when you factor into account how Singer values individuals in his animal ethics approach. In particular, the value of individuals in themselves, irrespective of mental states, is not important. Rather, the mental states caused by actions, or the pleasures and pains beings experience, are the ethically important aspect of moral entities (Korsgaard, 2011; Regan, 2005). How he values life forms the impetus for Singer's view on the 'replaceability' of individuals. The result is that Singer's utilitarian ethic allows lives to be traded against one another. According to Kemmerer (2007), Singer's "replaceability argument' permits killing animals (human or otherwise) that have no conception of themselves as existing in the future, provided such individuals lead a pleasant life beforehand, are killed painlessly, and are replaced by beings that will have equally pleasant lives' (p. 2). While this position may seem at odds with his larger animal ethic, Singer argues that replacing less satisfied or successful individuals would help maximize the 'overall satisfaction of interests' within a group (p. 2). According to Lockwood (1979), Jamieson (1983), and Miguel (2016), the replaceability argument pushes us to consider morally problematic possibilities. For example, Lockwood argues that this principle would allow us to painlessly kill puppies when they have grown beyond the puppy stage or when the owner is no longer interested in the dog, as then the owners can get a new cute puppy and thus increase their overall pleasure or satisfaction. Applied to hunting, one could argue harvesting animals, such as deer, geese, and lionfish, is ethical as long as the individual entities are replaced. Accordingly, waterfowling is ethical if the geese harvested are replaced by other geese. When we apply this principle to lionfish in particular, one could further argue that since lionfish reach sexual maturity in under a year and reproduce at high rates, removing mature lionfish from the ecosystem would be acceptable because they are already being replaced.²

However, applying Singer's (2015) work to questions concerning invasive species management could also be problematic, as utilitarianism has been used to support adopting a meat free diet. Singer himself endorses vegetarianism in his work. Specifically, he states that he is a vegetarian because he is a utilitarian, which stands in contrast to the above calculus. Singer writes the following

"For the great majority of human beings ... the most direct form of contact with members of other species is at mealtimes: we eat them. In doing so we treat them purely as a means to our ends ... There can be no defense of eating flesh in terms of satisfying nutritional needs, since it has been established beyond doubt that we could satisfy our need for protein and other essential nutrients far more efficiently with a diet that replaced animal flesh by soy beans, or products derived from soy beans, and other high-protein vegetable products."

While Singer's animal ethic could be used to justify meat eating in certain circumstances (such as when the benefits of eating the animal outweigh the harms), vegetarianism is the ethical action for the majority of those living in the industrialized world. In such places where food is abundant, dietary choices largely come down to nutrition and taste. As nutritional requirements can be met without meat and taste is a preference, the benefits we gain from eating meat clearly do not justify the harm caused during the raising and harvesting of food animals. This is the justification behind Singer's statement that he is a vegetarian because he is a utilitarian.

By extension, Singer's (2015) animal ethic could also be used to justify a mandate against hunting and fishing unless the suffering caused to the harvested animal is outweighed by the benefits of such harvesting. Singer's application of utilitarianism requires that we balance the trade-offs between pleasure and pain equally between all beings that would be impacted by the action in question. What this means on the ground is that a person's or group's pleasures cannot come at the expense of another group's or entity's suffering, unless the pleasures or benefits outweigh this pain.

In most circumstances, the pleasure of eating a fish taken from a healthy environment would not outweigh the pain caused during fishing. However, we argue that the pleasure caused by removing and eating lionfish taken from their invasive range *would* outweigh the pain caused during removal. First, Singer's (2015) 'replaceability argument' could be used to support the removal of lionfish (irrespective of if we eat them), as their high reproductive rate insures that harvested fish are replaced. But it should be noted here that Singer himself is still grappling with the implications of the replaceability argument (Faria, 2015). Second, his support of vegetarianism appears to be largely focused on industrial animal agriculture (Singer & Mason, 2007), where food animals are largely kept separate from wider ecosystems. Thus, it may not be applicable to the case of lionfish harvesting and consumption, as other pleasures and harms (such as the flourishing of native species) should be included in the utilitarian calculus.

In the case of lionfish, we acknowledge that if we simply focused on lionfish as a potential food source, then the pain caused during fishing is not outweighed by the pleasure of eating the fish. If we were applying Singer's utilitarian calculus to determine if we should eat lionfish in their native ranges, then a mandate against fishing could be supported along these lines. However, in ecosystems where lionfish are invasive, they are not being removed solely to meet consumption and/or nutritional needs, both of which could be fulfilled by vegetable alternatives. In these contexts, killing the fish could be justified by other pleasures, such as the flourishing of other marine life, that would otherwise be greatly harmed by presence of the invasive fish. When such broader impacts are considered, the pain experienced by lionfish during removal are outweighed by the pleasures of the small reef fishes that would otherwise make up 65% of the lost biomass (Green et al., 2012).

It is important to note here that the removal of lionfish is supported, not by human consumption needs, but by wider impacts to other marine life. This conclusion falls in line with Gamborg et al.'s (2012) analysis of wildlife management strategies, where they clearly state that utilitarian strategies could require culling, if this would reduce overall suffering in ecosystems. Due to small role that human consumption plays in the justification for the removal, consumption of the removed fish is not necessary. However, we argue that this act would bring pleasure to many, while not contributing to harms, and

thus could be used to further justify the removal. Eating the harvested fish would serve to increase the pleasures associated with harvesting, as well as provide a key component of a pragmatic management strategy, as will be discussed below. Thus, from Singer's utilitarian position, vegetarianism in this instance is not morally necessary and lionfish should be culled, regardless of the pleasures associated with consuming them. Though, subsequent eating of the fish could also be supported.

Regan's Animal Ethic

In addition to Singer's ethic, rights-based approaches have a long history of influencing dietary choices, such as adopting vegetarianism. Indeed, according to Lamey (2008), 'Peter Singer, Tom Regan and other philosophers ... have advocated vegetarianism and veganism as the dietary embodiments of their philosophies' (p. 331). With this context in mind, some eaters may think that fish have rights and thus culling lionfish, even for environmental reasons, could violate their rights. To explore this potential critique of eating invasive lionfish as a wildlife management strategy, we turn to Tom Regan's exhaustive rights-based analyses of ethical issues concerning animals (Palmer, 2010; Thompson, 1997). *The Case for Animal Rights* (Regan, 1985), which helped spark the animal rights movement, is one of the most influential treatises on animal ethics in the field. As Aaltola (2005) argues, 'although in the past the idea of animal rights has been at best marginalized and at worst rejected as absurd, today it is increasingly accepted, and in some jurisdictions, it has even been awarded constitutional recognition' (p. 20). Regan uses a rights-based theoretical foundation to ground his animal ethic, as he finds utilitarianism to be problematic. As Thompson (1997) states, Regan 'rejects utilitarianism because it permits the use of individuals ... as a means for maximizing the aggregate total of sentient pleasure ... Regan also rejects "indirect duty" views ... because they deny the possibility of owing moral duties to the animals themselves' (p. 9). He argues that all 'experiencing subjects of a life' should be thought of as possessing intrinsic value and thus deserve equal respect (Regan, 1985). This includes the right not to be harmed or treated as merely a means to achieve our own ends. In short, we must respect the interests of non-human animals unless they conflict directly with fundamental human rights, which take precedence.

Regan's (1985) ethic is categorically abolitionist, meaning that recognizing the intrinsic value (and thus rights) of non-human animals means that we, as ethical actors, need to drastically change our behavior toward them. For example, his ethic requires the abolition of pet ownership, as limiting their desires and spaying or neutering your pet could be seen as a violation of their rights. In addition, it requires the adoption of a vegetarian diet. Industrial farming and the slaughter of food animals, including both domesticated and wild animals, are problematic because his ethical position only allows for taking an animal's life in limited circumstances, such as when a human life is threatened. As Beauchamp (2011) states, some animal rights positions 'are sufficiently strong that they prohibit most, and likely all, of the practices involving animals that are familiar features of modern society including, biomedical research, toxicological testing factory farms, zoos, circuses, children's petting farms, hunting ...' (p. 198). As this list illustrates, Regan's animal ethic mandates giving up hunting and fishing in most circumstances, as this would violate the rights of those hunted or fished.

At face value, this position could be used to justify prohibiting lionfish culling, as recognizing non-human animals as subjects of a life with certain moral rights would problematize the harvesting of these fish. But are fish experiencing subjects of a life (ESL) for Regan? In *The Case for Animal Rights*, Regan (1985) fleshes out this criterion, arguing that being an ESL goes beyond having consciousness or being alive. Specifically, he states the following:

"[I]ndividuals are subjects-of-a-life if they have beliefs and desires; perception, memory, and a sense of the future, including their own future; an emotional life together with feelings of pleasure and pain; preference- and welfare interests; the ability to initiate action in pursuit of their desires and goals; a psychophysical identity over time; and an individual welfare in the sense that their experiential life fares well or ill for them (243).

Working from this definition of ESL, Regan contends that all mammals aged more than year have inherent value, or importance regardless of their usefulness to others (Norcross et al., 2016). However, fish are not mammals, so they do not necessarily fit the ESL definition. In fact, biologists are still debating whether fish are sentient and if they can feel pain, with some concluding their cognitive complexity and ability to feel pain parallels that of other vertebrates (Brown, 2015) while others argue fish lack consciousness and the neural architecture to feel pain (Key, 2015; Rose et al., 2014). In the absence of scientific certainty about fish consciousness and even ability to feel pain, lionfish do not definitively fit the criteria to be considered ESLs (though they could in the future). Thus, the argument that Regan's ethic would support the position that fish have rights is false and, for this reason, the rights perspective is not applicable to lionfish management plans.

Ecocentric Environmental Ethics

After applying Singer's and Regan's ethical approaches above, it appears that utilitarianism could be used to support lionfish hunting as a viable management strategy, while Regan's ethic is not applicable to this case. However, as invasive species management can be considered part of larger wildlife conservation plans (FWS.gov), it is important to apply ethical frameworks that guide these projects to the lionfish case study. According to Gamborg et al. (2012), wildlife management and conservation projects are driven by underlying values including maintaining the wellbeing (or flourishing) of individual animals, ensuring the continuation of species populations, and protecting ecosystem health (see also Sandoe and Christiansen 2008). Here it is important to note that utilitarianism and animal rights approaches are two important frameworks used to guide wildlife management decisions. However, for wildlife conservation projects, 'the wellbeing of individual animals matters less where species, ecosystems, or wild nature is emphasized – indeed, painful predation may be understood as promoting ecosystem health, or as applying the right kind of selective pressure on a species, as a whole' (Gamborg et al., 2012, p. 2). Environmental conservation's two main approaches historically included ensuring the continued use of nature and the preservation of natural areas, both of which move beyond purely individual focused ethics (Minteer & Corley, 2007; Rolston, 2015). While these approaches provide divergent management recommendations, they are concerned with ensuring the viability of ecosystems and species that have been or could be impacted by human activities and ecological changes (Sandler, 2012, p. 47).

Thus, conservation is often guided by a particular ethos that is at least partially nature centric in conception (though some may be guided by anthropocentric aims).

Nature centric approaches in wildlife management are overlapping views that focus on concerns beyond impacts to individual sentient beings, such as protecting species integrity, biodiversity levels, ecosystem functioning, or even naturalness itself (Gamborg et al., 2012). Ecocentrism is an important environmental ethic that falls under this larger umbrella. A key starting point of ecocentric approaches is the commitment that ecosystems are morally important. As ecosystems are self-organizing, benefit flora and fauna, and often include humans as an inseparable component, they should take central ethical consideration (Fennell, 2013; Ouderkirk, 2000). According to Fennell (2013), examples of ecocentric ethics include deep ecology (Fox, 1989; Naess, 1984), the land ethic (Leopold, 1968), ecofeminist approaches (Donovan, 1990; Warren, 2000), and the Gaia hypothesis (Lovelock, 1979). Ecocentric ethics differ from individual focused ethics, as the latter ascribes value to living elements of the environment, while ecocentrism is holistic.

Aldo Leopold, one of the founding voices of environmental ethics and ecology, significantly impacted current ecocentric approaches to wildlife management (Callicott, 2014, 1993; Fennell, 2013; Gamborg et al., 2012). For Leopold (1968), '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' (p.224–225). This 'land ethic' encourages adopting a systemwide perspective when making decisions regarding the environment. Wise land use begins when we move away from conceptualizing the land as a commodity and, instead, see the land as a community where humans are merely a member. Leopold purposefully extended moral consideration beyond humans, including flora, fauna, plants, soil, and other components of the land in the moral community (Callicott, 2014, 1993; Nelson, 2004). According to Fennell (2013), 'as long as the consequences of our actions do not compromise the integrity of the biotic community, i.e., if we act in a way that promotes the good, and not harm, of the biotic community on the whole, these actions are morally praiseworthy' (p. 192). From this view, the importance of individuals largely depends on how they impact the larger ecosystem or the land, to use Leopold's terminology. When applied to wildlife management, keystone species, or those that help ensure ecosystem stability, will be of particular importance, while invasive species that threaten ecosystem integrity, should be removed (Gamborg et al., 2012).

From this perspective, hunting and fishing would be acceptable, if these activities are beneficial for the ecosystem (Fennell, 2013). (Loftin (1985) supports this application of ecocentric ethics, arguing that we ought to be more worried about damage to ecosystems, rather than the death of individuals. In this vein, Varner (2011) clearly states that ecocentric ethics would support therapeutic hunting (rather than sports hunting), as this activity is intended to ensure overall ecosystem health (Varner, 2011). Thus, an ecocentric ethic would align with utilitarianism concerning the matter of lionfish culling. Active human intervention by hunting or otherwise culling lionfish thus becomes the ethically right course of action since the extant scientific evidence shows it can help the biotic community recover to its previous state. However, it should be noted here that the ecological efficacy of targeted removals is currently being debated in the literature, though there are numerous papers that offer suggestions for improving the effectiveness of such efforts (see, for example, Andradi-Brown et al., 2017; Barbour et al., 2011; Frazer

et al., 2012; Harms-Tuohy et al., 2018; Usseglio et al., 2017). With this being said, doing nothing to remove lionfish will result in maintaining the current ecological crisis.

Problems with Promoting Eating Lionfish

Interestingly, while there is often a conflict between individual and holistic approaches (Callicott, 1980; Jamieson, 1998), in the case of lionfish, both utilitarian ethics and ecocentric approaches to wildlife management would support culling lionfish. Additionally, programs aimed at increasing human consumption as a way to control invasive species have several benefits, such as increasing public awareness of invasive species (Jordan et al 2011; Simberloff 2003), improving their early detection and removal, and boosting the local economy (Nunez et al., 2012). However, from a policy perspective, there are several concerns that should be considered before adopting dietary focused wildlife management strategies. First, supporting lionfish consumption could lead to the creation of a market that creates pressure to maintain a robust population of the problematic species. As Nunez et al. (2012) argue, 'The ultimate goal in most eating invader campaigns is to eat the target species out of existence, just as humans have done for many native species. However, once a species becomes a genuine economic resource, it could be even harder to encourage complete removal of the monetarily valuable species' (p. 337). This is an important concern, as there are several historical examples where the promotion of hunting an invasive species ultimately ran contrary to wildlife management goals, especially when they produced economic benefits (see Lambertucci & Speziale, 2011; Fujimori, 2003). Additionally, if target species become economically valuable, then some groups may actively try to introduce these species into previously unimpacted areas and/or protect current populations to maintain the resource. Each of these scenarios has the potential to produce severe management issues.

While these are important considerations that need to be considered, it should be noted here that robust economic demand for lionfish is not currently a problem in impacted areas. This is supported by the fact that The Florida Fish and Wildlife Commission is currently working to incentivize the removal and eating of lionfish, as efforts thus far have fallen short of what is needed to effectively control this invasive species (Florida Fish and Wildlife Conservation Commission 2019). Thus the above concerns focus on future economic developments and not the current situation. Due to the uncertainty of whether these situations will come to pass, we argue that they are not strong enough justifications to stall dietary wildlife management strategies. However, if these eventualities do come to pass, then further ethical analysis would be needed. In fact, we might find ourselves in a situation where conservation's two historical approaches could once again come into conflict, or where anthropocentric focused management strategies conflict with preservationist focused goals (Minteer & Corley, 2007; Rolston, 2015). If this does occur, then further discussion will be needed.

One could also argue that culling may be supported but we are under no obligation to eat the culled fish. In fact, eating the invasive species could not only bring about the above eventualities but could also encourage other meat consumption not supported by the above ethical positions. The growing demand for meat products is currently unsustainable (Stoll-Kleemann & O'Riordan, 2015) and not supported by the animal ethics discussed above. Thus, we should be encouraging the population to reduce their intake

of meat, rather than to increase this intake. In reply to the latter concern, in this paper, we are making an argument that supports eating lionfish, in particular. We are not making the argument that all meat eating is ethically acceptable. This is a targeted recommendation that falls in line with other recommendations commonly found in food and animal ethics. In fact, these fields include a robust literature that weighs, debates, and delineates what foods are ethical or not ethical to eat (Barnhill et al., 2016; Singer & Mason, 2007; Thompson, 2015). Additionally, one could whole-heartedly decline from eating lionfish, while still supporting their removal. Not eating the invasive species could reduce the above potential negative impacts, but would face pragmatic challenges, including the need to publicly fund future lionfish removal. Again, due to the uncertainty of whether these situations will come to pass, we argue that they are not strong enough justifications to stall such strategies.

Conclusion

In this paper, we used utilitarian animal ethics, deontological animal ethics, and ecocentric environmental ethics to determine if eating lionfish as a wildlife management strategy is ethically justified. From a utilitarian perspective, lionfish should be culled, though we acknowledge that this position largely supports adopting a vegetarian diet in most circumstances other than invasive species management (Singer, 2015; Singer & Mason, 2007). Rights-based ethics, on the other hand, are not applicable in this case, while ecocentric environmental ethics would support lionfish removal. Scientific evidence supports lionfish removals because of concern for the ecosystem effects caused by their presence and consumption on native fishes and crustaceans, which alters existing reef communities. If people eat lionfish rather than other fishes, such as salmon, grouper, or snapper, whose populations are shrinking, this has the additional benefit of aiding in biodiversity protection. Removing lionfish from its invasive range is supported by or falls outside of the scope of two prominent animal ethics, has broader ecological benefits, and promotes environmental health. As such, hunting lionfish for consumption as part of a larger wildlife management strategy is the ethical choice.

Notes

1. It should be noted that lionfish are hunted, as removal requires divers to enter the water and spear the fish in order to cull them. Additionally, current methods of industrial fishing are not equipped to remove the fish. For this reason, harvesting lionfish is commonly described as 'hunting,' though spearfishing could and is also understood as a type of fishing. We acknowledge the conflicting terminology. With this being said, we will be using the commonly accepted term 'hunting' throughout this paper.
2. It should be noted here that Singer's (2015) replaceability argument is considered to be a controversial aspect of his ethic. Singer is still grappling with this problem, as is intimidated by *The Point of View of the Universe* (Lazari-Radek & Singer, 2014), where he states that all sentient beings would be harmed by death, as they are deprived of future benefits. According to Faria (2015), this work, along with a recent interview where he lists the 'badness of death' as one of the three most important questions in animal ethics, illustrates that Singer is still refining his position concerning the moral status of death.

ORCID

Brittany Davis  <http://orcid.org/0000-0001-9362-256X>

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