Invasives in Our National Parks

How Tourists Can Help Stop the Spread of Invasive Species

Graduate Thesis by Alexandria Marci
Acknowledgments

This book is dedicated to my amazing family and friends.

Without their constant push, encouragement, and never ending support, I would not have been able to accomplish all that I did for this project.

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Invasive species are a major issue around the world and more specifically in our U.S. National Parks. Ranging from plants to insects to animals, invasive species are a greater threat than many may imagine. The impact that invasive species have on an ecosystem encompasses more than taking over a native species’ environment; it includes competing for food, water, and other resources, as well as having an adverse effect on our economy and threatening us with deadly diseases. Many factors lead to the cause of spread of invasive species, but all point back to human interference, from purposely spreading invasive species to unknowingly spreading them. Various solutions have been created over the years to help decrease and remove invasive species from national parks. Nothing has worked and the National Park Service (NPS) has only been able to keep invasive species under control and manageable but have not fully been able to remove invasive species from the parks. This project serves as a way for people to start a conversation around invasive species and to work to decrease the spread, thereby allowing the NPS to manage invasive species currently in the parks more efficiently without having to worry about new invasive species entering or additional invasive species proliferating amount. The expected outcome of this research project is to decrease the spread of invasive species by creating awareness around the issue for tourists while simultaneously sparking a conversation around this issue of invasive species in the national parks. This process will hopefully encourage tourists to get more involved in national parks, start a conversation around invasive species, minimize the spread, and hopefully decrease the amount of money needed to remove the invasive species, since tourists will be working together to discourage the spread.

Fig. 0.1 Native Flower Species in New York
Chapter 1: Introduction

As a graphic designer and an avid outdoors aficionado, I could think of no better topic around which to center my thesis than that of invasive species and how tourists can help prevent their spread in national parks. I grew up camping, hiking, and backpacking in the Adirondack Mountains in New York, and as a passionate tourist, I constantly heard more and more about what I could and could not bring into parks and campgrounds. It was not until I got older that I understood why this was the case and was educated by doing a few Google searches on 'why does my watercraft need to be inspected. (i.e. Zebra Mussels or other invasive species that can latch on to firewood as well may have attached themselves to the vessel.)' The park rangers have signs at the front of parks, but most people drive past them without stopping to take note. Not to mention, the only time you verbally told about invasive species is if you are at a campground checking into a campsite directly with a park ranger.

In national parks though, you are rarely ever communicating with a park ranger or manager unless you, or they, engage in a conversation. Without there being a direct line of communication in the parks about invasive species, tourists will never be able to understand why the ecosystem and native species are at risk and how they can help reduce this risk. This inspires the questions of, 1)What are invasive species? 2)What are the types of invasive species? 3)How are they spread? 4)Are their plans put in place to help get rid of invasive species? 5)Who is in charge of controlling invasive species? 6)How do tourists spread invasive species? These questions should be answered so a tourist, who has no idea that there is even a problem

![Fig. 1.1 Invasive Japanese Barberry Bush found in the U.S. (Armstrong)\\n](Image)

Not to mention the only time you are verbally told about invasive species is if you are at a campground checking into a campsite directly with a park ranger.

Lastly, figuring out if tourists are willing to help combat invasive species through what they do and do not bring into the parks.

This project will provide an in-depth investigation of invasive species in a national park and the ecotourists that can spread them.

This project would benefit not only tourists but also the environment.

To complete this project, gaining knowledge in key areas was needed first. The first step was to understand the impact of invasive species on an ecosystem and

![Fig. 1.2 Invasive English Ivy found in the U.S. (Trees Atlanta)\\n](Image)

what they do and do not bring into the parks.

This project provides an in-depth investigation of invasive species in a national park and the tourists who can spread them. We will see which national parks are being affected, how long they have been affected, and if any programs or management plans have been put in place to help eliminate and reduce the spread of invasive species.

Tourists who visit national parks are very invested in the beauty and nature of the parks. If they were to realize they are bringing harmful things into the parks and significantly affecting the wildlife, they might take a second look and reconsider what they are transporting to make sure an invasive species is not hitching a ride. This would provide an educational benefit to individuals, allowing a conversation around this issue as well as preventing the spread.

This project benefits not only tourists but also the environment. It will allow the parks to be preserved over years to come, allowing wildlife to flourish once again.

Not only would this have environmental and educational impacts, but have an economic impact; it would have economic impacts as well. The National Park Service (NPS) is controlled by the U.S. Department of the Interior, which helps combat invasive species. This costs them billions of dollars every year. This project would help minimize the economic impact invasive species have and hopefully lower the spread in the process, which would allow the NPS to focus their efforts on spreading awareness rather than spending money on efforts that barely make a dent in the removal of invasive species.

The goal of this research is to provide an in-depth analysis of invasive species and their roles in an ecosystem, thereby leading to concrete ways that tourists can help prevent the spread of invasive species. Educating tourists can not only minimize the spread but also benefit the environment and economy on how much is being spent on the removal process of invasive species. Breaking down how invasive species spread and what they do to shift an entire ecosystem will help us to understand how tourists can play a role in the management and spread of nonnative species.
Chapter 2: Research

Invasive Species: A Brief Overview

Definition
According to the National Park Foundation, “invasive species are organisms that don’t belong in the ecosystem in which they are found. Usually a pest in their nonnative environments, they are capable of wreaking havoc on native populations in numerous ways” (Rivard). They are also sometimes referred to as nonnative species.

There are currently 419 parks managed by the National Park Service (NPS), covering around 84 million acres.

Not only do invasive species pose a risk to the environment, but they also have a significant impact on the economy and human health. Invasive species also threaten the environment through fragmentation of land use and environmental and weather shifts, causing even more risk to national parks. Not only are nonnative species a threat, they are a threat that humans introduced into the areas that are being taken over, either purposely or by accident (Swearingen).

There are currently 419 parks managed by the National Park Service (NPS), covering around 84 million acres. Within that 84 million acres are over 1,409 invasive animal species. Still, only 23% are managed under the National Park Service, and of that, only 11% are claimed as under control by the NPS (Mittleman). Invasive species are not fully managed; nonnative plant species alone cost “$20 billion per year in economic damages and affect millions of acres of public and private lands across the country” (Invasive Species U.S.). There are many invasive species around the world, and they are becoming an issue more and more. The most dangerous and successful nonnative species are ones that meet any of the following criteria according to Doria Gordon: “1-effective reproductive and dispersal mechanisms; 2- competitive ability superior to that of the natives in the original or modified system; 3- few to no herbivores or pathogens, especially in herbivore-controlled communities; 4- ability no herbivores or pathogens, especially to occupy a “vacant niche”; and 5- capability of altering the site by either significantly changing resource availability or disturbance regimes or both” (Gordon 976).

Types
Throughout the world and more specifically throughout the national parks there are thousands of types of invasive species, ranging from plants to animals. The vast array of invasive species comes from all around the world and even within the United States.

Fig. 2.1 Emerald Ash Borer (Agrilus planipennis) (David Cappaert)

Fig. 2.3 Invasive European Starling found in the U.S. (David Cappaert)

“Tens of millions of trees have already died in the U.S.” (Invasive Species National)

The main culprits are usually plant invasive species, which have taken over a majority of the United States due to their fast reproduction, even in poor soil conditions. These plant species threaten other plants because they compete for limited resources such as water, sunlight, soil, and nutrients (Swearingen). This leads to a shift in the native plants, causing a decrease in forest regeneration and change in the soil. Invasive plant species can even cause genetic changes within a plant species (Swearingen).

Invasive animal species can reorganize and shift an ecosystem. The competition for space is just as fierce among animals as it is among plants. Invasive animals are commonly birds, pigs, or reptiles in many areas. One invasive animal species, the European Starling, was spread across North America after being brought to New York City in 1890 from Europe (Invasive Species National). This bird species steals other birds’ nests, stopping their ability to lay eggs. They are also harmful to crops; and, even worse, carry deadly diseases to both humans and livestock (Invasive Species National). The main issue of invasive bird species is their migratory habits. If the birds migrate, then they are not only repopulating in one area but multiple other areas, creating a larger issue on a broader scale (Invasive Species National).

Insects and reptiles can be just as deadly to an ecosystem; invasive mammals also can pose a threat. The Emerald Ash Borer is an insect that came to the United States in 2002 from Asia via shipping materials. Though the adults of this species are not deadly to an ecosystem because they only feed on tree foliage, their larvae feed on the bark inside trees. This cuts off the trees’ supply of water and other nutrients leading to the death of the tree (Invasive Species National). “Tens of millions of trees have already died in the U.S.” (Invasive Species National). And with the spread of these invasive species, tens of millions more will die as well. This is an issue of shifting ecosystems and the extinction of species.

Fig. 2.4 Invasive Emerald Ash Borer found in the U.S. (City of Grand Prairie)
**Why They are an Issue**

Invasive species are not new to the world; they have been an issue across the globe for years. Their spread is due to human involvement, either on purpose or accidentally, as previously stated. Most were spread due to trade and the shipping of materials, while others were purposely put into environments to spread the beauty of animals from other countries, or to reduce certain populations of other animals (Swearingen). They affect the economy in many different ways. These include the millions of dollars spent on trying to get rid of them, and the livelihoods of those who depend on crops and other plants for income -- which consequently is diminished or affected due to the invasive species. Due to the destructive nature of invasive species, they not only pose a threat to the ecosystems but also to the economy and even to human life. A study was done by Manuel-Angel Dueñas et al. showing that invasive species may also be one of the leading causes in the decline of endangered species, creating yet another issue invasive species cause (Dueñas 9). With the constant arrival of new species to park areas, the issue and the spreading of invasive species increases dramatically.

“**If we don’t take action, native species will continue to struggle due to the invasives ...**”

Elisheva Mittleman, from Yale School of Environment, states, “Invasive animal species significantly impact native wildlife populations, introduce new diseases, impair visitors’ enjoyment of parks, and require substantial economic investments for control efforts” (Mittleman). Mittleman also interviewed Ashley Dayer, a wildlife biologist at Virginia Tech, who states, “If we don’t take action, native species will continue to struggle due to the invasives... But taking action is no small feat; it requires the commitment and resources of the National Park Service, neighboring lands, and the public.” The only way to combat these issues is if there is a plan in place that the NPS can follow and that will thoroughly protect native species in national parks.

**Effects of Invasive Species**

**On a Species**

Invasive species have a significant impact on multiple areas, ranging from ecosystems to species to the future of national parks. For species, it is more about competing for space, nutrients, water, and other survival necessities. Not only do invasive species invade the space where the plant, animal, or other organism once lived, but they compete for the same food, water, and nutrients needed to survive and reproduce. Most invasive plant species thrive in any climate, making it increasingly difficult for native species to survive (Swearingen). The main issue of invasive plant species is how fast they can reproduce in certain ecosystems, whether the soil is poor or good quality, or if the water is abundant.

Invasive plant and animal species together in one ecosystem can prove very harmful, which is usually the case in most national parks. There are usually 10-30 invasive species living in one area at a time, making it more challenging to maintain and harming more and more native plants and animals (Swearingen). If both an invasive animal and plant species thrive in the same environment this doubles the likelihood that native species will die out or no longer thrive in that environment, shifting the ecosystem.

One of the most significant factors contributing to the growth of invasive species is the deterioration of predatory species in an environment. Once a new predator is introduced into an ecosystem, it competes with the current predators. With no predatory species of their own, the invasive species decimates the native animal species that were once there. In a study conducted to see how predatory species were being affected in an ecosystem by invasive species it was found that the species researched had declined from 71% to 97% between 2007 and 2015. Some species even declined so much, that they were no longer detected at all, indicating deracination (Doody 2096), creating a shift in dominance and therefore altering an ecosystem and competitive systems. A statement by the USGS says, “The most severe declines... have occurred in the southernmost regions of the park” (Repanshek).

**On an Ecosystem Overall**

An article by Kurt Repanshek states, “invasive species threaten to not just re秩序, but rewrite ecosystems and cures remain elusive.” The effects invasive species have on an ecosystem vary, but all affect the overall outcome of native species. The different ways in which an ecosystem is affected are: biodiversity, water, wildfire, soils, disease, and atmosphere. These issues affect the overall structure, composition, and habitat quality of native species and communities (Gordon 975).

An issue of biodiversity occurs when a nonnative species hybridize, otherwise known as crossingbreeding, with a congenic species; altering the genetic makeup. This “completely displaces the native species,” allowing the invasive species to expand into other areas displacing other native species and competing for space (Chornesky 68).

The main focus of the impact nonnative species have is their influence on the destruction of agricultural systems and waterways because of the direct impact they have on human lifestyle. Even if the invasive species only attack or invade one particular native species or habitat, that creates a trickle effect in the rest of that ecosystem. This becomes the issue in the ecosystems; they could get rid of a plant that both people and animals depend on for food. If that animal cannot get that food source it may start to dwindle, and their predator may no longer have a food source either. Elaine Leslie, former chief of NPS Biological Resource Management Division, states, “The NPS is very concerned about nonnative and invasive species across the landscape within and outside of national park units and their impacts on native biodiversity, especially at-risk species and their habitats... Nationally and internationally, the world is
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Fig. 2.6 Grand Canyon (Fikar)

a large increase in zooplankton, which in turn has increased the temperature of the water, and has created a murky green look in the lake (Repanshek).

Previous & Current Management of Invasive Species:

Hawaii

In 2005, the NPS embarked on a two-year project to assess the number of invasive species as well as to decrease the number in Hawaii's national parks. “These methods included biological control using herbivorous fish, manual removal, shading, and re-cropping” (Invasive Species, U.S.). The work did not start there though. There have also been efforts to remove other nonnative species across many other national parks as well. “By aggressively taking steps to eliminate or prevent the establishment of invasive species, native populations of animal and plant species can thrive on parklands” (Invasive Species, U.S.). The NPS is constantly trying new efforts to eliminate or at least decrease the number of invasive species in national parks as aggressively as they can. In their efforts to eliminate nonnative species, and as a part of their two-year project, they assembled a team called the Exotic Plant Management Teams (EPMTs), which includes highly trained plant management specialists, “who assist parks in the identification, treatment, control, restoration, and monitoring of areas infested with invasive plants” (Invasive Species, U.S.). There are about 16 teams that cover 209 national parks across the country.

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Invasive Scoth Thistle found in the U.S. (Combs)

On National Parks

But for national parks, invasive species threaten more than human health and the wildlife that lives there. They threaten to ruin the recreational spaces that people visit, making them no longer useable. Nathan Owens, Coordinator for Aquatic Invasive Species in Utah's division of wildlife resources, states, “That’s kind of what we’re starting to see in a few areas at Lake Powell for the first time. I’ve been told by boaters, they’ve tried to pull up to land but they didn’t want to walk out because it was covered in mussels and they didn’t want to get cut up. So they just ended up going somewhere else” (Repanshek).

A majority of these species will never fully be removed from the area that they habituate. In Yellowstone, there is a species of trout that were dumped into the lake in the ’80s, and after all the efforts to remove the trout, they are still an issue in the lake, due to their fast reproduction. These trout have gotten rid of some of the other animals that live in the lake as well, which were a food source for the native bears, making them have to look elsewhere. The trout also have lead to a large increase in zooplankton, which in turn has increased the temperature of the water, and has created a murky green look in the lake (Repanshek).

Not only has this team helped and been successful with the removal of invasive species, but this model was additionally adopted by the U.S. Fish and Wildlife Service and the Student Conservation Association. These teams can serve multiple park areas, areas, and can adapt to conditions in their geographic lands (Invasive Species, U.S.). However, the NPS does not have an abundance of resources and continues to partner with companies and organizations to help in the removal of invasive species. They are a member of the Maui Invasive Species Committee, which works with state grants to control invasive species. The NPS says that partnership “offers valuable educational and cultural benefits by providing staff and field sites for hands-on educational activities for teacher workshops and student programs” (Invasive Species, U.S.).

Communication

In order to continue to help combat invasive species and get the funds they need, the NPS also needs to communicate with the state to prevent the introduction and the spread of invasive species. They struggle in some areas, such as the national parks near the Colorado River, where communication is one of the critical efforts in helping combat this issue. The NPS states, “the near impossible task of coordinating the efforts of four separate park units and five state governments, as well as several Tribal entities” (Otts 118). The estate’s efforts have not gone unnoticed though. There are many rules states have put in place to help in the overall conservation of wildlife.

Because of how open these parks, and most forests and habitats, are to humans, most of the world's ecosystems are not untouched by humans due to how interconnected they are. This remains the biggest challenge that the NPS faces when it comes to invasive species. The NPS has attempted to make park goers aware of invasive species and how to prevent the spread, but only on their website and in handbooks/ manuals, have they explicitly addressed the issue and the rules and regulations that people must follow. However, most people do not think to look

Fig. 2.7 Invasive Scoth Thistle found in the U.S. (Combs)

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Fig. 2.6 Grand Canyon (Fikar)
Introduction of Invasive Species in an Ecosystem: Quagga Mussels

One of the biggest culprits of invasive species is invasive mussel species because they tend to hitch a ride on boats or any other water transportation. In 2000, the NPS implemented the screening of any incoming boats because the mussels could have severe consequences if integrated into certain parts of Glen Canyon (Otts 131). With the NPS finding more and more infested screened vessels, it became mandatory to have decontamination for all watercraft in 2003 if they were not cleaned, drained, and dried before entering the lake. The program intensified again in 2007 when mussels were discovered in a nearby lake. This forced all boats to be deemed mussel-free before launching into the lake (Otts 131).

Some plans put in place remain temporary and are not as aggressively enforced, creating more issues. In 2006, the NPS stated that motorized travel would be restricted in the Colorado River due to the spread of invasive species and because non-motorized travel makes for a better “wilderness experience” (Zellmar 534). However, this was quickly taken away by the court because the NPS did not provide sufficient rules and regulations to go about this issue. Therefore leading to the potential spread of invasive species in the river whenever a motorized vehicle was used (Zellmar 535).

Over the years, some rules and regulations have been maintained by the NPS, and others have not. Even with the aggressive treatment of implemented programs in some state parks, invasive species are still a significant issue. Though some parks have strict and assertive rules that must be followed, others do not. This allows for more and more invasive species to be spread throughout the forests.

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Introduction of Invasive Species in an Ecosystem: Quagga Mussels

Invasive species are introduced to an ecosystem through multiple different ways but ultimately are spread due to human involvement. For instance, the quagga mussel found in the Lake Mead Recreational Area in Nevada was introduced to the area in 2007, due to a boat that came in from a previously infested lake and was not properly cleaned or inspected upon entering Lake Mead (Hickey 932).

Quagga mussels are freshwater mollusks that are native to Ukraine. Due to their ability to filter particulates, they remove a large amount of phytoplankton from the water, leading to a decrease in native species and the water becoming clearer with better visibility. Not only do they decrease the phytoplankton, but they also create acidic water quickly due to their decomposition (Hickey 933). Quagga also clog pipelines and water structures which can decrease power in water treatment plants, costing thousands of dollars to repair, leading to another area where money is spent removing invasive species. But how did these mussels end up in Lake Mead?

The quagga were first discovered in 1988 near Detroit, Michigan in Lake St. Claire, quickly spreading across the eastern United States. They eventually spread to a water source close to the Hoover Dam. From there park managers were told to prepare, monitor, and be on the lookout for any quagga mussels (Hickey 933). However, the monetization of the mussels was not conducted on boats entering from the pathway between Lake Mead and its corresponding lake through the Colorado River. Park Managers were only checking and monitoring the actual lake and any boats that were launching in the lake itself, not those coming in from the connected waterway.

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Fig. 2.8 Invasive Zebra Mussels found in the U.S. (Benson)

Fig. 2.9 Invasive Quagga Mussel (Utah Division of Wildlife)
had the financing to “implement the education and law-enforcement program” (Hickey 934).

Introduction of Invasive Species in an Ecosystem: Sweet Clover

The sweet clover is another one of these invasive species that was introduced into an ecosystem due to human involvement. When settlers in the 1800s moved out west, unknowingly, they brought with them the sweet clover plant (Wolf 532). The yellow and white sweet clover species, otherwise known as Melilotus, are a competitive plant species that can create “dense patches, and grow up to 90-300 cm in height (Wolf 532).” In some case studies, the median height of this species is around 120cm.

This competitive nature of the Melilotus, allows the species to invade grasslands that were once undisturbed and alter the composition and species richness. The Melilotus is one of the 120 invasive species documented in the Rocky Mountain National Park, among the 1000 documented species. This specific nonnative species can thrive in almost any environment, making it difficult to reduce and remove solely based on environmental factors. Melilotus can resist droughts, heavy rainfall, and grow extremely well in oil-rich soils, as well as bare mineral soils (Wolf 533).

In studying a specific area of the Rocky Mountains, scientists, observers, and park managers have found that “total species richness in both patches changed significantly; the changes from June to July (peak growing season) and from July to August were significant” (Wolf 534). The Melilotus was also found to have spread beyond their original area that was mapped in 1998, due to the germinating of the seeds each season. Invasive plant species can spread via germinating of their seeds, but they would not have originally been in this ecosystem if it were not for the involvement of humans. Not only have they spread because of germinating and humans, but their ability to grow in any soil and weather condition makes them harder to remove and easier for them to populate as they push other native species out of the area, diminishing them significantly (Wolf 538).

The Bio-Geomorphic Impacts Invasive Species Cause

Invasive species cause more than just environmental issues to an ecosystem; they cause geomorphic problems as well. Bio-geomorphology is the “study of the interactions between ecosystems and Earth surface processes and landforms” (Fei 70). Nonnative species can affect an ecosystem both directly and indirectly through geomorphology. Generally invasive species impact one or a combination of these three: ecology, geomorphology, and bioconstruction. “Among various ecosystems, geomorphically dynamic environments with strong bio-geomorphic coupling are more vulnerable to major geomorphic impacts” (Fei 82).

This can lead to a shift in landforms and in the composition of an ecosystem. This is where observing invasive species to prevent this shift is important. Park managers, scientists, and observers should be carefully studying and examining the geomorphic processes that can help detect the pattern and spread of invasive species. Reducing the overall impact they will have on the ecosystem, as well as the geomorphological and ecological changes they may cause.

Predicting the Patterns of Invasive Species

Studying the patterns of invasive species can help parks decrease the spread and
to occur in steep sites at lower elevations, more and more invasive species to thrive in that “light” (Underwood 456). If certain species are adapting faster than people thought they would which creates issues in competition for space, soil, and water with native species. According to Emma Underwood, “nonnative species composition changed from steep, low-elevation hillsides where soil moisture might be low, to flatter, mid-elevation sites (such as meadows) where soil moisture was relatively high. This is consistent with the fact that these species were all herbaceous, preferring areas with higher moisture and light” (Underwood 456). If certain species spread because of elevation, slope angle, and slope aspect, parks can monitor how they have spread over the years and possibly make changes or implementations to land, and where tourists can visit, preventing more and more invasive species to thrive in a non-natural environment from what they are used to. The research conducted in this study aims to assist Yosemite National Park.

A broader goal of this research is “that similar predictive models can be developed for other national parks where suitable plot data exist, or to other conservation issues such as rare plant distributions, to increase the efficiency and reduce the costs of fieldwork” (Underwood 456). Other studies have also been conducted to forecast the movement and spread of nonnative species, as well as the environments that they can thrive in. Buffelgrass is a key example of a species that has had case studies and observations conducted to help predict the patterns and spread of this invasive species. This type of nonnative species is both a local (United States) and global issue. During a study conducted on the forecasting of invasive species, it was found that the buffelgrass significantly changed some of the climates to better suit itself for survival. This cause an increase in temperature, and an increase in precipitation during the summer (see Fig. 2.13). These scenarios “resulted in an increase in the minimum mean winter temperature within the Park, resulting in a shift toward greater suitability for buffelgrass” (Jarnevich 9).

To make matters worse, the study found that “there is no evidence that measured environmental factors are limiting the abundance of buffelgrass across the Park, and thus, buffelgrass may become abundant anywhere with suitable habitat” (Jarnevich 7).

Not only did the buffelgrass increase the temperature of the area during the winter, but it also created an increase in precipitation. Buffelgrass cannot grow in dry unsaturated soil, therefore when buffelgrass enters an ecosystem and can survive long enough to change the environment it is in, it can thrive. During the study, it was “observed that buffelgrass either dies or persists without domination or spread with >600mm of precipitation during the growing season” (Jarnevich 9). However, during a three-year period studying buffelgrass in Mexico, it was recorded to be the wettest year they had at 358mm of precipitation. Buffelgrass also has been observed to dominate and spread throughout an ecosystem when “winter precipitation is <400mm” (Jarnevich 9).

Buffelgrass is just one of many invasive species that alter an ecosystem to further manage the nonnative species. Yellowstone National Park is one of the largest parks with a wide variety of species. In a case study focusing on native and nonnative species in Yellowstone National Park, 23% of the plots of land studied were covered in invasive species. There was not just one invasive species in each plot of land studied, sometimes there were up to two species per area. This study helped to predict how fast the invasive species would spread as well as the factors that allowed them to spread quickly. By using elevation, slope angle, and slope aspect, the patterns were studied.

The data collected in this study showed the plots with two invasive species, Bromus tectorum, and Vulpia Myuros, which “tended to occur in steep sites at lower elevations, while plots characterized by Poa pratensis and Cirsium vulgare were flatter and at higher elevations. The other two species groups tended to be in plots that were intermediate in elevation and moderate in steepness (Underwood 451).” By focusing their efforts on what invasive species were in each area and how they spread, they can further predict the movements of invasive species.

This data shows that the invasive species are adapting to the elevation, slope angle, and slope aspect to survive and thrive. They are adapting faster than people thought they would which creates issues in competition for light, space, soil, and water with native species. According to Emma Underwood, “nonnative species composition changed from steep, low-elevation hillsides where soil moisture might be low, to flatter, mid-elevation sites (such as meadows) where soil moisture was relatively high. This is consistent with the fact that these species were all herbaceous, preferring areas with higher moisture and light” (Underwood 456). If certain species spread because of elevation, slope angle, and slope aspect, parks can monitor how they have spread over the years and possibly make changes or implementations to land, and where tourists can visit, preventing more and more invasive species to thrive in a non-natural environment from what they are used to. The research conducted in this study aims to assist Yosemite National Park.

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**Recent Studies to Help with the Removal of Invasive Species**

**Management of Invasive Species in a National Park**

Not only is the prediction of invasive species patterns important, but the management and removal of them in any ecosystem is equally crucial. For instance, in one of the largest national parks in the U.S., Yellowstone, there are 225 invasive species, eight of which are aquatic (Koel 4). In 2020, a study was conducted to discuss the invasive species of lake trout in Yellowstone, to see if they could thin out this invasive species. If they could accomplish this, the native wildlife would once again be able to thrive.

In Yellowstone, there are 225 invasive species, eight of which are aquatic (Koel 2). The park was not even aware that this invasive species was in there until a fisherman caught one of these lake trout in 1994. After that, more and more were found and caught by fishermen. Koel suggests that these lake trout, like most aquatic invasive species, came from another lake through a waterway or connecting river. This causes “grave concern, because their potential to negatively affect native trout had previously been well-documented in other large lakes in the Western United States” (Koel 5). With the cutthroat trout being low in numbers and species richness, the invasion of these nonnative species is already an enormous risk (Koel 3).

There was a program of gillnetting, in the early 2000s, which was put in place to reduce the number of lake trout. However, in 2008, “Yellowstone National Park requested assistance from an independent scientific review panel to critically evaluate the effectiveness of the lake trout suppression program in Yellowstone Lake” (Koel 8). These scientists found that the gillnetting efforts in this program had not reduced the lake trout, but instead severely declined the cutthroat trout population (Koel 8).

The case study by Todd Koel, explains that due to this gillnetting and the invasive species patterns important, but the invasion of these species can cause shifts in the local food chain, changing competition and feedback from the annual science panel to proceed with the removal and management of lake trout in Yellowstone National Park.

**Shifting an Ecosystem: How Invasive Species can Shift an Entire Ecosystem**

Not only do invasive species affect the populations of native species and cause shifts in the local food chain, changing competition and feedback from the annual science panel to proceed with the removal and management of lake trout in Yellowstone National Park.

Lake trout can be managed over large areas of water, but will need constant long-term commitment and feedback.

Todd Koel concluded that eliminating this species of trout may not be feasible, but over the past years, the management and removal processes have decreased the species significantly. This shows that the lake trout can be managed over large areas of water, but will need constant long-term commitment and feedback from the annual science panel to proceed with the removal and management of lake trout in Yellowstone National Park.

- Lake trout in Yellowstone National Park.
- Invasives in Our National Parks | Alexandria Marci | Page 25
but the recovery of an ecosystem also needs to be considered. Almost all the invasive species studied in Florida were found to cause some sort of ecological change over time. These invasive species impacted: population levels of both community species and their competition, stand structures, disturbances, biogeochemistry, hydrology, and geomorphology (Gordon 985).

Fig 2.17 shows the increase in invasive species compared to native species. Of those, 6-22% of the invasive species that are listed “reported to alter geomorphological processes. Three to six percent increase erosion rates, or increased soil rates. “Casuarina equisetifolia modifies geomorphological processes by causing shoreline erosion and steepening, resulting in beach-width reduction. This erosion is thought to be accelerated indirectly by the exclusion of soil-stabilizing grasses” (Gordon 980).

Habituating the shallow soils it invades, another invasive species that causes a shift in soil development and increases erosion is the Schinus terebinthifolius. The Mimosa Pigra, though located in Australia, has the ability to shift sedimentation, accumulating and disrupting the waterways (Gordon 980-981).

All of these examples of invasive species show how big of a shift they can create within an ecosystem just by invading new territory. Not only are they able to reduce the population of species, but they also shift the ecosystem they inhabit. This makes them more and more dangerous in the areas of habitation, posing an even bigger reason to remove and manage the species.

How to Motivate Tourists to Combat Invasive Species

Motivating residents and tourists is one of the key factors that could lead to the successful removal of these invasive species, by both diminishing the population of them and preventing the spread. A case study conducted by Rebecca Niemiec et al. was created to discover whether residents and tourists would be motivated or interested in preventing the spread of invasive species to help diminish the population in their community.

The study was conducted using surveys and interviews asking a series of questions about invasive species, whether they (residents and tourists) believe they cause significant risk, if they are willing to help, and the risk they could pose to a person’s (resident’s) home.

The results of the study “suggest that residents do not have to feel that their personal property is threatened by invasive species to engage; rather, perceptions of risk to public goods in their community can motivate action” (Niemiec 8). However, they also found that “such interventions may be more effective if they seek to enhance perceptions of norms and community reciprocity regarding invasive species control” (Niemiec 8). The data suggests that the attitude, values, and context of a person are the ultimate factors in deciding whether they will help combat invasive species.

By examining the community-wide attitude and values, researchers can determine whether an individual will engage in invasive species control. Community reciprocity is one of the main factors in determining the motivation of residents in invasive species activism behavior. This has never been considered before when organizations were thinking of the combatant process and removal of invasive species. Lastly, the study concluded that individuals within a community who were active in combating invasive species also “believed that others in their community would notice and reciprocate their actions to reduce invasive species” (Niemiec 8).

Motivating residents and tourists is possible, as long as the necessary attitudes and values are present. The difficult part is trying to reach tourists and residents who may not know that invasive species pose such a risk to the environment and residential homes (due to the shift in an ecosystem: geomorphology, hydrology, etc.). Once you have grabbed their attention and the reciprocity of the community, it is easier to move forward and motivate tourists and residents to help combat this issue. Niemiec et al. suggest that landscapes that pose the greatest risk be looked at first, because of the potential in collective activism within the community to remove and prevent the spread of invasive species (Niemiec 9).

The Mapping of Tourists

Targeting national parks as the greatest risk mentioned above, the findings of this thesis will better motivate tourists and communities to help prevent the spread of invasive species. By looking at the national
It is home to over 400 vertebrae species, 100 tree species, and 5000 plant species.

Whereas the Great Smokey Mountains, which are a part of the Appalachian Trail are popular with hikers and backpackers. They are home to over 400 vertebrae species, 100 tree species, and 5000 plant species, showcasing a variety of beauty to experience and view when hiking the trails (Staff).

By targeting specific areas where tourists, residents, hikers, and campers will help us to better understand where to target them with design. In Yosemite National Park, the main attractions for people are the large cliffs, waterfalls, and sequoias, as well as a few trails used to view these attractions, making it easy to target the tourists and engaging with their values of what they are there to see. If it is phrased and worded in a way that it plays upon their attitudes and values then there is a higher chance the tourists will want to help decrease the spread of invasive species. Targeting large at-risk areas with a high population of visitors can create a ripple effect to other national parks and spread awareness to other tourists, preventing the spread altogether.

**Influencing Tourists**

Throughout the years, the NPS has passed out multiple brochures, ranging from general information brochures to maps and guides (National Park Brochures). This is one of the takeaways most people can remember collecting from the national parks. The issue with the current park brochures is that they are more like booklets, consisting of multiple pages and most likely losing the attention span of a single person within the first few pages. The brochures are known for their design, layout, and reliability. These brochures are a way for the limited park staff to communicate with the increasing tourist population on a broad basis (National Park Brochures).

As previously stated in this thesis document most tourists are uneducated in invasive species and do not know the large issue they pose to the national parks. Including a brochure to help educate the increasing tourists, will not only educate and add to the reliable communication that the NPS currently has. But from what the NPS has gathered, most people save and collect their brochures from the national parks, proving that this is an impactful way to help spread information and educate tourists to decrease the spread of invasive species (National Park Brochures).

Not only are brochures an ideal way to provide information and be sure that tourists know the issue at hand, but a video before they enter the parks showcasing how invasive species are spread and how they can play a part in their removal would be helpful. The idea is longer than one minute, almost half of your audience has tuned out (“How Long”).

**If a video is longer than one minute, almost half your audience has tuned out (“How Long”).**

NPS currently has multiple videos on science, animals, plants, and even natural sound videos. Adding a video on invasive species will add to the content and the awareness. However, to ensure that tourists would act on, respond to, and pay attention to a video, the video must be short, concise, and cut to the point. If a video is longer than one minute, almost half of your audience tunes out (“How Long”). Getting your point across within the first 30 seconds ensures that people will still understand, pay attention, and not lose focus on the main idea and purpose of the video. Having park rangers or workers discuss with the public what the video is and how it will help the national parks will also help build the credibility of the NPS as well as the video (“How Long”).

In a study conducted by Gareth Benest, et al., they created a case study to determine whether a video can provide accurate communication and exploration of issues leading to engagement, awareness, or the changing of one’s perception of an issue. In the early stages, they discussed how a “participatory video provides unique opportunities for people to explore their circumstances and investigate the issues they experience” (Benest 23). By incorporating screenings they were able to determine and test developing video messages which resulted in; validation, awareness-raising, engagement, and the changing of perspectives. This is something to strive for when creating the thesis project; having everyday tourists watching the video and resulting in one of these four uses thereafter (Benest 27).
Artistic Solutions to Educate and Reduce the Spread of Invasive Species

Jane Kramer

In the past, there have been artistic solutions to help educate and reduce the spread of invasive species. However, the downfall is that this artwork is not directly showcased to ecotourists and some tourists of the national parks, as well as those that could help prevent the spread, but rather in a gallery where the viewers are select and few have been to a national park or have an attitude to help prevent the spread on a large scale.

Jane Kramer creates printed pieces with paper that is made from invasive plant species she finds. The work represents the shadows of endangered plants, taken from photographs which is then printed on paper made of invasive species that threaten their survival (Kramer).

The shadows are transferred onto handmade paper, which also uses few chemicals; only soda ash, and hand sanitizer. There is no depth in the image, the lighting is the same across the entire painting, Kramer does this to show how the species is being overtaken by nonnative species. The shapes and lines in the images are somewhat irregular and can be transparent due to the hand sanitizer that is used to transfer them onto the paper. This is a symbolization of the relationship invasive and native species have; complex and complicated.

The shadow itself is not very detailed but shows the endangered plant species well using the thickness of the ink and space on the paper. All of the pieces Kramer has done revolving around invasive and native species never fill up the entire page. When looking at other pieces she has done for this series, she has some that are taller or thicker in width, but the entire page is never filled. This is another way Kramer emphasizes the relationship of invasive and native species, by depicting the invasive species as the paper and a majority of the piece and the native species as smaller and and not taking up a lot of space, showcasing the actual representation of what it looks like in the wild. Invasive species take up all the space and pushing out native species, who have little to no space (Kramer).

Scott Sutton

Scott Sutton, a photographer, captures invasive plant species and how human interaction helps spread the species more and more. In his photographs, he showcases the Scotch Broom and Sweet Peas Flowers. The photographs show two invasive plant species near the North Umpqua River in Oregon. The beauty of these flowers makes them seem harmless and just one of nature's beauties, but they are invasive and compete for soil (Sutton). They were introduced due to human involvement, and part of Sutton's reasoning and meaning behind these photographs is to showcase how humans have this way of asserting dominance in foreign lands, just like invasive species (Sutton).

The placement of the flowers in multiple sceneries shows the versatility of the invasive species and how it moved to this area, i.e., human involvement. Sutton places the petals of the flowers in the water, watching them move downstream and spread to new places, again, showcasing human involvement in the spread of invasive species. The lighting of the images is natural and almost looks untouched, other than the possible manipulation of brightness and contrast to push the flowers to the main focus of the image. Sutton places the petals in a pool of water, which has blue and gray tones, allowing the petals of the flower to stand out against a neutral toned background, even in an aerial view of the pool. The symbolism and meaning behind these photographs are more than just how humans spread invasive species. The photographs also capture the similarity of humans and invasive species, conquering and invading land as we have for many years (Sutton).
Lastly, Emily Katzin, is an artist who makes collages using leaves, stems, and flowers from invasive plants to bring attention to invasive insects. The collages are designed to educate people on the dangers of spreading invasive species in an ecosystem (Katzin). With a focus on sustainability and the use of nontoxic materials, Katzin adheres everything together using plant-based glue. The artist places particular focus on invasive species that pose a significant negative risk to ecosystems, especially in Texas and Ohio, where she has lived. Her hopes with this project are to educate and inspire others to consider the dangers and impacts of invasive species and work to prevent their spreading (Katzin).

These collages are very detailed and use a variety of colors, shadows, and untreated natural plant material. Her Asian Ladybird Beetle the artist uses bright red Burning Bush leaves for the back of the bug with numerous spots on the elytra made from Japanese Barberry leaves, stained dark by the plant’s berries. Katzin includes the telltale white M shape at the back of the beetle’s head, which distinguishes the invasive Asian Ladybird Beetle from our common ladybug—the two are frequently confused with one another. Katzin even includes the fine lines on the back of the ladybird to create more detail and depth in the image.

Not only do her collages showcase a great amount of hue in color, but they also produce shadow and allow light to emphasize shadow and highlights. In Katzin’s collage of a Cactus Moth Caterpillar, the way she layered Burning Bush leaves with many veins and cracks, allows the light to bounce off of the crevasses and emphasize the shadows and highlights of the insect’s body.

Fig. 2.26 Asian Ladybird Beetle 2013 (Bryant)

Fig. 2.27 Cactus Moth Caterpillar 2011 (Bryant)

Research Conclusion

Overall, the research conducted on invasive species proves how big of a risk they are not only to other native species but also to an ecosystem. The ability to shift an environment to its liking to help it reproduce faster or create more suitable conditions allows the species to conquer space and push out native species, causing the populations to dwindle. Case studies have been conducted to help understand what works and what does not in the removal and prevention of the

Mostly though, it has been found that it is impossible to eliminate an invasive species from an ecosystem, and national parks can only manage and control their spread, in hopes of preventing them from repopulating in another area.

National parks are at greater risk due to the millions of people that visit every year, especially those that are not educated on invasive species and any rules and regulations put in place to help prevent the spread. However, national parks make for a great target area to educate tourists and residents on invasive species, to help combat them. All in all, invasive species are a large risk to ecosystems and native species and must be dealt with accordingly. Reiterating the research statement, there are an enormous number of people (tourists) who are not adequately educated on what they can and cannot do in the National Parks, as well as what they can and cannot bring into the parks to stop the spread of invasive species: emphasizing the fact that once educated they can help reduce the spread of invasive species. What better way to control and manage the invasive species population than by educating tourists.

Fig. 2.28 Invasive Spotted Lantern Fly found in the U.S. (Barringer)

Fig. 2.29 Invasive Ferral Swine found in the U.S. (Bell)
Chapter 3: Visual Process

When I began this process of creating artwork as a response to my research on how to educate tourists on invasive species, I came across several questions that I needed to answer. The questions I needed to answer were:
- Will my artwork have interactivity?
- How will I get the tourist to watch the full one minute video? Will there be an incentive?
- What information is key to pass to a tourist visiting the national parks?
- How can art encourage a tourist to help stop the spread of invasive species?

Inspiration

For as long as I can remember, camping, backpacking, hiking, and visiting the national parks has been a yearly event that my family partakes in. Getting to submerge myself in the wilderness and not have to think about the outside world is one of the main reasons why I love it. Even with the surge of Covid-19, my family still found time to go camping and backpacking. When I was growing up, and even now, I remember hearing about certain things you could and could not take into the campgrounds in hopes of not spreading invasive species. This became most evident here in New York with our firewood regulations. You are not allowed to transport untreated firewood more than 50 miles or bring it in from another state. I always found this interesting and curious as to how firewood could potentially harm my campground. However, I was young and did not think much of it. After a few years, as I got older and still heard this regulation and the rules for watercrafts, I was curious as to WHY? No one ever explained to me at the front gate of a campground why you could not bring these in. As the years went on, they stopped spreading the message altogether.

This sparked my thesis in a way where I could give back to help the wildlife I care so much about...

For years and even yearly, as my family continues to visit national parks and campgrounds, I do not hear about why this is an issue and have not heard about any regulations or even the “Carry In Carry Out” rule of thumb, which is to carry out whatever trash, food, or supplies you carried in. I did see a singular poster on the wall with large font on an 8.5inx11in piece of paper. But how effective is this to people who may not see? I would think not at all.

National parks are the perfect place to start. At the early stages of the pandemic, around July of 2020, I remember there being a large increase in the amount of people that were venturing into the outdoors to mainly get out of the house and be outside. With larger numbers of people visiting, especially due to covid, national parks are the perfect place to begin. In the early stages of the pandemic, around July of 2020, I remember there being a large increase in the number of people that were venturing into the outdoors to mainly get out of the house and be outside. However, many people are not educated on what they can and cannot bring into not only the national parks, but hiking trails, campgrounds, lakes, etc. Spreading invasive species is a high risk.

Getting Tourists to Watch a Video and Interact with a Brochure

As I began my research on invasive species in national parks, I found this was a larger issue than I had originally thought. With this research came the conclusion of my artwork. There needed to be something that would make tourists stop and listen, educating them on how to help rather than spread. With this, came the idea of a brochure and short video.

Some national parks charge an entrance fee, which is decided to pair my project. When people go to pay the entrance fee, they will be handed a brochure and prompted to watch my video animation. When you purchase an annual park pass and are handed the brochure with a QR code bringing you to the video. There will be an icon on your park pass indicating you have received the brochure and watched the video. By watching the video they will be given some sort of national park incentive, such as a token, water bottle, kids book, magazine, etc. driving the tourist to watch and focus on the video. If you are purchasing an annual park pass then you will be given a discount on the fee as well as the incentive above (getting more people to want to purchase an annual pass rather than a regular one day pass).
**Ideation**

**Moodboard & Videos**

I began my creative process by starting off with a moodboard for the brochure and researching short animation videos on invasive species and general nature videos to see what route I should take, as well as what has been successful in the past. When looking at educational and informational brochures I found that using geometric shapes was the path I should take. I added infographics rather than a large amount of text to keep the viewer focused and not overwhelmed by the amount of information. It helps the viewer to understand the statistical information while at the same time keeping them focused on the remainder of the brochure.

During this research and moodboard process, I also found it helpful to include a QR code, social media icons with the naming tag, or some form of interactivity between the brochure itself and a smartphone, allowing them to be able to access a website and social media links anywhere they go. This allows a viewer to look at more information on their own time and a better way to stay informed with a direct link on their smartphone.

Lastly, I came up with the color scheme that I thought would best suit this project. I wanted to go with colors that aligned well with invasive species and not something that was completely different. This led to choosing one darker color, a dark blue to use for the background, geometric shapes, and text. I then chose three lighter colors: a yellow, green and dusty sky blue— as more of an accent and to align as geometric shapes close to the darker blue and green creating uniformity and flow in the brochure. These colors would end up changing as I began my process but started out as seen on the moodboard (Fig. 3.3).

When researching videos both on invasive species and nature video shorts, it was hard for me to find exactly what I was looking for: a short 30 second video that was educational, visually appealing, and would be successful in reaching a wide audience. Most of the videos I found there were educational and visually appealing that had thousands or even millions of likes on the video itself; however, the videos ranged between one and seven minutes. Most of these videos averaged four minutes, which is still short, but if I wanted to be able to capture my audience and not lose them the best way for me to go about this was to make a video no more than a minute and a half.

This led to me realizing that a 30 second video is what really captures an audience compared to a longer one minute video where almost half of your audience can be lost (“How Long”). However, I needed to figure out a way to make a concise 30-second video that was educational and informative without being too overbearing for a viewer.
**Sketches**

I began my creative process by starting a moodboard and creating a color scheme (Fig 3.3). As the next step after creating a moodboard and conducting research on what would work in my designs, I began creating sketches. For the brochure, this started as rough thumbnails showing the location of shapes, text, titles, etc. I drew these thumbnails indicating the entire front and inside of the brochure, the front side included: the front cover, back middle panel, and outside part of the flap, leaving the inside of the brochure on the opposite side of the paper.

As I created the thumbnails, I would work on two at a time, showcasing what the entire brochure might look like if I chose to go along that path. Once I completed the sketching process I was able to pick and choose elements that I thought worked well together and created two brochure versions or four sketches total, illustrating a more refined look that could be followed when creating the brochure.

The storyboard was my next step, and as I created the storyboard and mapped out the times and frames I had to keep the length I was going for in the back of my head. This helped me not to stray off course with the time length I was aiming for, which would have led me to eventually have to go in and cut down or refine it in the future if it exceeded more than one minute and thirty seconds.

One of the more successful videos that I watched when researching, (that was nominated for an Emmy), started the video off with a definition of the topic they were discussing. I thought this was a clever idea and would allow the viewers of my video to see exactly what the topic is and why it is important. I also decided to make scenes and times no more than ten seconds to keep my viewer focused and have constant movement on the screen. I found most videos had at least one moving feature at all times, allowing no distraction and keeping the eyes focused on the video itself. By the end of the storyboard sketching I had reached one minute and twenty seconds which I knew would be cut down and moved around, making me happy that I was able to stay within my and without removing any scenes or frames.
When I started to build the brochure, I realized building a skeleton version with shapes and filler text would be the best way to go about shaping the brochure, allowing me to see exactly what it would look like. This also permitted me to move the shapes and text as I saw fit, as well as to adjust how big the text should be while allowing the text to take up the space but not overpower the page; the same was done with the shapes.

Creating a template before inserting my information allowed me to see what exactly was going to be created and how it would work alongside everything, rather than inserting information and changing the statistics, info and layout constantly. By creating this template, I also decided I wanted to add a bit of texture to it as well, creating depth on the page and behind imagery. I decided on a stipple texture rather than any other subtle texture because I wanted it to seem aligned more with my topic, rather than for design purposes only.

I simultaneously worked on the animation, and began by creating all of the necessary assets for each scene. This process included looking at videography and images created by others to gather inspiration into how to continue in this process. I began by shooting video for the backgrounds of each scene, so I would not have to resort to using stock footage. I then worked on creating still graphics for the invasive species that would appear in certain scenes as well as other graphical elements. I planned to use the same typography and colors from the brochure in the animation, to maintain consistency.
**Design Process: Brochure**

I decided the best way to proceed further with the brochure was to add the information into the pages, rather than more imagery and statistics. I came to this conclusion when I started to implement information here and there and realized that some of the template might not work for certain information. This happened when I began inputting the different information into the brochure. I realized some of my layout styles that I mocked up in a template might not work, leaving me to rearrange the entire template I had created. After that I decided that the information was the more important part and wanted to make sure all of my information that I wanted added to the brochure was there. I spent time rearranging to accommodate the text, as well as rewording to fit the space provided. This meant rearranging where imagery would go, as well as where certain text would be. I did not want the “about invasive species” on the middle panel because you read left to right, not starting in the middle. I worked on creating another layout that worked well graphically but also appropriately for the layout. Not only was the template itself an issue, but also colors. After I started inputting the information, I realized my color scheme was not up to par with what I was trying to convey. That being the case, I started changing the colors slightly each time. On my first pass of inputting information, I came to the conclusion that in the original template I had created there were too many shapes and different colors that were not working together the way I had intended them to.
Design Process: Brochure

However, once I added imagery and infographics, the layout and color scheme was still not where it should have been. I rearranged more to try to get the correct layout, which then led me to another brochure style and eliminated one of the two brochure versions I had created for both the front and back. I created different versions to help narrow my ideas down to one and through this process I found a structure and layout I enjoyed, but the color scheme was still not there.

WHAT ARE INVASIVE SPECIES?

Invasive species are species that do not belong in a certain ecosystem. The wreak havoc and become a nuisance to the native species, causing a shift in the native species' ecosystem. Throughout the world and more specifically the national parks, there are thousands of types of invasive species, ranging from plants, insects and animals. The main culprits are usually plant invasive species, taking over a large majority of the United States due to their fast reproduction, even in poor soil conditions.

Due to the destructive nature of invasive species, they not only pose a threat to the ecosystems but the economy and even human life.

Nonnative plant species alone are costing around $20 BILLION PER YEAR in damages.

There are over 1,409 invasive species in U.S. national parks

23% are managed under the National Park Service
11% are claimed as under control by the NPS

419 PARKS are currently managed by the National Park Service, covering around 84 MILLION ACRES

DO YOUR PART, STOP THE SPREAD!

1. Clean off your boat thoroughly before transporting it to a different body of water.
2. Clean off your bags and boots before and after you hike in a new area to get rid of seeds and other plant pathogens that could spread.
3. Be sure to check if you have an unwanted pest in your park. Fruits, vegetables, plants, insects and animals could potentially carry pests or even become invasive themselves.
4. Check your states rules on firewood before transporting it.
5. Most importantly, follow the Carry in Carry out rule. Anything you carry in, be sure to carry it back out.

FOLLOW US @USNATIONALPARKS
INVASIVES IN OUR NATIONAL PARKS:
HOW YOU CAN HELP STOP THE SPREAD

CHECK OUT THE U.S. NATIONAL PARKS WEBSITE FOR MORE INFORMATION

Fig. 3.18 Brochure Filled 1

Fig. 3.19 Brochure Filled 2

Fig. 3.20 Brochure Filled 3
WHAT ARE INVASIVE SPECIES?

Invasive species are species that do not belong in a certain ecosystem. They wreak havoc and become a nuisance to the native species, causing a shift in the native species’ ecosystem.

Throughout the world and more specifically our national parks, there are thousands of types of invasive species, ranging from plants, insects and animals. The main culprits are usually plant invasive species, taking over a large majority of the United States due to their fast reproduction, even in poor soil conditions.

Due to the destructive nature of invasive species, they not only pose a threat to the ecosystems but the economy and even human life.
Design Process: Animation

After I completed the storyboards to go along with the animation, I proceeded to create the assets needed for the animation for each scene that they would appear in. I started out by creating all the assets needed for scenes 1-4, and then those from 5-7. In the process, I rearranged some scenes, and cut down the time significantly. Scene 2 was no longer three frames, but one; scene 3 changed from two frames to one and so on. The main purpose of this was to shorten the length of the video a bit. I had done more research and discovered that most people tune out after about 30 seconds of video and realized that this video was over 1 minute and 20 seconds. Half of the tourists would be tuning out after 30 seconds of the video. Therefore, I went back through and rearranged the scenes, editing the flow of the storyboard, to fit the narrative better. This helped me create a 30-50 second storyboard, better fitting my end goal.

After looking at other videos created, I decided that I would create video footage to go behind the graphical images giving my film more of an ambiance and option later on to just include video, text, and narration in certain areas. Once I started this, I began taking video for the background and focus of the scenes. I wanted simple movement and vibrant color schemes, and luckily the leaves, flowers and other wildlife living around me are are vibrant and beautiful in mid-morning.

During this process of videotaping, I also began writing the script for the narration to go along with. Writing the script helped with narrowing down timing of scenes, how long videos would be and finalizing what assets and imagery would go in each scene.

Scene 1
( Begin with a video playing and black overlay on top.)
( Definition of invasive species appears on screen. No narration.)

Scene 2
( Video going through wildlife)
Narrator: Throughout the world and more specifically the national parks, there are thousands of types of invasive species, ranging from plants, insects and animals.

They are costing $20 billion per year in damages. Resulting in more than just a decline in native species, but an economic issue.

Scene 3

(Scene 3)

Scene 4

(Scene 4)

Scene 5

(Scene 5)
Scene 6

(list animating on)

Narrator: To protect our national parks from invasive species

1. Clean off your boat thoroughly before transporting it to a different body of water.

2. Clean off your bags and boots before and after you hike in a new area to get rid of seeds and other plant pathogens that could spread.

3. Be sure to check if you have an unwanted pest in your pack. Fruits, vegetables, plants, insects and animals could potentially carry pests or even become invasive themselves.

4. Check your state’s rules on firewood before transporting it.

5. Most importantly, follow the Carry in Carry out rule. Anything you carry in, be sure to carry it back out!

Scene 7

(Video with black overlay)

Narrator: Let’s work together to save our national parks.
Chapter 4: Visual Solution

My final visual solution includes a brochure and 1-minute animation, allowing for two interactive hands-on pieces of work. These deliverables are meant to be passed out to tourists entering national parks before they pay the fee to enter. If there is no entry fee, park rangers or volunteers working the booths would hand the brochure out and require the video to be watched in exchange for a park token as a keepsake for those visiting, showing completion of watching the video. The viewer is intended to begin by receiving the brochure and briefly looking it over before being prompted to watch the animation. They will then be given a link, or to scan the QR code on the back of the brochure to watch the video. Both the video and brochure are meant to be interactive for the viewer and spark a conversation surrounding invasive species in the United States national parks. By creating deliverables that inspire a conversation surrounding invasive species in our national parks and will hopefully allow tourists to see how they are causing the spread of invasives as well as how they can avoid this.

Brochure

The process of creating the brochure was time consuming in the sense of the constant changing of font sizes, spacing, hyphenation, and the infographics. I realized that some of the infographics and images did not work well in certain spaces. From that point onwards, I began working on the color scheme and used Adobe Explore to gain some inspiration regarding invasive specie colors schemes. I settled on a dark blue and different hues of green along with a light off-white as the highlight. With the rearranging of the layout as well as the colors, the brochure finally came together. Beginning with the brochure, as people start on the front and see the title, they automatically know what the topic is about. I added imagery and infographics throughout the brochure to create a movement for the eye and allow a break between text. Adding texture to the empty shapes in the brochure, allowed for an extra bit of depth on the pages. As you open the brochure you are greeted with the definition of invasive species and why they are an issue. On the outside part of the flap, I added a “Do your part” section, to keep everything tied together on the inside. On the back of the brochure, I included social media icons and a QR code to watch the video animation.
WHAT ARE INVASIVE SPECIES?

Invasive species are species that do not belong in a certain ecosystem. They wreak havoc and become a nuisance to the native species, causing a shift in the native species’ ecosystem. Throughout the world and more specifically our national parks, there are thousands of types of invasive species, ranging from plants, insects and animals. The main culprits are usually plant invasive species, taking over a large majority of the United States due to their fast reproduction, even in poor soil conditions. Due to the destructive nature of invasive species, they not only pose a threat to the ecosystems but the economy and even human life.

In damages, nonnative plant species alone are costing around $20 BILLION PER YEAR

There are over 1,409 invasive species in U.S. national parks

23% are managed under the National Park Service (NPS)

11% are claimed as under control by the NPS
Color & Texture

The color and texture played a large role in both of my artistic solutions. I wanted the printed brochure to be able to have some sort of texture in the colors to help highlight the text and imagery that is in the front and inside of the brochure. The texture adds a visual element to the brochure, rather than having a solid color. I decided that a balance between texture and solid colors should be achieved throughout the brochure. For instance, in Fig. 3.16 the brochure that I was working on uses the texture on the middle-front side of the brochure, but ideally should be used throughout the brochure, rather than one section. I believe this is why a majority of my solid colors do not work well together, because there is no texture or depth to help them work harmoniously.

After I decided to incorporate textures and by continuously changing the layout of the brochure, I changed the color scheme multiple times, whether that were subtle changes in hues between the green and tan, or drastically adding a new color. This was the largest struggle I faced with the brochure: color. I wanted to start with the brochure color before the animation because I wanted to be able to carry over the colors and textures to the animation, creating a smooth transition and similarity between the two and maintaining consistency.
DO YOUR PART. STOP THE SPREAD!

1. Clean off your boat thoroughly before transporting it to a different body of water.

2. Clean off your bags and boots before and after you hike in a new area to get rid of seeds and other plant pathogens that could spread.

3. Be sure to check if you have an unwanted pest in your pack. Fruits, vegetables, plants, insects and animals could potentially carry pests or even become invasive themselves.

4. Check your state’s rules on firewood before transporting it.

5. Most importantly, follow the Carry in, Carry out rule. Anything you carry in, be
Finalizing the Brochure

Throughout the process of creating the brochure I kept in mind the important information I had gathered for this dissertation and decided what important facts should be clearly represented in the artistic solution. Because I am trying to reach a wide audience in a somewhat unconventional way compared to what the NPS usually does, I wanted the visual appeal to stand out using color, texture and imagery, with minimal paragraph text. Brochures can lose people if the order of your information is lacking directive. The headlines and photography also impacts the effectiveness your brochure may have on your audience (Floy).

I purposely used a heading on the front panel directing the brochure at the audience to intrigue them. Not knowing how they can help prompts them to open the panel and be welcomed with typographically displayed facts, photography images, and what invasive species are. This inside panel allows the eye to move between the pages and keep the viewer intrigued. Once on the back panel, or outside flap, it has the information needed to tell the viewer how they can help in just 5 easy steps. Lastly by including a contact panel with social icons and a QR code, this makes the brochure interactive and easy to find the US National Park social media pages. The QR code is not only an interactive tool, but allows the audience to watch the mandatory video, again on their own time.

By creating a well-designed brochure that is easy to navigate, intrigues the audience and is visually appealing, the viewers are more responsive and willing attention. The colors, texture and photography allow for the brochure to stand out compared to others. Gaylen Floy discusses that if a brochure was on a rack full of others asking the questions “would it stand out? Do the headlines text and photos work together to get your point across? Is there too much information for a quick scan with your eye? Is the tone inviting or dry?” (Floy) helps to create a well-designed brochure that people would pick up on their own and read without being prompted to. Though my brochure will be handed out, it is important that the audience enjoys and is intrigued by it. Say a park were to get busy and there was no time to ensure a video was watched, by having a brochure that the audience will be prompted on their own to go through and read should have the same effect as the video, but also be intriguing at the same time. I believe my brochure is designed to the point where if needed it could stand alone on a shelf and be picked up by tourists in the area.

Fig. 4.8 Brochure QR Code Link: https://www.youtube.com/watch?v=3-zPxgkcw70

Fig. 4.9 Brochure Social Media Icons
DO YOUR PART. STOP THE SPREAD!

1. Clean off your boat thoroughly before transferring into different bodies of water.
2. Clean off your boots and hull before and after you hike in new areas to get rid of seeds and other plant pathogens that could spread.
3. Be sure to check for unwanted pests in your pets, plants, vegetables, plants, pets, and animals. You could potentially carry those on your own and become invasive yourself.
4. Check your pets and vehicles for invaders before transporting it.
5. Most importantly, follow the Carr's law. On Carr's rate, anything you carry to be.

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WHAT ARE INVASIVE SPECIES?

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In damages, nonnative plant species alone are costing around $20 BILLION PER YEAR

23% are managed under the National Park Service (NPS)

11% are claimed as under control by the NPS
**Animation**

Once all of my assets were complete including the voiceover, I began making tweaks and changes to the animation, being mindful of the 30-second limit and trying not to exceed more than one minute. This meant going back into the projects and editing sections and completely getting rid of other scenes allowing for a fast and easy video to watch. Upon completion, I ended up with a one-minute video that is informative and moves the viewer to want to do what is best for our national parks.

The animation originally started as a complex animation with a lot of text and imagery appearing on screen. However, after putting the animation together, creating a concise video was more of the route I decided to take. The very beginning of the video starts with a definition of invasive species, introducing you to the topic of the video. The voiceover then begins discussing what types of invasive species there are, as well as why they are such an issue. A large ‘$20 billion’ appears on screen, to get the point across of how much is being spent on the removal. In the third scene, it begins to discuss how many parks are being managed and how large that is in comparison. The fourth scene discusses how important it is for people to help out in the removal just by being aware. Scene six then discusses the steps you can take to prevent the spread of invasive species when entering a national park. I chose to have a younger person do the voiceover to have it seem as though youth find this important, and it is their generation which we are trying to preserve these parks for. By creating a short one-minute video, I am helping park-goers to understand the risk invasive species pose to national parks and what they can do to help.

**DEFINITION:**

Invasive species are animals or plants from another region of the world that don’t belong in their new environment.
Adding Voiceover & Music

The longest process of the animation was creating the voice-over and also choosing the proper music to go in the background. I began by using the script I had written (Fig 3.23) and decided what words and phrases I wanted to emphasize as well as natural breaks between words. This changed multiple times before the final script came to be. Then I began creating the voice-over itself. I had originally asked a family member to record their voice but was overthinking how I wanted it to sound. I decided to do the voiceover myself making sure to properly enunciate and speak clearly. However, once I started putting the animation together, I realized I wanted a younger-sounding voice to make it seem like it was a younger generation speaking about invasive species to touch those who can truly make an impact. Throughout the process of recording, I found that recording each scene separately, made it easier to edit into the animation rather than chopping up one voice recording. I am no expert in voiceovers, which made this part extremely challenging in many ways.

Once the voiceover was completed, I searched for music to lay onto the background of the animation, to give more depth and movement during the quieter voiceover parts. I decided on music that was upbeat with a “looking to the future” feel. When searching for music, I did not want to give off an excited or overly joyous feel because the purpose of the video is to give a sense of seriousness and teach people what they can do to help stop the spread of invasive species. I settled on a song that I believe fits the project perfectly, and added it to the animation. I had the music start loud before the voiceover begins and then fade as the voiceover starts, picking back up towards the end of the video. Once I had finalized a majority of the animation, revising the script and voiceover was the next step. This took time, as I was trying to cut down the animation from 1 minute and 20 seconds to 30 sec-1 minute.

Color & Texture:

The color and texture played a large role in both of my artistic solutions. I wanted the printed brochure to be able to have some sort of texture in the colors to help highlight the text and imagery that is in the front and inside of the brochure. The texture adds a visual element to the brochure, rather than having a solid color. I decided that a balance between texture and solid colors should be achieved throughout the brochure. For instance, in Fig. 3.16 the brochure that I was working on uses the texture on the middle-front side of the brochure, but ideally should be used throughout the brochure, rather than one section. I believe this is why a majority of my solid colors do not work well together, because there is no texture or depth to help them work harmoniously.

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3. Check your state's rules on firewood before transporting it.

4. Most importantly, follow the Carry in Carry out rule. Anything you carry in, be sure to carry it back out!
Scene 1

(Begin with a video playing and black overlay on top.)

(Definition of invasive species appears on screen. No narration.)

Scene 2

(Video going through wildlife)

Narrator: Throughout the world and more specifically the national parks, there are thousands of types of invasive species, ranging from plants, insects and animals.

They are costing $20 billion per year in damages. Resulting in more than just a decline in native species, but an economical issue.

Scene 3

(New background fades on and United States appears with the trees appearing on screen representing national parks)

Narrator: Currently, 419 national parks that are currently managed by the national park service which cover around 84 million acres.

Scene 4

(show US with National Parks animating on again)

Narrator: With our hundreds of national parks and the countless invasive species that live within, you play a crucial role in the spread of invasive species.

Scene 5

(List animating on)

Narrator: To protect our national parks from invasive species

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Scene 6

(Video with black overlay)

Narrator: Let's work together to save our national parks.
Recap of Research

In conclusion, research has shown that invasive species are a major issue in our national parks. Ranging from a variety of different species (i.e., plants, insects, animals, etc) as mentioned throughout this document, this poses a risk to native species as well as the decline of native species. Invasives can also cause an economic issue, hurting crops. As mentioned in this thesis the main cause of invasive species is human involvement whether that was a purposeful spread, accidental, or rather spreading for the enjoyment of a species from another land. The thousands of dollars spent on the removal of invasive species shows that it is only possible to manage the species rather than completely remove them from their environment.

The thousands of dollars spent on the removal of invasive species have been shown to only manage the species rather than completely remove them from their environment.

If tourists continue to travel from park to park without knowing they could be transporting invasive species, they may contribute to the decline of many different native species without even knowing. There are multiple ways to avoid transporting invasive species, from washing off water vehicles before placing them in another body of water, checking firewood regulations, as well as simply wiping off clothes and shoes before and after leaving a park. But many tourists are not aware of these easy steps that they can take before entering a park and are not told about any guidelines before entering, making invasives easier and easier to spread.

Incorporating artwork into this issue it will not only spread awareness of this major issue in national parks but also will decrease the spread of invasive species altogether. National parks are not only a great trip for people to take to get a quick hike in, but beauty that should be preserved for future generations to experience as well. Without at least decreasing the spread of invasive species, our national parks are at risk of losing many varieties of native species.

The Process

Visual Solution Summary

The process for creating my deliverables involved extensive researching, planning, designing, problem-solving, and peer reviews for each step of the process. I began first by researching the topic of invasive species and why they have continuously been an issue. This not only involved researching the topic itself, but case studies that have been conducted on the removal of invasives in certain areas, how fast they can populate and why they spread at a fast pace. This also included conducting research on tourists in national parks, which are frequented the most or have the most invasive species due to tourists. The research also provided information on my thesis deliverables and how to entice tourists to watch the one-minute-long video, how long the video should be, and more in depth research.

Brochure

After conducting the research, a majority of time was spent selecting which information seemed to best fit the deliverables. From there, I began sketching for the brochure and animation, to give myself an idea of visual composition and where I wanted certain facts, assets, and information to be displayed. I then started assembling a template for the brochure, and mocking up where information should go and inputting any additional information and design elements I wanted to include. A good
amount of time was invested as all elements were inputted into the brochure document, and needed rearranging and color changes. I decided to add imagery throughout the brochure to breakup the amount of information I was including.

**Animation**

As far as the video animation went, it consisted of first creating a storyboard of sketches of what I would intend on creating and from there creating video, animation assets, and voice recordings to go along with the video. I am lucky to live in an area where there are woods and trees right outside my front door. I used this as my backdrop throughout the video, and especially on bright sunny days to capture the vibrant colors of greens and yellows of the flowers. Once my video was captured, I created a generic script to get the basic feel and flow of my animation. I then designed a few illustrations to go along with the video. I used the voice of a younger person to give the feel of the next generation talking to you and really hearing how important it is in their voice. I feel the use of a younger child allows the viewer to really connect with the video-- more so than they would if it was a generic narration. Once the voice over was complete, I began putting the video together and tweaking the animation by elongating scenes, cutting scenes altogether, and rearranging scenes when necessary.

**Final Visual Solution**

The final visual solutions consisted of a brochure titled “Invasives in Our National Parks: How You Can Help Stop the Spread” and a video animation titled “Do Your Part: Stop The Spread of Invasive Species.” Both deliverables help to support the research I have conducted by ensuring visitors to national parks will be informed about invasive species and do their part to help stop the spread; thinking twice before loading their boats into the water or even checking their clothing before hiking a trail can be a small step towards a bigger end goal. These deliverables are meant to spread awareness to tourists on invasive species so that they can double check and do their part to help preserve wildlife and our national parks.

**Where They Will Be Displayed**

These deliverables are to be found, first, at park entrances as people enter the parks. When park goers enter a park, some parks require an entry fee. At this point, tourists will be handed the brochure and prompted to scan the QR code to watch the educational video. Once they have completed the quick one-minute video and paid the entrance fee, they will be given their park pass, a keepsake token thinking twice before loading their boats into the water or even checking their clothing before hiking a trail can be a small step towards a bigger end goal.
and entry into the park. This method ensures that the tourist viewed the video and was handed a brochure. Even if it gets busy and say a couple tourists could not watch the video or the park rangers did not have time to make sure they watched it, each brochure has a QR code that links to the video which can then be watched even after you leave the park or again once you enter.

These two deliverables were created to spark a conversation around something that slips the minds of most people. By having these deliverables be the first thing park-goers are told to see, it will imprint into their minds and help them to think about what they are trekking into the national parks. A conversation surrounding this issue would not only benefit national parks but also other wildlife reserves, campgrounds, hiking trails, and more, allowing more than just our national parks to be saved.

**Future Goals**

My ultimate goal is for this thesis project to help spread more awareness of this topic and encourage those traveling to national parks to think twice about what they are bringing into the parks. I hope this project not only helps decrease the spread of invasive species but can also be used as a catalyst for other artists and researchers to further investigate this topic and issue. As little as one conversation can go a long way in preventing the spread and saving our national parks from declining in rich resources and native species, preserving the parks for future generations to come.

At last, this project could encompass not only a few parks but all of them, as well as turn into a website that can be searchable by tourists. And more deliverables can be created sparking even more conversations around decreasing the spread of invasive species.

I started this project having some knowledge regarding invasive species and that they were an issue here and there. The more I found out shocked me with how many native species are dying because of invasives and just how many invasive species there are in our national parks. This project not only opened my eyes to a large ongoing issue but it also allowed me to use my artistic abilities to try and solve it; furthermore it put me in touch with some amazing and talented artists who have been traveling the world and creating gallery pieces on invasive species over the years. Getting insight and knowledge about their works and their stories on how they became involved in invasive species is a part of researching this thesis I will never forget.

I hope this project not only helps decrease the spread of invasive species but can also be used as a catalyst for other artists and researchers to further investigate this topic and issue.
Appendix:
Imagery Permission
Requesting Permission to Use Imagery

Benson, Amy J <abenson@usgs.gov>  
Tue, Jun 22, 2021 at 9:07 AM

Hello Alexandria,

The zebra mussel image is not copyrighted because I took the photograph as part of my job as a federal employee. Therefore, the image is considered to be in the public domain. This is the case with just about all things produced by federal agencies, they belong to the public -- paid for by tax dollars. So feel free use in your project, permission is not necessary. An image credit is appreciated though.

Best of luck with your research.

Amy Benson

Amy J. Benson
Fisheries Biologist
U.S. Geological Survey
abenson@usgs.gov

Imagery Permission Given Via Email from Artist Amy Benson for Zebra Mussel Image: Page 18

Image

Kris Bell <kristianbell@gmail.com>  
Tue, Jun 22, 2021 at 4:42 PM

HI Alexandria,

Feel free to use the attached image for materials relating to your NPA Dissertation - and good luck.

Cheers,

Kris

WildBoars1400px.jpg 779K

Imagery Permission Given Via Email from Artist Kristen Bell for Wild Boars Image: Page 33

Invasive Species Artwork

Emily <eblairbryant@gmail.com>  
Sun, Aug 1, 2021 at 10:29 PM

Alexandria,

Please find attached a document that has the text you wrote with some suggested edits to add some more information about my artwork, such as the types of plants I use and some more information about my art making process. I also included at the bottom of the document a note on how I would like the images to be captioned. Please feel free to include them in your thesis.

Please let me know if you have any questions and thanks again for reaching out. Please send me the final thesis when it is finished--I would enjoy reading it!

Best wishes,

Emily

[Quoted text hidden]

Marci Thesis Suggested Edits.doc 39K

Imagery Permission Given Via Email from Artist Emily Katzin (née Bryant) for: Cactus Moth Caterpillar 2011 & Asian Ladybird Beetle; Page 32 (With Suggested Edits)
Imagery Permission Page 1/2 Given Via Signed Digital Document from Artist Jane Kramer for “A shadow of cream wild indigo printed on paper made from the invasive species, Phragmites australis” Image: Page 30

Copyright Letter
©2021

Dear Jane Kramer:

I am requesting permission to use the following work:

Claire Jane: “A Shadow of Cream Wild Indigo.” Great Lakes Echo, Great Lakes Echo, 21 Oct. 2015, greatlakesecho.org/2015/10/21/artist-print-tissue-paper-made-from-invasive-species/. This would be used on one page, along with other imagery regarding invasive species, plants, nature, etc.

This request is for permission to include the above content as part of the following project that I am preparing:

1. Alexandria Marci, am creating a MFA Dissertation Paper, at Liberty University surrounding invasive species in U.S. National Parks. The research I am conducting for my Master’s dissertation revolves around invasive species in the United States national parks. This project is being conducted under the supervision of my dissertation committee provided by Liberty University; our chair (Professor David Meyer) and two readers (Cheryl Haus, and Jim Gilliland). In my thesis I am discussing how tourists can help stop the spread of invasive species in our national parks and using artwork to help convey this issue and stop the spread. The artwork I am creating includes a brochure and animation. Throughout my thesis document I have imagery and scientific reasons to help show invasive species and how they are an issue, why they are an issue and how to help stop the spread. The project will be developed during calendar year 2021 and made available online to the public shortly thereafter with continuation updates and changes.

This request is for permission to include the above content as part of the project, as Reference imagery. My work in progress project is attached and you can review exactly where your image will appear along with the citation that follows it, giving credit to you in my dissertation. We expect to make it available indefinitely to the public with no restriction or charge.

I believe that everyone company, and is currently the holder of the copyright, because the original work status that copyright is held in your name and the name of the publisher, and my research indicates that you own this artwork, based on the website I found in the citation above.

If you do not currently hold the rights, please provide me with any information that can help me contact the re-post holder. Otherwise, your permission confirms that you hold the right to grant this permission.

This request is for a non-exclusive, irrevocable, and royalty-free permission, and it is not intended to interfere with other uses of the same work by you. Because of changing technologies, I am also requesting permission to use the materials in connection with future versions of the project, in any format, including electronic and print media. I would be pleased to include a full citation to the work and other acknowledgement as you might request.

I would greatly appreciate your permission. If you require any additional information, do not hesitate to contact me at the address, email, and number above. A duplicate copy of this request has been provided for your records, along with the page the image will appear. If you agree with the terms as described above, please sign the letter where indicated below and return via email or mail to the above address.

Sincerely,
Alexandria Marci

Permission is hereby granted:

Signature: Jane
Name & Title: 
Company/Affiliation: 
Date: 

Imagery Permission Email Confirmation that document is hers from Artist Jane Kramer for “A shadow of cream wild indigo printed on paper made from the invasive species, Phragmites australis” Image: Page 30

Re: Requesting Permission to use Imagery

Jane Kramer

To: alexandriamarci@gmail.com

No problem at all. It was so nice to talk to you as well. Best of luck to you as you finish your degree and move on to the next adventure.

The signed copy is attached.

Jane
Imagery Permission Given Via Email from Trees Atlanta’s for “Invasive English Ivy found in the U.S.” Image: Page 11

Imagery Permission Given Via Email from Andy Fisher from the NPS that “Invasive Buffelgrass found in the U.S.” Image is in the public domain for use: Page 23

Imagery Permission Given Via Email from Artist Lawrence Barringer for “Invasive Spotted Lantern Fly found in the U.S.” Image: Page 33
Dear Scott Sutton:

I am requesting permission to use the following work:

This would be used on one page, along with other imagery regarding invasive species, plants, nature, etc.

This request is for permission to include the above content as part of the following project that I am preparing:

I, Alexandria Marci, am creating a MFA Dissertation Paper at Liberty University regarding invasive species in U.S. National Parks. The research I am conducting for my Master’s dissertation revolves around invasive species in our national parks and using artwork to help convey this issue and stop the spread. The artwork I am creating includes a brochure and animation. Throughout my thesis document, I have imagery and scientific sources to help showcase invasive species and how they are an issue, why they are an issue, and how to help stop the spread. The project will be developed during the calendar year 2021 and made available online to the public shortly thereafter with continuous updates and changes.

This request is for permission to include the above content as part of the project as

Reference imagery. My work in progress project is attached and you can review exactly where your image will appear along with the citation that follows it, giving credit to you in my dissertation. We expect to make it available indefinitely to the public with no restriction or charge.

I believe that you are the current holder of the copyright, because the original work states that copyright is held in your name by the name of the publisher, and my research indicates that you own this artwork, based on the website I found in the citation above. If you do not currently hold the rights, please provide me with any information that can help me contact the proper rightsholder. Otherwise, your permission confirms that you hold the right to grant this permission.

This request is for a non-exclusive, irrevocable, and royalty-free permission, and it is not intended to interfere with other uses of the same work by you. Because of changing technologies, I am also requesting permission to use the materials in connection with future versions of the project, in any format, including electronic and print media. I would be pleased to include a full citation to the work and other acknowledgement as you might request.

I would greatly appreciate your permission. If you require any additional information, do not hesitate to contact me at the address, email, and number above. A duplicate copy of this request has been provided for your records, along with the page this image will appear. If you agree with the terms as described above, please sign the letter where indicated below and return via email or mail to the above address.

Sincerely,

Alexandria Marci

Permission is hereby granted:

Signature: Scott Sutton
Name & Title: Scott Sutton - Artist
Company Affiliation:
Date: 6/27/21
Dear Mike LeValley:

I am requesting permission to use the following work:

Image: Invasive White Sweet Clover found in the U.S. (Image: Page 20)

This would be used on one page, along with other imagery regarding invasive species, plants, nature, etc.

This request is for permission to include the above content as part of the following project that I am preparing:

I, Alexandria Marci, am creating a MFA Dissertasion Paper, at Liberty University surrounding invasive species in U.S. National Parks. The research I am conducting for my Master’s dissertation revolves around invasive species in the United States national parks. This project is being conducted under the supervision of my dissertation committee provided by Liberty University; one chair (Professor David Meyer) and two readers (Chelsea Blaes, and Jim Gilliland). In my thesis I am discussing how tourists can help stop the spread of invasive species in our national parks and using artwork to help convey this issue and stop the spread. The artwork I am creating includes a brochure and animation. Throughout my thesis document I have imagery and scientific sources to help showcase invasive species and how they are an issue, why they are an issue and how to help stop the spread. The project will be developed during calendar year 2021 and made available online to the public shortly thereafter with continuous updates and changes.

This request is for permission to include the above content as part of the project as reference imagery. My work in progress project is attached and you can review exactly where your image will appear along with the citation that follows it, giving credit to you in my dissertation. We expect to make it available indefinitely to the public with no restriction or charge.

I believe that you/your company, are the current holder of the copyright, because the original work states that copyright is held in your name/the name of the publisher, and my research indicates that you own this artwork, based on the website I found in the citation above. If you do not currently hold the rights, please provide me with any information that can help me contact the proper rightsholder. Otherwise, your permission confirms that you hold the right to grant this permission.

This request is for a non-exclusive, irrevocable, and royalty-free permission, and it is not intended to interfere with other uses of the same work by you. Because of changing technologies, I am also requesting permission to use the materials in connection with future versions of the project, in any format, including electronic and print media. I would be pleased to include a full citation to the work and other acknowledgement as you might request.

I would greatly appreciate your permission. If you require any additional information, do not hesitate to contact me at the address, email, and number above. A duplicate copy of this request has been provided for your records, along with the page the image will appear. If you agree with the terms as described above, please sign the letter where indicated below and return via email or mail to the above address.

Sincerely,

Alexandria Marci

Permission is hereby granted:

Signature: [Redacted]
Name & Title: Mike LeValley
Company/ Affiliation: [Redacted]
Date: 24 June 2021
3. What can I do with Content?

- AIIHA encourages Authorized Users to engage in research activities, including downloading or printing Content in reasonable amounts for non-commercial, scholarly purposes, as well as use the Content on its platform in the following ways (as long as you abide by the prohibited uses in Section 4 below) (collectively the ‘Permitted Uses’):
  - classroom or organizational instructional and activities (for example, a discreet handout or projection of a Content item within a classroom setting);
  - in student assignments, educational presentations, and student or faculty curatorial portfolios (so long as such use conforms to the customary and usual practice in the field), or in research papers or dissertations, including reproductions of the dissertations (provided such reproductions do not include Books, and are only for personal use, library deposit, and/or use solely within your institutional licensee);
Copyright Letter  
6/20/2021

Dear Utah Division of Wildlife Resources:

I am requesting permission to use the following work:


This would appear on a single page along with other imagery as well as information regarding invasive species.

This request is for permission to include the above content as part of the following project that I am preparing:

I, Alexandria Marci, am creating a MFA Dissertation Paper at Liberty University surrounding invasive species in U.S. National Parks. The research I am conducting for my Master’s dissertation revolves around invasive species in the United States national parks. This project is being conducted under the supervision of my dissertation committee provided by Liberty University, one chair (Professor David Meyer) and two readers (Chelsea Bass, and Jim Gilliland). In my thesis I am discussing how tourists can help stop the spread of invasive species in our national parks and using artwork to help convey this issue and stop the spread. The artwork I am creating includes a brochure and animation. Throughout my thesis document I have imagery and scientific sources to help showcase invasive species and how they are an issue, why they are an issue and how to help stop the spread. The project will be developed during calendar year 2021 and made available online to the public shortly thereafter with continuous updates and changes.

This request is for permission to include the above content as part of the project as imagery. My work in progress project is attached and you can review exactly where your image will appear along with the citation that follows it, giving credit to you in my dissertation. We expect to make it available indefinitely to the public with no restriction or change.

I believe that you, your company, are currently the holder of the copyright, because the original work states that copyright is held in your name/the name of the publisher, and my research indicates that based on the link in the citation. If you do not currently hold the rights, please provide me with any information that can help me contact the proper rightsholder. Otherwise, your permission confirms that you hold the right to grant this permission.

This request is for a non-exclusive, irrevocable, and royalty-free permission, and it is not intended to interfere with other uses of the same work by you. Because of changing technologies, I am also requesting permission to use the materials in connection with future versions of the project, in any format, including electronic and print media. I would be pleased to include a full citation to the work and other acknowledgement as you might request.

I would greatly appreciate your permission. If you require any additional information, do not hesitate to contact me at the address and number above. A duplicate copy of this request has been provided for your records. If you agree with the terms as described above, please sign the letter where indicated below and return via email or mail to the above address.

Sincerely,

Alexandria Marci

Permission is hereby granted:

Signature: ________________________________

Name & Title: Faith Heaton Jolley, Utah Division of Wildlife Resources Public Information Officer

Company/Affiliation: Utah Division of Wildlife Resources

Date: June 22, 2021
You may use the requested images listed just below this paragraph. Please be sure to credit the images as indicated on the website. The numbers below are hyperlinked and the citation for each picture is on the linked page.

2100048, 5205097,

You can view this request again by visiting the "Your Account" section of the website and selecting "View Image Usage Requests". It is also directly available via this link.

Thanks,
Joe LaForest
Bugwood Image Database Manager
Center for Invasive Species and Ecosystem Health
The University of Georgia
To: alexandriamarci@gmail.com

Thank you for using the Light Box on Insect Images to request permission to use images in a Educational publication. If you are unsure as to if this is the correct type of request, please see our image usage guidelines.

You have entered the following information for this request:

Educational for publication
Publication: The Do's and Don'ts in National Parks
Request generated from: Insect Images
Comments: This would be used on one page, along with other imagery regarding invasive species, plants, nature, etc.

This request is for permission to include the above content as part of the following project that I am preparing: I, Alexandria Marci, am creating a MFA Dissertation Paper, at Liberty University surrounding invasive species in U.S. National Parks. The research I am conducting for my Master's dissertation revolves around invasive species in the United States national parks. This project is being conducted under the supervision of my dissertation committee provided by Liberty University; one chair (Professor David Meyer) and two readers (Chelsea Bass, and Jim Gilliland). In my thesis I am discussing how tourists can helps top the spread of invasive species in our national parks and using artwork to help convey this issue and stop the spread. The artwork I am creating includes a brochure and animation. Throughout my thesis document I have imagery and scientific sources to help showcase invasive species and how they are an issue, why they are an issue and how to help stop the spread. The project will be developed during calendar year 2021 and made available online to the public shortly thereafter with continuous updates and changes. This request is for permission to include the above content as part of the project as Reference imagery. My work in progress project is attached and you can review exactly where your image will appear along with the citation that follows it, giving credit to you in my dissertation. We expect to make it available indefinitely to the public with no restriction or charge. I believe that you/your company, are/is currently the holder of the copyright, because the original work states that copyright is held in your name/the name of the publisher, and my research indicates that you own this artwork, based on the website I found in the citation above. If you do not currently hold the rights, please provide me with any information that can help me contact the proper rightsholder. Otherwise, your permission confirms that you hold the right to grant this permission. This request is for a non-exclusive, irrevocable, and royalty-free permission, and it is not intended to interfere with other uses of the same work by you. Because of changing technologies, I am also requesting permission to use the materials in connection with future versions of the project, in any format, including electronic and print media. I would be pleased to include a full citation to the work and other acknowledgement as you might request. I would greatly appreciate your permission. If you require any additional information, do not hesitate to contact me at the address, email, and number above. A duplicate copy of this request has been provided for your records, along with the page the image will appear. If you agree with the terms as described above, please sign the letter where indicated below and return via email or mail to the above address.

Sincerely, Alexandria Marci

You may use the requested images listed just below this paragraph. Please be sure to credit the images as indicated on the website. The numbers below are hyperlinked and the citation for each picture is on the linked page.

2100048, 5205097,

You can view this request again by visiting the "Your Account" section of the website and selecting "View Image Usage Requests". It is also directly available via this link.

Thanks,
Joe LaForest
Bugwood Image Database Manager
Center for Invasive Species and Ecosystem Health
The University of Georgia
Imagery Permission Granted Via JSTOR Policy, (with Specification from Document on next page) by Emma C. Underwood for “Chart showing the probability invasive species will occur in the area of Yosemite National Park.” Image: Page 22

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- classroom or organizational instruction and activities (for example, a discreet handout or projection of a Content item within a classroom setting);
- in student assignments, educational presentations, and student or faculty curatorial portfolios (so long as such use conforms to the customary and usual practice in the field), or in research papers or dissertations, including reproductions of the dissertations (provided such reproductions do not include Books, and are only for personal use, library deposit, and/or use solely within your Institutional Licence);
Re: NPMaps Contact Form

Matt  alexandria marci
To  alexandria marci

Yep, you're good to go with those. Best of luck!

Matt

On Wed, Aug 11, 2021 at 6:30 AM alexandria marci wrote:
Great!
Here is the link for the maps:
as well as this one: http://nmaps.com/wp-content/uploads/yosemite-valley-hiking-map.jpg

Thank you so much for getting back to me!

Alexandria Marci

On Tue, Aug 10, 2021 at 9:52 PM Matt wrote:
Thanks for checking in, Alexandria! Most of my maps are public domain, but not 100% of them so I’d be curious to get a heads up for which ones you were hoping to use (I don’t need to see the context). If you can send me the link to each map, I can confirm permissions for each of them. Thanks!

Matt

On Sun, Aug 8, 2021 at 8:33 AM Alexandria Marci <wordpress@nmaps.com> wrote:
Message Body:
Hello,
I am a graduate student at Liberty University finalizing my MFA in Graphic Design degree and finishing my thesis. I would love to use a few images of the maps from Yosemite that are on this site as a part of my thesis research. I can directly send the images as well as how they will be displayed in the document. Please email me back with permission to use, proof of display and what images, or any questions you may have!
Thank you,
Alexandria Marci
Bibliography


