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OUTDOOR RECREATION AND INVASIVE SPECIES AT PRESQUE ISLE STATE PARK

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ABSTRACT

Among the many challenges park managers face today, the impact of invasive species has been increasingly evident. Managing invasive species requires knowledge and skills in areas such as natural history, biology, chemistry, and economics, as well as human dimensions. More specifically, the public's views of invasive species' role in their recreation pursuits is another fundamental element to successful invasive species management. However, few studies have assessed outdoor recreationists' views on invasive species and invasive species management. This study investigated differences in park visitor perceptions of invasive species at Presque Isle State Park (PISP) based on their primary outdoor recreation activity (e.g. boating, birding, beach use, trail use) through an online survey. Results indicated that various outdoor recreation user groups at PISP reported different perceptions of the relationship between invasive species and their recreational experiences. However, their perceptions and opinions toward invasive species management (and specific management practices) were relatively homogenous across the outdoor recreation user groups. Study findings can be used to improve an already strong invasive species management program at PISP and provide direction for further research on this topic.

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CHAPTER 1

INTRODUCTION

Invasive species, along with climate change and habitat loss, is one of the biggest threats to Earth's biodiversity (Smout, 2011). It is well understood that all three of these threats have vast implications for global ecology and the natural environment. Additionally, invasive species have already shown effects on societal systems such as global trade, settlement patterns, agriculture, economies, and water management (McNeely, 2011). However, the implications do not stop there. There are also expected to be a considerable number of consequences from invasive species on the social wellbeing of people (Binimelis, Born, Monterroso, & Rodriguez-Labajos, 2007; Pryor, Townsend, Maller, & Field, 2006; Weissbecker, 2011). One specific potential consequence of invasive species is their impact on outdoor recreation experiences.

Because of this, parks and natural resources managers are especially conscious of the issue of invasive species' relationship with the social dimensions of recreation because of their dual mission to both conserve the natural environment and provide opportunities for outdoor recreation. For example, the Pennsylvania Department of Conservation and Natural Resources (PA DCNR) Bureau of State Park's mission is to, "...conserve natural, aesthetic, cultural, and historic resources, to provide opportunities for enjoying healthful outdoor recreation, and to serve as outdoor classrooms for environmental cultural and historic resources education, and to conserve these areas for future generations" (DCNR Bureau of State Parks, 2012). As a result of this mission, there is a need to create better linkages between ecological and societal needs. Park management must make decisions on invasive species management based on both social (recreational) and ecological needs. They must promote environmental knowledge and concern among users to maintain the ecological health of parks, while at the same time, meeting the demands and recreational needs of park visitors and the public at large.

In an effort to address the ecological health of parks, various studies in the natural sciences have gathered considerable evidence documenting invasive species' disturbance on the environment by altering nutrient cycles and shifting population distributions (Blossey, Skinner, & Taylor, 2001; Cote, Rooney,

Tremblay, Dussault, & Waller, 2004; Pimentel, Zuniga, & Morrison, 2004). Invasive species impacts are evident in parks nationwide when plants such as phragmites, fish such as carp, and even mussels such as the zebra mussel are introduced to an area. Typically, the environmental changes caused by these invasive species leave the ecosystem in a worse condition than it was before the invasion (Blossey et al., 2001). There is even a claim that invasive species have such an environmental impact that they will be a significant contributor to the next geologic epoch that has been coined the Anthropocene [named such because of the strong human influence that is currently being placed on the environment] (Barney, Tekiela, Dollete, & Tomasek, 2013). Successful management to diminish these impacts of invasive species is likely to be heavily dependent on the public's awareness and proactive support for strategies to mitigate invasive species.

Understanding the social dimensions of invasive species management such as these is a recent direction of invasive species research. For instance, many studies have looked at the invasive species' impact on the economy (Rosen, Grover, & Spencer, 2012; Dolesh, 2012; Eagle, Eiswerth, Johnson, Schoening, & Kooten, 2007; Kovacs et al., 2010; Prinbeck, Lach, & Chan, 2010; Pimentel et al., 2004; Pejchar & Mooney, 2009). Additionally, emerging research is now exploring the human dimensions of invasive species' social impacts. Specific topics that are being explored include the knowledge, attitudes, beliefs, and felt impact of the public related to invasive species in parks and natural settings. However, most of the existing research in this area considers these factors without differentiating the views of a diverse constituency, by creating their own categorizations (e.g. ecocentric, adaptive-ecocentric), or by focusing on specific stakeholder groups (e.g. owners of private woodlands) rather than comparing perceptions across diverse stakeholder groups (Adams, Lee, Bucaram, & Bwenge 2007; Ceurvorst & Allred, 2013; Kapler, Thompson, & Widrlechner, 2012; Selge, Fischer, & Wal, 2011; Sharp, Larson, & Green, 2011). Few studies have made empirical comparisons of invasive species knowledge, attitudes, and management preferences across various recreation user groups. This sort of comparison is important because outdoor recreation user groups are a readily identifiable type of categorization that can be used to provide more targeted park programming and be more easily accounted for in management decisions.

From a park management standpoint, the results from these studies previously reported, although valuable, reveal a need for more exploration into this topic. Several studies even suggest that examining distinctions between outdoor recreation user groups regarding views of invasive species would be a valuable continuation of future research from their work (Ceurvorst & Allred, 2013; Eiswerth, Darden, Johnson, Agapoff, & Harris, 2005; Prinbeck et al., 2011). This also appears to be a promising avenue to pursue because visitors' outdoor recreation user group has historically been an effective way to understand and differentiate the visiting public when considering environmental topics. For example, studies of environmental attitude and environmental impact have shown that there are distinguishable differences in study results based on various recreation user groups (Thapa 2000; Wall & Wright, 1977). Understanding specific outdoor recreation user group views of invasive species will be especially helpful for park and natural resource managers. This is because being able to consider their views while dealing with invasive species will make the balance between environmental concerns and park visitor interests more clear and attainable.

Study Purpose/Significance

It is evident there is a need for information on how diverse recreational user groups might differ in their perspectives regarding invasive species and their management. Findings from such research might allow for the discovery of differences between recreation groups that can be used to better understand the broader park visitor population. This is important for on-going programming and for making positive management decisions. The difference in perspectives from the public is expected to be based on outdoor recreation user group membership and general demographics. This expectation is based upon findings of previous research, such as a study by Sharp et al. (2011), and the importance of recreation activities in defining a person's general character. Thus far, despite specific calls for quantitative investigations into these assumptions, no studies were found that described perspectives of invasive species and their management across specific types of outdoor recreation user groups. The findings from investigating this topic could be used as an important tool for park management faced with the related issues of invasive species in the environment and providing recreational opportunities. Specifically, outdoor recreation user groups that have distinguishable perspectives on invasive species could be better targeted with

educational devices and other support programs that are more pertinent to these groups. Management can also potentially reduce conflict situations such as polarization of the public, determine potential resource providers, and identify areas of concern with invasive species for recreation user groups. This study was therefore conducted to determine any possible relationships between park visitors' primary outdoor recreation user group, reports of invasive species impact on their recreation experience, and ultimately their attitudes towards invasive species management as they may differ across the various outdoor recreation user groups. It was carried out using quantitative methods based on online surveys of recreation users of a single state park (Presque Isle State Park) with an active invasive species management program. To assess these issues the following research questions are posed and tested in this study:

Research Questions

1. Self-reported knowledge and awareness of invasive species and their management
 - a. Are there significant differences in Presque Isle State Park invasive species self-reported knowledge across various outdoor recreation user groups?
 - b. Are there significant differences in the level of awareness of Presque Isle State Park's efforts in invasive species management across various outdoor recreation user groups?
2. Reported Impact of Invasive Species on Outdoor Recreation
 - a. Are there significant differences in the perceived impact of invasive species on specific elements of the recreation experience at Presque Isle State Park across various outdoor recreation user groups?
 - b. Are there significant differences in the perceived overall impact of invasive species on outdoor recreation at Presque Isle State Park across various outdoor recreation user groups?
3. Park visitor attitudes and awareness regarding invasive species management
 - a. Are there significant differences in the level of support for invasive species management in general at Presque Isle State Park across various outdoor recreation user groups?

- b. Are there significant differences in support for specific invasive species management practices at Presque Isle State Park across various outdoor recreation user groups?

Definitions

Invasive species - any population that does or is likely to cause economic harm, environmental harm, or harm to human health (The National Invasive Species Council, 2005)

Outdoor Recreation - experiences that result from leisure activities that occur in and depend on the natural environment (Moore & Driver, 2005)

Outdoor recreation user group - a category of individuals created based upon an identifiable, reasonably apparent, commonality in their leisure pursuits

Primary outdoor recreation activity - a leisure pursuit an individual participates in which they feel more invested in than any of their other pursuits

Delimitations

This study was delimited to four outdoor recreation activity groups (i.e. birders, boater, trail users, beach users) who had participated in these activities at Presque Isle State Park over the past 12 months.

CHAPTER 2

LITERATURE REVIEW

This chapter aims to examine existing literature related to the public's view of invasive species and their management. First, it will look at the broad topic of invasive species and the development of the term. Next, the focus shifts to examine the ecological, economic, and social impacts of invasive species as presented in the current literature. The social impact will then be further explored through studies regarding public perspectives of invasive species and invasive species management strategies. The review will then focus on different perspectives of invasive species and their management based on outdoor recreation user groups.

Invasive Species

It is approximated that 50,000 invasive species have been introduced into the United States since the first European settlements (Pimentel et al., 2004). This number includes plants (e.g. phragmites), mammals, birds, amphibians (e.g. red-eared slider), reptiles, fish (e.g. round goby), arthropods (e.g. emerald ash borer), mussels (e.g. zebra mussel), and pathogens. It has been further estimated that 3% of the world's ice-free surface has become dominated by invasive species in the last 500 years (Mooney & Clelend, 2001). However, the term "invasive" species has been historically ambiguous. Colautti and MacIsaac (2004) report that many sources argue over different views on how the term should be used. One generally accepted definition of an invasive species that was established by the 1999 executive order of Bill Clinton is "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Along with this definition, invasive species are generally characterized by their rapid population growth that allows them to easily spread through the environment.

However, it has been shown that native species can have the same qualities as nonnative invasive species and as such, have been termed "native invaders" (Simberloff, 2011). An example of a native invader that is sometimes referred to is the white-tail deer. This species' population size can cause an alteration of vegetative diversity based on their grazing to the point of causing environmental harm (Cote et al., 2004). Additional native species that could be considered invaders are Canada geese, raccoon, and

brown-headed cow birds (Carey, Sanderson, Barnas, & Olden, 2012). These types of native species invasions are particularly prominent in urban settings. In these areas, it has been postulated that native species invasions are possible because of human-mediated environmental changes (Carey et al., 2012). For example, landscaped parks are a prime habitat for nonmigratory Canada geese because they provide an artificial source of fresh water, open lines of sight, and palatable grasses that then allow for the geese to exist in populations that can be considered invasive (Heintzelman, 2005).

This evidence supports that the “nativeness” of a species is not as relevant to the identification of an invasive species as was once thought. Instead it shows that an invasive species is more related to the amount of impact the given species has on the environment and human wellbeing. The government has further highlighted this development since its originally accepted definition by explaining that not all nonnative species are invasive because most of them cause no significant harm to their new environment (National Invasive Species Council, 2005).

Invasive Species’ Impacts

Since the level of impact is critical in the determination of an invasive species’ existence, it is important to be able to identify the impacts of a species accurately and completely. If this understanding is not accomplished, species could be overlooked and left unaddressed despite a need for action. The direct impacts of invasive species can be broadly divided into three interrelating categories. These categories include the ecological, economic, and social impacts of invasive species.

Ecological Impacts

Invasive species have the potential to permanently disrupt ecosystems and become a major component of the Anthropocene (Barney et al., 2013). For example, the earlier example of deer invasions has caused at least six separate swaps of one dominant tree species for another (e.g. eastern hemlocks for sugar maples) due to the deer’s selective herbivory (Cote et al., 2004). This is an impact that can cause significant changes in the future diversity of the forest canopy. Similarly, an article by Blossey et al. (2001) about the invasive, nonnative purple loosestrife plant cited eighteen other studies that indicate that purple loosestrife causes a reduction of high quality bird habitat, a reduction in plant biodiversity, and alteration of wetland function. This review also supported that not only do invasive species directly have

an impact on the survival of other species, but they influence the abiotic environment that they invade by altering water, nutrient, and energy cycles (Blossey et al., 2001).

It is estimated that 42% of all the threatened or endangered species are at risk primarily because of invasive species (Pimentel et al., 2004). This is because invasive species predate, out compete, or otherwise inhibit the fitness of these species and others that they rely on in the environment. However, it is worth noting invasive species can also have some positive impacts for the ecosystem. For example, the invasion of the round goby to the Great Lakes Region provides for 90% of the diet of the once endangered Lake Erie water snake that is now on a path to recovering at least partially due to this invasive species' presence (King, n.d.).

Despite these known biological impacts, it is difficult for people to understand their importance because the severity of effects are not immediately evident. For example, it may not be evident how the introduction of narrow-leaf cattail, which only has subtle visible differences from the native cattail (i.e. a few millimeters shorter width of the leaf), could have any impact. Yet, upon further investigation it is found that the narrow-leaf cattail occurs in more dense stands that crowd out other species which then alters the ecosystem entirely. Complicated cases like these have caused researchers to look towards other methods of illustrating the importance of invasive species impacts to the public.

Economic Impacts

One way to more directly relate the impacts of invasions to people is the economic impacts of invasive species. A species' management budget includes its harm to production, harm to trade of agricultural, ecological benefits, and required management efforts made for the species. Estimates of total economic costs of invasive species in the USA are around \$130 billion cumulatively, but range to as high as \$130 billion annually (Dolesh, 2012; Prinbeck et al., 2011 Pimentel et al., 2004; Pejchar & Mooney, 2009). However, these numbers are developed from studies conducted without systematic methods and typically fail to consider the possible benefits of the invasion which may offset losses caused by the species being considered (Pejchar & Mooney, 2009).

Other studies that focus on a particular invasive species or geographic regions seem to better analyze and more accurately understand the economic impacts involved. For instance, yellow star thistle

costs the ranching industry in California \$7.65 million annually (Eagle et al., 2007). Another example is the predictive study on the emerald ash borer costing the United States \$10.7 billion between 2009 and 2019 (Kovacs et al., 2010). Yet another example is that the range of invasive species present in the Great Lakes are estimated to cause economic damages of close to 129 million dollars a year (Rosen et al., 2012).

No matter how the subject of economics of invasions is approached, it is difficult to convert all the impacts of invasive species into economic terms. There are too many elements of invasive species impacts that are not properly represented in a monetary value. Therefore, to fully understand the impact of invasive species for people, it is important to go beyond these economic dimensions.

Social Impacts

The most holistic view of invasive species impacts includes a consideration of the social impacts that flow from and interrelate with the environmental and economic impacts. These social impacts explain how the invasive species are actually felt, understood, and experienced by the public. Without considering this, it is likely that management efforts to address invasive species will be less effective. Furthermore, if the social impacts are not adequately considered, it may prevent necessary measures from being taken altogether since invasive species management generally begins when the management activity's benefits outweigh the costs (Osteen & Livingston, 2011). Put another way, often the impact of invasive species is only evaluated on the level of ecology and economics while leaving out the direct effects on the public. As a result, crucial early management efforts are denied or wrongly continued because of a shortcoming in the identification of social impacts that the invasive species have. One case of this that recently occurred was the social outcry against management for invasive eucalyptus trees in the Mount Sutro Forest of San Francisco (Bricker, 2013).

Social impacts can be approached from different social stratification levels. These levels include individual (e.g. human health impact such as with AIDS), household (e.g. leisure time disruption such as with stinging insects), community (e.g. cost and benefit distribution impacted such as with deer population's cost to gardeners and benefit to hunters), regional (e.g. recreational opportunities impacted such as with trails disappearing from invasive brush), and national (e.g. heritage impacted such as with

tree pathogens) (Fitzgerald & Wilkinson, 2009). Part of the reason that the impacts at each of these levels are currently not as well considered is because they can be difficult to recognize and measure. The social impacts of invasive species are largely a subjective matter. The beliefs, values, and attitudes that are shaped by the culture of the people affected are the basis of invasive species' social impacts (Pejchar & Mooney, 2009, p.502). Research has to become more targeted to gain an accurate understanding of these social dimensions for specific species. For example, the different needs and cultures of outdoor recreationists might influence how different activity groups (e.g. gardeners, hunters) view invasive deer populations. However, few studies have examined social perspectives based on factors that influence the public perspective of invasive species (Garciallorente, Martinlopez, Gonzalez, Alcorlo, & Montes, 2008).

Public Perspectives of Invasive Species

Perceptions of invasive species are primarily shaped by five factors which are: damage to property, damage to ecosystem, appeal of species, peer influence, and media portrayal (McNeely, 2001). When these factors accumulate to a point of disapproval by the general public, and the species becomes unwanted, the invasive species becomes a pest. Just as the extent of nativeness has been determined to have little weight in defining an invasive species, the extent to which a species is native to an area is rarely a cause of concern for the public (Selge et al., 2011). History shows that the perspectives held by the public are much more directed by the impacts that people feel from the invasion.

For example, in Pennsylvania the issue of invasive species was first approached by the government as early as 1862 (Pennsylvania Invasives Species Council, 2009). At that time a law was enacted to protect farmers from introduced weeds that would compete with their crops or harm livestock and have obvious social impacts (Geist, Pick, & Brittingham, 2001). It was not until the mid to later 1900s that scientists began to show concern for the ecological impacts of invasive species because there was a shift from understanding invasive species on a species-by-species basis to an understanding that many species are involved in the total ecosystem. Scientists saw what the invasions were doing to the environment, their living laboratory, and this caused social stress for them too (Oosting, 1948; Oosting, 1956; Bates, 1956; Elton, 1958; Dasmann, 1971). Even with the rise of the environmental movement in the 1970s, the broader public's focus in the United States did not shift to the widespread environmental

concerns that invasive species presented until the 1990s because until then the invasions had no meaning for them (Simberloff, 2011). Only most recently, with occurrence of large global shifts in environmental conditions (i.e. widespread habitat disruption, climate change) and globalization, have the invasive species began to spread and thrive enough to cause the public to recognize the possible impacts on their wellbeing (Binimelis et al., 2007; Pejchar & Mooney, 2009).

The public's awareness of invasive species existence is currently high (Ceurvorst & Allred, 2013; Daab & Flint, 2010, p. 396; Garciallorente et al., 2008). For example, a study found that 69.9% of public stakeholders considered invasive species to be a high priority (Kapler et al., 2012). An even greater number of participants in that same study agreed that invasive plant species are more than just weeds or plants growing where they are unwanted (Kapler et al., 2012). Another study found that invasive species is a high enough priority that the public reported a higher willingness to pay to reduce invasive species than for the improvement of public facilities or increases in native abundance (Adams et al., 2007). However, the awareness of invasive species in the public is at a basic, generalized level and when asked about specific species, their awareness decreases significantly (Daab & Flint, 2010).

The perception of impacts is diverse, dynamic, and heavily dependent on the contexts for each stakeholder (Binimelis et al., 2007). Adams et al. (2007) found that level of knowledge, perceived effects on their recreation, and previous engagement in actions against invasive species were factors when Florida survey participants were categorized by their recreation setting (i.e. ocean and beach, wooded park, river and lake). Garci-allorente et al. (2008) categorized the surveyed visitors by type (e.g. general tourist, nature tourist) and found differing levels of knowledge as well. Kapler et al. (2012) found less pronounced differences in perspectives of invasive species based on groupings including conservation professional, gardener, horticulturalist, and woodland landowner.

These differences in research results all relate back to how the study groups were defined. A common theme between study groups was that those with closer nature-relatedness (i.e. forest and lake recreation users over beach users, nature tourists over general tourists, any nature focused occupation) were likely to have similarly negative perceptions of invasive species. It is therefore appropriate to look at specific stakeholder groups that may show disparity in perceptions, rather than trying to gain an accurate

picture from an undefined general population. Equally important to understanding perspectives towards invasive species of stakeholder groups like these is an understanding of their support for specific management strategies to control and address invasive species.

Public Perspectives of Invasive Species Management

A recent article in the National Recreation and Park Association magazine states, “Clearly, there are opposing views on the amount of time, effort, and funds that should be expended on the control of invasive species in parks” (Dolesh, 2012, p.41). As supported by this article, the importance of the public’s perspective is undeniable for successful management efforts (Binimelis et al., 2007). However, public perspectives of invasive species management has, until recently, been widely ignored (Sharp et al., 2011). The public is generally in favor of on-site management practices, especially for the correction of negative changes that humans were responsible for (Ceurvorst, & Allred, 2013; Sharp et al., 2011; Kapler, et al., 2012). As discussed earlier, there is even expressed willingness to pay for these actions (Adams et al., 2007).

Studies have found that perspectives on more specific management actions can differ based on stakeholder groups, especially when considering specific species in specific settings. For example, Sharp et al. (2011) found that of all the factors considered the absolute eco-centric attitude and adaptive eco-centric attitude of the stakeholders best categorized the public’s view of management strategies either being a hands-off approach, complete eradication, or on-site management. They found that generally older, more educated, and more frequent park users were more accepting of on-site management than the younger, less-educated, and less frequent park users (Sharp et al., 2011). The effect that media exposure and socio-demographics had were also considered, but found to be insignificant (Sharp et al., 2011). Prinbeck et al. (2011) found in focus groups of hunters, fishers, boaters, and gardeners views of invasive species that subjective norms and behavioral control beliefs also influenced perspectives of invasive species management. The participants felt that management’s expectations of their own actions to prevent invasive species were too difficult, not enforced, and not well explained (Prinbeck et al., 2011). Another shared belief from this study was that institutions are not doing their share for management of invasive species themselves (Prinbeck et al., 2011). In a separate study including both focus groups and in-depth

interviews, two considerations were most important to the participants in the acceptance of active invasive species management (Selge et al., 2011). These two items were how harmful the species is to the environment and whether humans were responsible for the spread of the species (Selge et al., 2011). If the invasion could be shown harmful and human induced, perceptions of invasive species management then further depended on public assessment of the need to reduce numbers, effectiveness of the chosen management tool, and the moral aspects regarding species control (Selge et al., 2011).

Many of these studies looked at participants engaged in the natural environment with some form of categorization whether it was through employment, park visitation, or hobbies (Garciallorente et al., 2008; Kapler et al., 2012; Selge et al., 2011; Sharp et al., 2011). Since, outdoor recreation participants are inherently in a relationship with the natural environment, they appear to be the most logical grouping for the ease of park management. However, only one study specifically considered identified outdoor recreation user groups that were easily discernible for future communications and engagement in park management (Prinbeck et al., 2011). This exploratory study was framed around the Theory of Planned Behavior and was more focused on the leisure activities themselves rather than the environment in which they occurred. There is a need to document differences in perspectives of invasive species management further using specific outdoor recreation user groups at park or natural resource settings. One reason for this need is because they are possibly the most closely related social groups (and cultural stratification) to the impacts of invasive species and their management in parks. Another reason is that of all the social impacts of invasive species, recreation and tourism are most likely to be quantified (Pejchar & Mooney, 2009). This puts specific outdoor recreation user group members in a position as key stakeholders who can be easily identified and targeted for education and park management strategies for invasive species.

Outdoor Recreation's Relationship with Invasive Species

Outdoor recreation has been described as recreation experiences that result from recreation activities that occur in and depend on the natural environment (Moore & Driver, 2005). When interested in environmental topics, researchers have taken advantage of this relationship for an accessible and identifiable study population. Previous research has focused on outdoor recreation participants impacting the environment, such as a study by Wall & Wright (1977) on the environmental impact of outdoor

recreation. Another study focused on how outdoor recreation can be associated with views the participants have regarding the environment, and many more similar examples exist (Thapa, 2000). From any approach, it is understood that outdoor recreation participants have a connection between themselves and the natural environment.

Since invasive species are a part of the outdoor recreation environment, they too impact outdoor recreation participants. Therefore, the views of outdoor recreation participants can be used to better understand invasive species management in the outdoor recreation environment. For example, hikers are being cut by yellow star thistle in the western United States (Mooney, 2005). Zebra mussels overheat boat engines (Zebra mussels threaten inland waters). Eurasian water milfoil makes paddling a kayak near impossible (Fritz, 2012). Terrestrial invasive plants make trails impassable or dangerous (Sprajcar). The list of presumed invasive species' impacts on recreation participants continues, but still a gap exists because there is no quantitative representation or comparison of the perspectives of invasive species and their management in parks based on the outdoor recreational user groups.

This knowledge gap is a challenge for public land management officials. It is especially important to approach public views of invasive species from the lens of various outdoor recreation user groups because recreation, above subjects like ecology and aesthetics, is reported to be the most valuable aspect of parks for the public (Manning & More, 2002). Without this information, managers are hindered in delivering tailored educational programs and management strategies that target key constituencies. For example, in an education program by DCNR there was an attempt to provide targeted information to twelve separate recreational user groups that can be found from their website portal, www.dcnr.state.pa.us. However, inspection of the fliers created showed that invasive species of concern, prevention strategies, and implications for recreation were almost identical across all the fliers despite potential differences that may exist between the various recreation user groups.

Understanding key differences in outdoor recreation user groups as they pertain to invasive species might provide more targeted, effective invasive species education and management practices. Similarly, a study of this sort has the potential to highlight new social impacts that may otherwise be

overlooked. Therefore, a need exists to examine the potential differences in perceptions of invasive species and their management based on outdoor recreation user groups.

Summary

Invasive species are defined based on the ecological, economic, and social impacts that they cause. In park management, social impacts appear to be the element that is most often overlooked or generalized. This is potentially a result of the difficulty in establishing a value for social impact among the differing perspectives of invasive species and their management. These differing perspectives arise from many stakeholder factors. One way to approach this problem that has not yet been used is to explore stakeholders' perspective of invasive species and their management based on outdoor recreation user groups to make comparisons quantitatively. This categorization will be particularly valuable because these groups can then be more easily targeted by park management for education and invasive species management programs that are most pertinent to them.

CHAPTER 3

METHODS

Study Setting

The study setting was Presque Isle State Park (PISP) in Erie, Pennsylvania. This park is a 3,200 acre day-use park operated by the Pennsylvania Department of Conservation and Natural Resources (DCNR). The park's boundaries primarily encompass a peninsula that extends into Lake Erie. It is a combination of developed areas, sandy beaches, wetlands, and woodlands. The water areas of the park include the many interior lagoons as well as a 500 feet buffer into Lake Erie and Presque Isle Bay (DCNR Bureau of State Parks, 2009). The ecosystem and its geographic location make the park a key site for migratory birds and a variety of rare plant life among the other typical wildlife of the region.

PISP has a considerable amount at stake with respect to invasive species and is one of the leading state parks in Pennsylvania when it comes to the scale of their invasive species management operations. For example, the park is continually managing as many as ten major invasive species. Since summer 2012, control of the park's invasive species has become considerably more aggressive as well, especially for species such as common reed, oriental bittersweet, narrow-leaf cattail, bush honeysuckle, purple loosestrife, and garlic mustard. The most frequently used control method for these species has been chemical control using glyphosate, triclopyr, and imazapyr products. Additional control has been done mechanically by weed trimming, hand-pulling, and mowing. A volunteer program related to invasive species exists as well. Progress from these control methods is being monitored ecologically through several ongoing studies in the park coordinated by organizations such as the Regional Science Consortium. These efforts have been done in parallel to efforts for public awareness through interpretive programs and media spots on the topic.

Data Collection

Along with being a focal point for invasive species management, PISP is also an extremely attractive venue for outdoor recreation. The park has over 4 million park visitors annually that participate in variety of recreational activities (Mowen, Graefe, Kerstetter, & Ferguson, 2013). The DCNR identifies

twelve different outdoor recreation user groups in their “what you need to know” educational series on invasive species and this information can be found on the park’s website portal, www.dcnr.state.pa.us. These twelve different user groups were used as a starting point to identify categories of PISP outdoor recreationists who could participate in an invasive species study. One of these twelve groups, trail maintainers, was not applicable to the study for categorization because it is not considered to be an outdoor recreation group. Three of the other groups, (ATV riders, horseback riders, campers) were also not considered in the study because they are not outdoor recreational activities that the public are allowed to participate in at PISP. The remaining possible recreation user groups from these DCNR user segments were bird watchers, wildlife watchers, hikers, hunters, campsite lessees, bikers, anglers, and boaters. However, some of these recreation groups did not have a significant enough presence in the park for a large enough sample to be feasibly gathered for this study. Considering these restrictions, the final grouping of outdoor recreation users were boaters (both motorized and non-motorized), trail users (e.g. biking, running), beach users (e.g. sunbathers), and bird watchers.

To address the research questions posed in this study, a self-administered online survey was used to reach these four outdoor recreation user groups. This research design was determined to be most appropriate because it allowed the sample’s responses to be quantified and compared statistically in a timely, cost effective manner (Creswell, 2009). This method and subsequent short data collection period also minimizes changes in response as a result of continuing invasive species management work in PISP.

The survey became available to self-identified PISP visitors for their participation during May 2014. Non-probability, purposive sampling was used to send the survey by e-mail to organizations active at Presque Isle State Park (e.g., Erie Yacht Club, Presque Isle Audubon) and request their members’ participation in the online survey. These groups represent or include the four outdoor recreation user groups of interest to this study. Access to e-mail lists and posting areas (e.g. PISP Facebook page) were made possible through personal contact with organization leaders and through collaboration with the PISP office staff. The survey was distributed to specific boating organizations including *Paddle Without Pollution*, *Presque Isle State Park Marina*, and *Erie Yacht Club*. The specific groups of anglers that the survey was distributed to were *S.O.N.S. of Lake Erie* and the *Erie PA Sport Fishing Association*. The

specific group of birdwatchers that the survey was distributed to was the *Presque Isle Audubon*. The specific group of multi-purpose trail users that the survey was distributed to is the *Erie Runner's Club*. Additionally, non-probability convenience sampling was used to make the online survey available to a wider audience of park visitors by posting it on the Presque Isle State Park Facebook page and to Presque Isle State Parks Volunteers List-serv.

The survey was distributed to the contacted leaders of each targeted recreation user group on May 2, 2014. The initial message sent to the leaders of these organizations generally followed the order of thanking them for agreeing to distribute the survey, a description of the purpose of the research, an excerpt to include in the survey's distribution to their members, the survey link, and a request for them to reply to the message once they have distributed the information to their members. If a reply was not received by May 8, 2014, from this leader, a reminder email was then sent to them. On May 13, 2014, the survey was made available on the Presque Isle State Park Facebook page and distributed to Presque Isle State Park's volunteer email list. A final notification was sent to all the organization leaders on May 18, 2014, to encourage any final survey responses before the closing date. The survey was closed on May 23, 2014. The explanatory excerpt that was provided for distribution with the survey by the organization leaders to their members read as follows:

“Nick Decker is an undergraduate student at Penn State University and an Erie area native pursuing a degree in Recreation, Park, and Tourism Management. He is investigating relationships between recreation and invasive species at Presque Isle State Park for his thesis research. Your participation in the survey that he created for this purpose is important for him to be able to provide valuable insights to Presque Isle's management. Please take the survey now by following the link below. At the conclusion of the survey, you will be given a chance to enter a drawing to win a \$50 Visa gift card. Thank you.”

Instrumentation

The survey questionnaire instrument for this study (Appendix A) was developed and distributed using *Qualtrics* online survey software. It is composed of four parts, 1) Park visitors' recreation at

Presque Isle State Park, 2) Invasive species at Presque Isle State Park, 3) Park visitors' invasive species management opinions, and 4) Park visitors' socio-demographic characteristics.

The first component regarding outdoor recreation activity at Presque Isle State Park was formatted in a way similar to the approach taken in the 2014 Pennsylvania Resident Outdoor Recreation Survey instrument. These adapted items measured the survey participants' frequency and type of recreation at PISP. The activities listed in the survey to choose from included trail use (e.g. biking, hiking, in-line skating), fishing from boats, fishing from shore, motorized boating, non-motorized boating (e.g. kayaking, sailing), birdwatching, beach use (e.g. swimming, sunbathing), and three opportunities for the survey participants to list their own activities. An additional activity selection item was developed to determine which recreation activity participants identify as their *primary* activity. All these items were necessary to identify which of the four outdoor recreation user groups the participant most strongly identified with and was used as a basis for activity group classification.

Activity questions were followed by a multiple choice item inquiring the level of knowledge the survey participants felt they had of invasive species. This strategy is similar to that taken by Ceurvorst and Allred (2013) before the participant delves into further, more detailed questions about invasive species. The question also served as a lead into a brief educational page similar to the section in the Adams et al. (2007) survey document. This page included a description of invasive species in general and pictures of key invasive species on the park. As part of this picture list, survey participants were asked to indicate if they have felt each species had or did not have an impact on their recreation at PISP (See Question 5, Appendix A). An opportunity was also provided to the survey participant to identify any other species that impacted their recreation at PISP in the past 12 months. The educational page was included to collect this data but also develop at least a baseline knowledge of PISP invasive species among survey participants.

The second component regarding invasive species' role in the user's recreation at PISP began with a list of outdoor recreation elements that invasive species have been reported to impact. These items included the participant's well-being (Pejchar & Mooney, 2009), functionality of equipment (Pejchar & Mooney, 2009), access to recreation areas (Adams et al., 2007), views (Ceurvorst & Allred, 2013; Pejchar

& Mooney, 2009), and natural resource availability (Eiswerth, Donaldson, & Johnson, 2000). Participants were asked, "From the list provided below, please indicate the type of impact invasive species has had on various aspects of your outdoor recreation at Presque Isle State Park in the past 12 months." The response categories ranged from 1 = Extremely Negative Impact, 2 = Negative Impact, 3 = No Impact, 4 = Positive Impact, and 5 = Extremely Positive Impact (See Question 6, Appendix A). This item was followed by a scale item to determine the overall felt impact from invasive species that was adopted from the Adams et al. study in 2007 as well. The item in the survey read, "Invasive species overall effect on your recreation at Presque Isle State Park." The response categories for this item ranged from 1= Extremely Detrimental, 2 = Detrimental, 3 = Neither Detrimental or Beneficial, 4= Beneficial, and 5 = Extremely Beneficial (See Question 7, Appendix A).

The third component of the survey related to the participant's preferences for invasive species management and began with a question to determine if the survey participant was aware of invasive species management efforts on the park (See Question 8, Appendix A). Survey participants were asked, "Are you aware of any efforts Presque Isle State Park has made to manage invasive species?" The available responses included, "Yes, I have seen and/or heard about the efforts the park has made to manage invasive species," "No, I am not aware of any efforts the park has made to manage invasive species," and "Not sure." This was followed by a list of items that survey participants were asked to respond to in order to determine their attitudes for invasive species management in general at PISP (See Question 9, Appendix A). The response categories ranged from 1= Strongly Disagree, 2 = Disagree, 3= Neither Agree or Disagree, 4 = Agree, and 5 = Strongly Agree (See Question 9, Appendix A). The items listed in order were, "Presque Isle State Park's management of invasive species makes the park a better place," "Actions taken by Presque Isle State Park to manage invasive species do more harm than if the species were left alone," "The efforts made by Presque Isle State Park to manage invasive species are ineffective," "Actions taken by Presque Isle State Park to manage invasive species are necessary," and "My recreational experiences at Presque Isle State Park are improved by the management of invasive species." This list of items was computed into an overall index that had an acceptable internal reliability based upon a calculated Cronbach's Alpha level of 0.787. The next item in the survey was a series of items

that identified specific strategies that the park has been using or could use as an option for invasive species management. Survey participants were prompted to respond based on what methods they felt would be agreeable for their future recreational use of the park. Strategies included in the series were invasive species mechanical removal, chemical control, biological control, native introductions, controlled burn, public education, and public volunteer involvement. The response categories ranged from 1 = Strongly Oppose, 2 = Oppose, 3 = Neither Oppose or Support, 4 = Support, and 5 = Strongly Support (See Question 10, Appendix A).

In order to better understand the profile of activity groups, a final survey component involved collecting basic data concerning participant demographic characteristics. Information that was requested from the survey participants included age, gender, the highest level of education completed by the survey participant, and the zip code of their current residence. The logic for including each of these items was drawn from a 2013 article by Smith regarding the value of demographic survey items. Finally, at the conclusion of the survey the participants were given an opportunity to enter a drawing for a \$50 Visa gift card as a thank you for their time. If a participant chose to enter this drawing they were asked to provide their name and phone number that would only be used to contact them if they were a winner.

Analysis

The survey was distributed through email lists and social media using convenience sampling procedures. Despite these targeted efforts to increase survey response rates, high nonresponse that is common as part of this self-administered approach was still an issue (Bethlehem, 2009). It was roughly estimated this survey could reach a potential audience of 5,860 people involved in the organizations approached (not including Facebook users) based upon the size of each organization as reported from their lead representative. The survey was closed for participation with a total of 718 initial responses (response rate estimate = 12.25%). It is suspected that the largest contributors to this response rate were the Facebook users and PISP Volunteers because until the survey was made available to these groups the number of responses was significantly lower.

After the data collection period, analysis was performed using SPSS Statistics. The data set was refined by removing surveys which were incomplete or surveys where recreationists were not identified

as boaters, birders, trail users, or beach users. This resulted in a reduction from the 718 total responses to 517 usable survey responses that broke down further as 84 boater respondents, 44 birder respondents, 227 trail user respondents, and 162 beach user respondents. Additionally, the scales for the negatively framed items in the index regarding overall invasive species management approval were reversed to improve the ease of research analysis.

Two types of information were analyzed by calculating percentage of total members from each outdoor recreation user group with cross-tabular analysis. The first of these areas was the socio-demographic information from survey participants. The other cross-tabular analysis was among the reported awareness of PISP management efforts. These cross tabulations were then used to perform Chi-square tests for statistical differences between the percentages of response in each category for the various outdoor recreation user groups considered.

Further general topics of research identified in research questions 1a., 2a, 2b, 3a, and 3b presented in Chapter 1 were approached using one-way Analysis of Variance (ANOVA) and Tukey's B post hoc test. Specifically, the variables of self-reported knowledge of invasive species, perceived impacts on recreational experiences, support for invasive species management at PISP, and the use of various management strategies were assessed through a series of one-way ANOVAs to determine statistical variations. Tukey's B post hoc tests were employed to determine which groups were significantly different from one another. This allowed for statistical comparisons of responses among the outdoor recreation user groups considered to be made for each item while accounting for statistical significance and data reliability.

CHAPTER 4

RESULTS

Survey participants were first asked to provide information about their outdoor recreation participation at PISP to determine which outdoor recreation user group they would be categorized in for analysis. Of the 517 completed surveys, 44 survey participants were categorized primarily as birders (8.5%), 84 survey participants were categorized primarily as boaters (16.2%), 227 survey participants were categorized primarily as trail users (43.9%), and 162 survey participants were categorized primarily as beach users (31.3%). The survey participants were also prompted to provide additional socio-demographic information at the end of the survey. This section included questions about their age, gender, the highest level of education completed by the survey participant, and the zip code of their current residence. Generally across the four outdoor recreation user groups, the majority of survey participants were females from the two older age categories with at least some college experience (Table 1). The majority of survey participants across each outdoor recreation user group also did not visit the park weekly or with greater frequency (Table 1). However, there were statistical differences between the outdoor recreation user groups for each socio-demographic percentage response considered (Table 1).

Table 1. Stakeholder Socio-Demographic and Visitation Characteristics

Variable	Birders n (%)	Boaters n (%)	Trail Users n (%)	Beach Users n (%)	χ^2 (p)
Sex/Gender					
Female	26 (66.7)	42 (55.3)	147 (74.6)	107 (83.6)	20.55
Male	13 (33.3)	34 (44.7)	50 (25.4)	21 (16.4)	(.000)
Age					
18-34	3 (7.7)	11 (14.5)	30 (15.0)	28 (21.5)	
35-54	7 (17.9)	32 (42.1)	75 (37.5)	67 (51.5)	31.23
55 or older	29 (74.4)	33 (43.4)	95 (47.5)	35 (26.9)	(.000)
Education					
High School Diploma or Less	8 (20.5)	4 (5.3)	16 (8.0)	14 (10.9)	
Some College/Bachelor Deg.	16 (41.0)	49 (64.5)	134 (67.0)	89 (69.5)	16.21
Masters Degree or Higher	15 (38.5)	23 (30.3)	50 (25.0)	25 (19.5)	(.013)
Park Visitation Frequency					
Weekly	17 (38.6)	40 (47.6)	97 (42.7)	27 (16.7)	36.03
Less than Weekly	27 (61.4)	44 (52.4)	130 (57.3)	135 (83.3)	(.000)

Knowledge and awareness of PISP invasive species and their management

The mean self-reported knowledge level across all the outdoor recreation user groups ranged from 2.17 to 2.82 on a 5 point scale (Table 2). This indicates individual outdoor recreation user groups self-reported knowledge levels for each grouping was between some (knowing a few things about invasive species) and moderate (knowing the basic information and a few details about invasive species). Results from the one-way ANOVA and post hoc analysis indicated that there were significant differences between the means for these self-reported knowledge levels of PISP invasive species ($F=8.62$, $p=0.000$; Table 2). Birders' self-reported knowledge level was significantly higher ($M=2.82$) than trail users' ($M=2.35$) and beach users' ($M=2.17$). Additionally, boaters' self-reported knowledge level was significantly higher than beach users' ($M=2.17$) (Table 2). This indicates that in response to research question 1a., there were significant differences in Presque Isle State Park invasive species self-reported knowledge across various outdoor recreation user groups.

Table 2. Comparison of PISP visitors self-reported knowledge levels of invasive species across outdoor recreation user groups

Item*	Birders (n=44)	Boaters (n=84)	Trail Users (n=227)	Beach Users (n=162)	F**	p
Self Reported Knowledge Level	2.82 ^a	2.61 ^{ab}	2.35 ^{bc}	2.17 ^c	8.62	.000

* Knowledge of PISP invasive species was measured with a single item measured on a 5 point scale where 1=None (I have no knowledge about invasive species), 2=Some (I know only a few things about invasive species), 3=Moderate (I know the basic information and a few details about invasive species), 4=Advanced (I know a considerable amount about invasive species), and 5=Expert (I have extensive knowledge about invasive species)

** Superscripts indicate significant mean differences across outdoor recreation user groups.

When considering the outdoor recreation user groups' awareness of efforts that PISP has made to manage invasive species, a considerably high percentage of survey participants across all the groups had seen or heard about efforts the park had made to manage invasive species. The highest percentage of outdoor recreation users who reportedly have seen and/or heard about the efforts the park has made to manage invasive species was the birders (94.9%) and the lowest was the beach users (58.9%; Table 3). The results for boaters and trail users indicates percentages between these two at 80.3% and 77.0%,

respectively (Table 3). This indicates that in response to research question 2a., there were statistical differences in awareness of efforts that PISP has made to manage invasive species, $\chi^2 = 27.05$, $p = .000$.

Table 3. Awareness of efforts that PISP has made to manage invasive species

Response	Birders n (%)	Boaters n (%)	Trail Users n (%)	Beach Users n (%)
Yes, I have seen and/or heard about the efforts the park has made to manage invasive species	34 (94.9)	61 (80.3)	154 (77.0)	76 (58.9)
No, I'm not aware of any efforts the park has made to manage invasive species	1 (2.6)	12 (15.8)	32 (16.0)	38 (29.5)
Not sure	1 (2.6)	3 (3.9)	14 (7.0)	15 (11.6)

Note: The results from Chi-square testing for statistical difference in these response values were $\chi^2 = 27.05$, $df=6$, $p = .000$

Impact of invasive species on outdoor recreation

Results from the one-way ANOVA and post hoc analysis show various significant differences in how impacts are perceived across the various recreation user groups. Birders reported having a more significantly negative impact ($M=2.07$) from invasive species on their sights than any other outdoor recreation user group ($F=6.70$, $p=0.000$; Table 4). Analysis also showed birders reported significantly more negative impact ($M=2.34$) of invasive species on their recreation activity goals than beach ($M=2.73$) and trail users ($M=2.77$; Table 4). Boaters reported significantly more negative impact ($M=2.49$) of invasive species on their recreation activity goals than did trail users, ($F=6.94$, $p=0.000$; Table 4). Analysis of responses to invasive species' impact on functionality of equipment revealed that boaters reported a significantly more negative impact ($M=2.59$) than the other three outdoor recreation user groups ($F=13.30$, $p=0.000$; Table 4). Birders reported a significantly more negative impact on their access to recreation areas ($M=2.24$) from invasive species than the other three outdoor recreation user groups ($F=3.74$, $p=0.011$; Table 4). There were no significant differences among the outdoor recreation user groups' reported impacts of invasive species on quality of recreation, well-being, or availability of natural resources necessary for recreation found in the analysis. This indicates that in response to research

question 2a., there were some specific elements of the recreation experience at PISP on which invasive species are perceived to have significantly different impacts across various outdoor recreation user groups.

Results from the survey item regarding the overall impact of invasive species on recreation at PISP indicated that birders reported invasive species as more detrimental (M=2.39) to their recreation than trail users(M=2.64) and beach users (M=2.74), while boaters reported more detrimental impacts to their recreation (M=2.51) than beach users (F=5.43, p=0.001; Table 4). This indicates that in response to research question 2b., there were significant differences in the perceived overall impact of invasive species on outdoor recreation at PISP across some outdoor recreation user groups.

Table 4. Comparison of invasive species' perceived impact on outdoor recreation across outdoor recreation user groups

Type of Impact*	Birders (n=44)	Boaters (n=84)	Trail Users (n=227)	Beach Users (n=162)	F**	p
Sights (viewscapes, sightlines)	2.07 ^a	2.56 ^b	2.51 ^b	2.70 ^b	6.70	.000
Well-being (physical health)	2.85	2.88	2.96	2.89	0.79	.499
Recreation activity goals	2.34 ^a	2.49 ^{ab}	2.77 ^c	2.73 ^{bc}	6.94	.000
Functionality of equipment	2.58 ^b	2.30 ^a	2.78 ^b	2.78 ^b	13.30	.000
Access to recreation areas	2.24 ^a	2.59 ^b	2.65 ^b	2.69 ^b	3.74	.011
Quality of recreation	2.54	2.70	2.77	2.70	1.15	.274
Availability of nat. resources necessary for recreation	2.69	2.77	2.78	2.86	1.30	.328
Overall Impact	2.39 ^a	2.51 ^{ab}	2.64 ^{bc}	2.74 ^c	5.43	.001

* Specific elements of outdoor recreation measured on a 5 point scale where 1=Extremely Negative Impact, 2=Negative Impact, 3=No Impact, 4=Positive Impact, and 5=Extremely Positive Impact; Overall impact measured on a 5 point scale where 1=Extremely Detrimental, 2=Detrimental, 3=Neither Detrimental or Beneficial, 4=Beneficial, and 5=Extremely Beneficial.

** Superscripts indicate significant mean differences across outdoor recreation user groups.

Attitudes towards invasive species management

Results from the one-way ANOVA and post hoc analysis performed for the index of management support items indicate that there were no significant differences found between outdoor recreation user groups for any the specific item listed (Table 5). These items included “PISP invasive species

management makes the park a better place,” “Actions taken by PISP to manage invasive species do more harm than if the species were left alone,” “The efforts made by PISP to manage invasive species are ineffective,” “Actions taken by PISP to manage invasive species are necessary,” and “My recreational experiences at PISP are improved by the management of invasive species.” Overall, the computed index indicated there was no significant difference found between the outdoor recreation user groups general support for invasive species management at Presque Isle State Park (Table 5). Generally, all the recreation user groups indicate at least slight agreement with statements in support of invasive species management at PISP, ranging from 3.67 to 3.94 on a 5 point scale (Table 5). This indicates that in response to research question 3a., there were no significant differences in the levels of support for invasive species management in general at PISP across various outdoor recreation user groups.

Table 5. Comparison of support for PISP invasive species (IS) management across outdoor recreation user groups

Statement*	Birders (n=44)	Boaters (n=84)	Trail Users (n=227)	Beach Users (n=162)	F	p
PISP IS management makes the park a better place	4.13	3.92	3.94	3.83	1.48	.220
Actions taken by PISP to manage IS do more harm than if the species were left alone (R)	3.97	3.72	3.85	3.71	1.49	.217
The efforts made by PISP to manage IS are ineffective (R)	3.49	3.30	3.40	3.33	0.69	.553
Actions taken by PISP to manage IS are necessary	4.26	4.05	4.08	3.95	1.39	.245
My recreational experiences at PISP are improved by the management of IS	3.87	3.61	3.56	3.55	1.73	.161
Overall Index**	3.94	3.72	3.77	3.67	2.21	.087

(R) indicates items that were reverse coded during analysis

* Support for invasive species (IS) management was measured with various statements on a 5 point scale where 1=Strongly Disagree, 2=Disagree, 3=Neither Agree nor Disagree, 4=Agree, and 5=Strongly Agree. Overall index represents an average score of the five items.

** Superscripts indicate significant mean differences across outdoor recreation user groups.

Finally, comparisons of support for specific PISP invasive species management practices across the four outdoor recreation user groups indicated no significant differences for six of the seven specific management strategies presented. Overall, the outdoor recreation user groups reported the least support

and even some opposition to chemical and biological control practices as well as controlled burn practices. Alternatively, the outdoor recreation user groups generally reported the most support for mechanical removal, native introductions, public education programs and volunteer involvement in invasive species work. With the exception of one management practice, the results indicated a range of support from 3.13 to 4.33 on a 5 point scale. This indicates at least slight agreement from all outdoor recreation user groups with these management strategies. The only strategy that outdoor recreation user groups expressed significantly different levels of support that fell below this range (and into the realm of opposition) was chemical control. Specifically, boaters (M=3.07) and birders (M=3.05) indicated significantly more agreement with chemical control strategies than beach users who had a slight opposition (M=2.45) to this strategy (F=5.98, P=0.001; Table 6). Trail users expressed a slight opposition (M=2.64) to chemical control strategies, but this was not significantly different from any other outdoor recreation user group (Table 6). This indicates that, in response to research question 3b., there was only one specific management practice for which some outdoor recreation user groups have significantly different levels of support for at PISP.

Table 6. Comparison of support for specific PISP invasive species (IS) management practices across outdoor recreation user groups

IS Management Strategy*	Birders (n=44)	Boaters (n=84)	Trail Users (n=227)	Beach Users (n=162)	F**	p
Mechanical Removal	4.18	4.09	4.05	4.15	0.66	.576
Chemical Control	3.05 ^a	3.07 ^a	2.64 ^{ab}	2.45 ^b	5.98	.001
Biological Control	3.23	3.19	3.13	3.16	0.14	.936
Controlled Burn	3.67	3.49	3.35	3.28	1.86	.136
Native Introductions	4.23	4.21	4.12	4.16	0.45	.716
Public Education Programs	4.41	4.40	4.36	4.31	0.31	.821
Volunteer Involvement in Invasive Species Work	4.33	4.31	4.25	4.33	0.40	.756

* Support for specific invasive species management practices measured on a 5 point scale where 1=Strongly Oppose, 2=Oppose, 3=Neither Support nor Oppose, 4=Support, and 5=Strongly Support

** Superscripts indicate significant mean differences across outdoor recreation user groups.

CHAPTER 5

DISCUSSION

While other studies such as Adams et al. (2007), Prinbeck et al. (2011), and Sharp et al. (2011) have approached public perceptions of invasive species and their management from various perspectives (e.g. willingness to pay for management, barriers to public behavioral changes, environmental attitudes and basic demographics indicating perceptions) this study investigated yet another unique perspective of potential value especially for park and public land managers. This study investigated potential differences in public perceptions based on the survey participants' reported primary outdoor recreation user group while at PISP. The results from this study indicated there was no difference in the level of general support for management of invasive species at PISP between the four outdoor recreation user groups that were considered. Additionally, of the seven specific invasive species management strategies, only one (chemical control) resulted in significantly different levels of reported support between the outdoor recreation user groups. However, there were identifiable differences in perceived impacts from invasive species on recreation experiences across the user groups as well as differences in self-reported knowledge of invasive species at PISP.

Outdoor recreation user group member characteristics

The outdoor recreation user groups' socio-demographics were largely consistent with what would be expected based upon previous studies. The sample sizes for each outdoor recreation user group was generally proportional with the activity participation rates reported at PISP by an earlier visitor survey (Mowen et al., 2013). In the current study it was found that females generally had higher representation in the sample than males across all outdoor recreation user groups considered. This led to some inconsistency with national data such as the recreational boater data from the United States Coast Guard which reported slightly higher male participation than female (2012). Also, the survey participants were generally from the older age categories which might indicate this particular group's heightened interest in the invasive species topic since some might likely remember "the way it used to be" at PISP. However, when looking at a specific outdoor recreation user group, birders stood out from the other activities in

terms of their age and education levels. The findings of this study regarding birders reflect findings reported by Carver (2011). In both these studies the highest percentage of birders were 55 or older and predominately female. Even the percentage of birders that had a high school diploma or less, which was higher than the other outdoor recreation user groups in this study, was consistent with Carver's report that 25% of birders had 12 years of education or less (2011). This can probably be accounted for because of this older cohort would have been in school when the typical top range of education was high school. In contrast to this older demographic and lower levels of reported education, beach goers in this study were generally younger, as would be expected. They also reported more college experience at the bachelor's level than any of the other outdoor recreation user groups considered. Additionally, the frequency of visitation to PISP was considerably lower for beach users than the other outdoor recreation user groups included in the study. This could be at least partially attributed to the higher seasonality of beach use in the region, but could also be a function of the distance between the user group members' homes and PISP, which was not considered in the current analysis. Trail users were apparently similar to beach users in most of the socio-demographics considered, but the trail users had the highest percentage of female participants compared to the other outdoor recreation user groups. This is consistent with another study's reported higher proportion of women who tend to use multi-purpose trails than men (Troped, Saunders, & Pate, 2005). Finally, boaters surveyed in this study were somewhat unique in that a higher percentage of boaters than the other outdoor recreation user groups) visited PISP at least weekly over the past 12 months. This might be able to be accounted for by the high level of dedication that Erie Yacht Club members (a boating organization targeted in the data collection) have to being active in their organization.

Knowledge and awareness of PISP invasive species and their management

The highest level of self-reported knowledge of invasive species in this study was from birders. This could be the result of numerous factors. One particularly intriguing possibility is that birders have closer ties to biological systems because it is an inherent part of their recreation experiences. In fact, bird-watching is more wildlife-dependent than any of the other outdoor recreation user groups that were considered in the study. Therefore, birders are likely to know more about aspects of the wildlife and their habitat such as invasive species. Birders also had the highest percentage of members who reported having

a Master's degree or higher. Furthermore, the lack of significant difference in self-reported knowledge between birders and boaters might be accounted for by an emphasis on the prevention of aquatic hitchhikers by the Pennsylvania Fish and Boat Commission. This messaging specifically targets boaters for its invasive species educational series. Signs related to this issue are readily visible at boat launches around the park.

Trail users and beach users self-reported knowledge was lower than boaters and birders. This is likely because, unlike, boaters and birders these other outdoor recreation users may be less interested in and not as well targeted for conservation and biodiversity messages. Indeed, the PA DCNR invasive species educational series found on their website portal (www.dcnr.state.pa.us) does not include beach users while the issues that were addressed in the hiker's series (e.g. overgrown trails) are not a large concern for users of the paved, well-maintained trails that attract the bulk of trail use at PISP.

The reported awareness of PISP invasive species management efforts is consistent with the level of self-reported knowledge of invasive species at PISP across the outdoor recreation user groups considered. This generally high awareness reflects earlier findings of high awareness among the public regarding invasive species topics (Ceurvorst, & Allred, 2013; Daab & Flint, 2010; Garciallorente et al., 2008). Still, statistical differences in the percentage of participants in these groups who were aware of management efforts for invasive species at PISP indicated some other influences that are specific to each group probably exist. For instance, birders' high awareness levels are, again, likely linked to their increased nature relatedness through their recreation experiences. Support for this view exists in Green and Jones (2010) report on bird-watching tourists in Australia in which they said, "Birders appear to have a general awareness and concern for conservation" (2010, p. 41). Also, the majority of more obvious management efforts that have been conducted at PISP have taken place in settings where birders are more likely to be in contact with it.

Impacts of invasive species on outdoor recreation experiences

When the outdoor recreation user group members were asked about specific impacts of invasive species on their recreation experiences, birders reported the most negative impact among almost all of the categories provided. The categories in which birders were most negatively impacted by invasive species

were sights and access to areas for recreation. It seems obvious, especially at PISP's Gull Point area that this would be the case. It is the primary birding site at PISP which has historically been dominated by invasive plants (e.g. narrow-leaf cattail, common reed) that obstruct lines of sight. Results from this study verify this specific negative impact among birders.

It is well known among birders that, "A lot of birds can be followed on certain trails, but others cannot" (Campor, 2014, Tips for First-Time Bird Watchers, para. 5). This is where invasive species are causing access issues that differ from trail users. Birders seem to sometimes find themselves wandering off the trail in order to track the birds they hear or otherwise suspect to find. This "bushwhacking" strategy is likely when the invasive species are being thought of as a negative impact to their recreation experience. Birders may be encountering thick patches of multiflora rose and bush honeysuckle that are practically impossible to pass through.

The only category of impact in which birders did not report more negative impact than all the other outdoor recreation user groups was the functionality of equipment. The most negative impact in this particularly category was reported by boaters and their views on this impact were different from the other user types. This is consistent with frequent claims from other aquatic based recreation sources that report aquatic weeds entangle propellers, zebra and quagga mussels causing engines to overheat, and round gobies wasting bait (Pennsylvania Sea Grant, 2012; "*Round Goby*," n.d.; "*Zebra mussels threaten inland waters*," n.d.).

All these specific impacts for various outdoor recreation user groups serve as a good indicator of the overall reported impact of invasive species by the outdoor recreation user groups that were considered. Beach users, trail users, and boaters were all found to be slightly negatively impacted while the birders were the closest to expressing an overall negative impact. This tendency is likely the result of multiple influences. Some of them might include invasive species greatest areas of prominence (e.g. more invasive species in the forested areas where birders are than on the beaches where beach goers are), management's success in eliminating recreational interference of invasive species for certain groups (e.g. paved paths prevent invasive species from interfering with trail use), and again the extent to which the

specific user group is dependent on wildlife (e.g. birders require more interaction with wildlife than beach goers for a successful recreational experience).

Attitudes towards invasive species management at PISP

Invasive species management is not a static concept. Invasive species can be managed with a variety of methods such as those examples provided in the survey. Of these approaches, various items can be generalized into two basic categories: direct and indirect management approaches. The direct approaches would include items such as mechanical removal and controlled burn. The indirect management approaches are items such as public education programs. As supported in prior literature, the study results suggest that all the outdoor recreation user groups prefer more indirect management strategies (Manning, 2007). However, the results of this study indicate some outdoor recreation user groups have similarly higher levels of approval for less intrusive direct management strategies (i.e. mechanical removal). This may mean that a transition is occurring where particular outdoor recreation user groups are realizing the necessity for such direct actions to improve conditions for their recreational experiences.

Another reason for lower support for chemical control, biological control, and controlled burns may be because of the terminology used; the detailed information about these methods may not be clearly understood. Their perceptions of these methods may be overshadowed by past stories of misuse, mishaps, or other instances that generally increased a feeling of elevated risk with these management practices. Moreover, higher support levels for management practices such as educational programming and native introductions (e.g. tree plantings) could be partially attributed to the romanticism or general appeal regarding these indirect management practices.

Chemical control was the only specific management strategy that was significantly different across the outdoor recreation user groups. This is a strategy that is being used at PISP and has been a controversial topic among visitors at least the past few years (Drahos, 2013; Beyond Pesticides, 2013). Response to chemical control may have been different during previous periods at the park, but given that chemical control is currently done in conjunction with other methods (e.g. mechanical removal) it is

possible that outdoor recreation user groups have found that there is evidence indicating higher chemical control effectiveness in many instances.

Practical implications for park management

As intended from this study's original purpose, results can provide direction for PISP to increase the effectiveness of invasive species management. First, the overall support for invasive species management across all the outdoor recreation user groups is very favorable. It is a clear indication that PISP should continue to take steps to manage the invasive species at PISP. However, there is still room for improvement of public perceptions of invasive species and management at the park, particularly among trail users and beach users who make up a large percentage of park visitors.

Although none of the other outdoor recreation user groups should be ignored, beach users and trail users should be particularly focused on for efforts to convey how chemical control methods have been shown to be effective for managing certain invasive species. Furthermore, better connecting possible negative recreation experiences (e.g. painful pricks of zebra mussel shells scattering the shorelines) to the broader issue of invasive species for these outdoor recreation user groups may be beneficial to further promoting the need for invasive species management at PISP.

Another outdoor recreation user group, birders, are reportedly most negatively impacted by the invasive species while still having high value for their recreation experiences at the park. This indicates that they should be most willing to do something to manage for increased recreational quality through invasive species management efforts. In other words, birders and their supporting organization are likely sources of indirect management strategies (e.g. volunteers).

Also, boaters' high level of self-reported knowledge and reported impacts are possible indications of educational promotional strategy effectiveness. Similar education and promotion efforts used for this outdoor recreation user group could be effective for the other outdoor recreation user groups. Furthermore, it is advisable that management remain conscious of outdoor recreation user groups' more likely acceptance of indirect management strategies while direct strategies (e.g., chemical control) may require more time and explanation for groups such as beach goers and trail users. These communications

should strive to relate not only the biological importance of the management strategies, but also how it will improve recreational experiences for these particular user groups.

Study limitations and future research

There were several limitations to this study that should be acknowledged. These limitations include terminology, sampling methodology, and collapsed data. Using the term “invasive species” within the survey instrument immediately creates the potential for response bias. This is because responses to questions including this term could have been based upon the term’s connotation which would steer participants towards generally more negative reported views. Also, despite the survey instrument’s specific explanation for what is qualified as an invasive species, there was likely still confusion about the term’s true meaning to survey participants.

Another limitation was the convenience sampling used to take advantage of existing outdoor recreation associations for sampling of specific activity user groups . These activity groups might hold certain values and activity needs making them more attuned to invasive species and not a true representation of all visitors to PISP. For example, the S.O.N.S. of Lake Erie is a group of primarily anglers who were targeted for the survey. The acronym in this organization’s name means save our native species which obviously would influence these group members’ responses compared to other survey participants not a part of this specialized organization.

Additionally, this study only defined one outdoor recreation user group (birders) specifically enough to be able to assume what a typical group member’s recreational experience involves at PISP. Other defined groups such as boaters were collapsed into a generic category in order to have sufficient sample sizes for the purpose of activity comparisons. This group of boaters for instance contains a diverse pool of motorized (e.g. speed boaters, personal watercraft users) and non-motorized (e.g. kayakers, rowers, sailers) members who could have very different perceptions and opinions. Future studies should attempt to target sufficient numbers of specific boating users with respect to invasive species awareness, knowledge, and impacts.

Furthermore, this study focused only on users of one park (PISP) that had an ongoing invasive species management program. These results should not be generalized to other park settings without

careful consideration of the particular context. Future research could address this limitation by assessing different types of outdoor recreation settings and different regions of the state or nation. One future research idea would also be to focus on the specific invasive species that are impacting each outdoor recreation user group. For instance, when birders report that their sights and access to recreation areas are the most negatively impacted aspect of their recreation experience, are they referring to phragmites, oriental bittersweet, bush honeysuckle or something else? Also, how do the species reported by them differ from those a trail user might identify? This information could help park managers consider recreational values while prioritizing invasive species work areas and timing. More intricately designed field studies could also take advantage of abilities to compare outdoor recreation user group members' perception of recreation impacts in pristine (invasive species free) areas compared to areas occupied by invasive species.

Conclusion

Invasive species is not an issue that can be resolved overnight and will certainly be an ongoing challenge for park managers in the years to come. By exploring invasive species' relationships with recreational activities and experiences at parks, managers will be able to make more informed decisions that benefit not only ecosystems, but also recreation opportunities. This study specifically found that outdoor recreation user groups have different perceptions of invasive species and, to a lesser degree, their management. Understanding social impacts in this way is becoming increasingly important at PISP and other parks as the value of outdoor recreation increases concurrently with the threats to the natural resources that these activities depend on. It will be important that differences such as the ones found in this study are accounted for in future invasive species management practices and policies. Their inclusion could ease the strain that invasive species puts on recreational experiences, improve target educational programs, and ultimately improve park management decision making.

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APPENDIX

SURVEY INSTRUMENT

SUMMARY EXPLANATION OF RESEARCH

The Pennsylvania State University

Title of Project: Outdoor recreation and invasive species at Presque Isle State Park

Principal Investigator: Nick Decker

Telephone Number: 814-602-8626

Advisor: Andrew Mowen

Advisor Telephone Number: 814-865-2102

You are being invited to volunteer to participate in a research study. This summary explains information about this research.

- The study results will be aggregated to help park managers make more informed decisions involving invasive species and your recreation for the betterment of Presque Isle State Park.
- As a participant in this study you will be expected to progress through four sections of a survey which are 1) Your Outdoor Recreation at Presque Isle State Park, 2) Invasive Species at Presque Isle State Park, 3) Invasive Species Management at Presque Isle State Park, 4) Basic Demographics. The survey is estimated to take 10 minutes to complete.
- Your confidentiality will be maintained to the degree permitted by the technology used. Specifically, no guarantees can be made regarding the interception of data sent via the Internet by any third parties.
- Participants in this study must be 18 years old and fluent in the English language

If you have questions or concerns, you should contact Nick Decker at 814-602-8626. If you have questions regarding your rights as a research subject or concerns regarding your privacy, you may contact the Office for Research Protections at 814-865-1775.

Your participation is voluntary and you may decide to stop at any time. You do not have to answer any questions that you do not want to answer.

Your participation implies your voluntary consent to participate in the research.

SECTION 1. Your Outdoor Recreation at Presque Isle State Park

In this first set of questions, we would like to know more about your outdoor recreation at Presque Isle State Park.

1. During the past 12 months, how often did you participate in outdoor recreation at Presque Isle State Park? Please check the category that best describes your level or frequency of participation.

- Two or more times per week
- About once per week
- About once or twice per month
- Several times during the year
- Once or twice a year
- I never participate in outdoor recreation at Presque Isle State Park

2. Look at the list of activities provided directly below. Please check any activity you have participated in and indicate how many times you participated in that activity in the past 12 months at Presque Isle State Park. Even if you do not know the exact number, please enter your best guess.

	Check if you participated during the past 12 months	Number of times you have participated in the past 12 months
Trail use (e.g. biking, walking, hiking, in-line skating)	<input type="checkbox"/>	<input type="text"/>
Fishing from boats	<input type="checkbox"/>	<input type="text"/>
Fishing from shore	<input type="checkbox"/>	<input type="text"/>
Motorized boating	<input type="checkbox"/>	<input type="text"/>
Non-motorized boating (e.g. kayaking, sailing)	<input type="checkbox"/>	<input type="text"/>
Birdwatching	<input type="checkbox"/>	<input type="text"/>
Beach use (e.g. swimming, sunbathing)	<input type="checkbox"/>	<input type="text"/>
Other Activity #1:	<input type="checkbox"/>	<input type="text"/>
Other Activity #2:	<input type="checkbox"/>	<input type="text"/>
Other Activity #3:	<input type="checkbox"/>	<input type="text"/>

3. From the activities listed above which one do you consider as your primary recreation activity during your visits to Presque Isle State Park? Please select one activity from the drop-down menu.

Not selected
 Trail use
 Fishing from boats
 Motorized boating
 Non-motorized boating
 Birdwatching
 Beach use
 Other Activity

Section 2. Invasive Species at Presque Isle State Park

The next series of questions pertain to invasive species at Presque Isle State Park. For the purpose of this survey, invasive species are considered any population that does or is likely to cause economic harm, environmental harm, or harm to human health.

4. What level of knowledge do you have of invasive species at Presque Isle State Park? Please check the item that best describes your knowledge level.

- None - I have no knowledge about invasive species at Presque Isle State Park.
 Some - I know only a few things about invasive species at Presque Isle State Park.
 Moderate - I know the basic information and a few details about invasive species at Presque Isle State Park.
 Advanced - I know a considerable amount about invasive species at Presque Isle State Park.
 Expert - I have extensive knowledge about invasive species at Presque Isle State Park.

Presque Isle State Park has:

A range of unique habitats

A diverse plant and animal community

A number of invasive species

Below you will find some examples of species considered to be invasive at Presque Isle State Park

5. Check any species that you feel has impacted your recreation at Presque Isle State Park in the past 12 months. **Common name** (*scientific name*)

— **Common Reed** (*Phragmites australis*)



— **Zebra mussel** (*Dreissena polymorpha*); **Quagga mussel** (*Dreissena rostriformis bugensis*)



— **Round goby** (*Neogobius melanostomus*)



— **Eurasian watermilfoil** (*Myriophyllum spicatum*)



— **Oriental bittersweet** (*Celastrus orbiculatus*)



— **Bush honeysuckle** (*Lonicera sp.*)



— **Narrowleaf cattail** (*Typha angustifolia*); **Hybrid cattail** (*Typha x glauca*)



Are there any other invasive species not displayed above that have affected your outdoor recreation at Presque Isle State Park in the past 12 months? Please check your response.

Yes, in the past 12 months my outdoor recreation at Presque Isle State Park has been affected by other invasive species. Please identify the invasive species the best you can in the box provided.

I am not sure if my recreation at Presque Isle State Park has been affected by any other species than already indicated above.

No, in the past 12 months my outdoor recreation at Presque Isle State Park has not been affected by any other species than are already indicated above.

6. From the list provided below, please indicate the type of impact invasive species has had on various aspects of your outdoor recreation at Presque Isle State Park in the past 12 months.

	Extremely Negative Impact (1)	Negative Impact (2)	No Impact (3)	Positive Impact (4)	Extremely Positive Impact (5)
Sights (i.e. viewscapes, sightlines)	—	—	—	—	—
Well-being (i.e. Physical health)	—	—	—	—	—
Recreation activity goals	—	—	—	—	—
Functionality of equipment	—	—	—	—	—
Access to recreation areas	—	—	—	—	—
Availability of natural resources necessary for recreation	—	—	—	—	—
Quality of recreation	—	—	—	—	—
Other:	—	—	—	—	—

7. What is the overall impact of invasive species on your outdoor recreation at Presque Isle State Park? Please check the item that best describes your opinion.

	Extremely Detrimental (1)	Detrimental (2)	Neither Detrimental or Beneficial (3)	Beneficial (4)	Extremely Beneficial (5)
The overall impact of invasive species on your recreation at Presque Isle State Park	—	—	—	—	—

Section 3. Invasive Species Management at Presque Isle State Park

In this next set of questions, we are interested in your awareness of and opinions regarding invasive species management at Presque Isle State Park.

8. Are you aware of any efforts Presque Isle State Park has made to manage invasive species?

- Yes, I have seen and/or heard about the efforts the park has made to manage invasive species.
- No, I am not aware of any efforts the park has made to manage invasive species.
- Not sure

9. Please respond to the following statements while considering your recreational interests at Presque Isle State Park.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Presque Isle State Park's management of invasive species makes the park a better place.	—	—	—	—	—
Actions taken by Presque Isle State Park to manage invasive species do more harm than if the species were left alone.	—	—	—	—	—
The efforts made by Presque Isle State Park to manage invasive species are ineffective.	—	—	—	—	—
Actions taken by Presque Isle State Park to manage invasive species are necessary.	—	—	—	—	—
My recreational experiences at Presque Isle State Park are improved by the management of invasive species	—	—	—	—	—

10. Please look at the different methods of invasive species management listed below. Indicate the extent to which you oppose or support these methods when considering your future recreational use of Presque Isle State Park.

	Strongly Oppose (1)	Oppose (2)	Neither Oppose or Support (3)	Support (4)	Strongly Support (5)
Mechanical removal of invasive species (i.e. mowing, raking, tilling, netting)	—	—	—	—	—
Chemical control of invasive species (i.e. herbicide)	—	—	—	—	—
Biological control of invasive species (i.e. introduced predator)	—	—	—	—	—
Controlled burn of invasive species	—	—	—	—	—
Native introductions (i.e. plantings, stocking)	—	—	—	—	—
Public education programs	—	—	—	—	—
Volunteer involvement in invasive species work	—	—	—	—	—

Section 4. Basic Demographics

This survey is almost finished! We just have a few more questions about yourself to help us understand how recreation users with various backgrounds perceive invasive species.

Please select from drop-down menus the choices that best describe yourself.

Age

Not selected
 Under 18 years old
 18-24 years old
 25-34 years old
 35-44 years old
 45-54 years old
 55-64 years old
 65-74 years old
 Over 74 years old

Gender

Male
 Female

Highest degree or level of education completed

Not selected
No schooling completed
Nursery to 8th grade
Some high school, no diploma
High school completed, diploma or equivalent
Some college credit, no degree
Trade/technical/vocational training
Associate degree
Bachelor's degree
Master's degree
Professional degree
Doctorate degree

What is your home zip code?

Before you go, would you like to be entered in a drawing for the \$50 Visa gift card prize?

Winners will be randomly selected in Summer 2014.

Yes, sign me up!
 No thank you.

So that we may contact the winners of the drawing for the \$50 Visa gift card, please provide your name and phone number. Personal identifiers will not be used for any other purpose and will be removed from the data prior to analyzing the results.

Name: _____

Phone Number: _____

Your survey is now complete. Thank you for participating! If you have any questions, please contact the lead researcher for this study, Nick Decker, by clicking [here](#).

ACADEMIC VITA

Nick Decker
nmd5177@psu.edu
(814) 602-8626

Objective: To obtain a career in outdoor recreation services industry.

Professional Experience:

Pennsylvania Department of Conservation and Natural Resources - Prospect, PA
Engineering, Scientific, and Technical Intern (May 2014 - Present)

Penn State Agricultural Sciences - University Park, PA
Research Assistant (February 2013 - Present)

Penn State Adventure Recreation - University Park, PA
Trip Guide (February 2013 - Present)

Pennsylvania Department of Conservation and Natural Resources - Erie, PA
Semi-skilled Laborer/Intern (Summer 2012; Summer 2013)

YMCA Camp Fitch - North Springfield, PA
Summer Camp Counselor; Weekend Activities Facilitator (June 2009 - May 2014)

Education:

The Pennsylvania State University - University Park, PA
B.S. Recreation, Park, and Tourism Management - Outdoor Recreation, Park Management
Expected Graduation: August 2014

Honors and Awards:

- **Eagle Scout** - Boy Scouts of America - French Creek Council (2010)
- **The President's Freshman Award** - The Pennsylvania State University (2012)
- **The Evan Pugh Scholar Award (Junior)** - The Pennsylvania State University (2014)
- **Mills Trustee Scholarship** - The Pennsylvania State University - Jon Mills (2013)
- **Robert W. Crawford Scholarship** - The Pennsylvania State University - Robert Crawford (2014)
- **Student Honor Award** - Pennsylvania Recreation & Park Society (2014)

Association Memberships/Activities:

- **Pennsylvania Recreation and Park Society** - Student Member (2014 - Present)
- **RPTM Student Society** - Student Member (2013-2014)
- **Nittany SCUBA Divers** - Treasurer (2013-2014)
- **Boy Scouts of America** - Assistant Scoutmaster (2010-2013)

Certifications:

- **Wilderness First Aid (WFA)** - NOLS Wilderness Medicine Institute (Nov. 2013 - Nov. 2015)
- **ESRI ArcGIS Desktop for ArcGIS 10** - ESRI (Oct. 2012 - Present)
- **Public Pesticide Applicator** - Commonwealth of Pennsylvania (March 2013 - Sept. 2015)
- **Amateur Radio Technician** - Federal Communications Commission (Oct. 2005 - Oct. 2015)
- **Adult First Aid/CPR/AED** - American Red Cross (March 2014 - March 2016)
- **Boating Safety Education License** - Pennsylvania Fish and Boat Commission (Jan. 2012 - Present)
- **Open Water SCUBA Diver** - NAUI (July 2012 - Present)