

Service Learning Project Proposal

Edge Effects: Exploration of Human Disturbances and their Effects on Habitat

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Photo Credit: josephagresta

Introduction

Florida's ecosystems are some of the most distinctive in the world; its geographic location provides a climate that is unique to Florida alone. It's peninsular location, bordered by the Gulf Stream to the east and Gulf of Mexico to the west helps keep temperatures relatively warm and mild in comparison to other places of the same latitudes, this provides exceptional habitats¹ not found anywhere else (Whitney et al 2004). Florida spans several climactic zones allowing it to host a wide range of species originating from tropical, semi/sub tropical, arid, and temperate climates (Jewell 2002). Central Florida specifically is host to a humid subtropical climate, characterized by a summer rainy season from June through September when traditionally the most fires are started by lightning strikes which burn the ample fresh growth (Lodge 2005). The dry season ranges from October through May and is characterized by a dryer, cooler climate brought on by low-pressure fronts from the north (Whitney



Florida panthers are endemic and one of the rarest creatures on the planet.

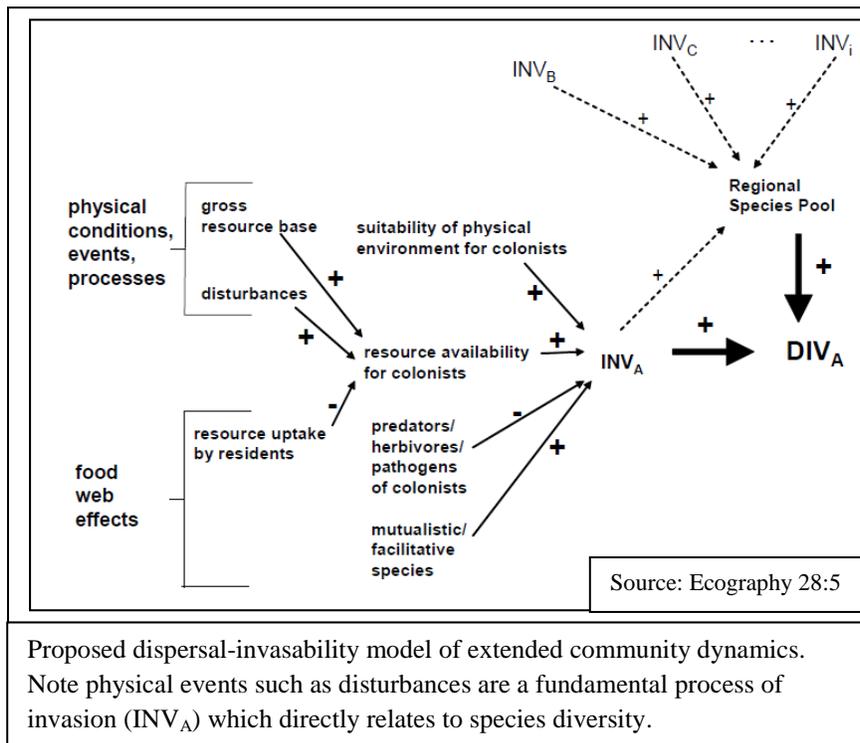
Photo Credit: Brian Kenney

et al 2004). The southern peninsula of Florida is subject to a more moderate climate than that of Central Florida due to warm air from the Gulf Stream (Whitney et al 2004). It is because of this climatic disparity that Florida provides a tremendous diversity of rare ecosystems and species, many of which are endemic² to Florida only. Habitat types range from tropical mangrove forests and marsh in the South to pine flatwoods and wetlands, primarily located in the Central region. Continental climate and mixed forest are prevalent in Northern regions, a more reminiscent of

¹ **Habitat**- the set of ecological conditions under which particular species and their communities live (Cain et al. 2008)

² **Endemic species**- occurring in a particular geographic region and nowhere else on Earth (Cain et al 2008).

northern latitudes (Black 1993). It is because of this hospitable, diverse, and temperate environment that has attracted agriculturalists to import many exotic and ornamental species able to thrive in this area (Lodge 2005). This practice also makes Florida's unique ecosystems vulnerable to colonization by hardy, exotic, invasive plants with vigorous growth rates and few limiting physical factors³ (Cain et al 2008). The term "*Invasive Species*" is used to describe a sustained introduced growing population that displaces native species and has other large negative effects on native communities (Cain et al 2008). The term "*invasibility*" is used to describe the factors involved in an ecological community's⁴ susceptibility to colonization and



subsequent establishment of individuals of species not currently part of the resident community (Davis et al. 2005 Fig. 1). This term specifically relates to the study of habitat edges. When a habitat is disturbed by anthropogenic or natural events it creates a drastic

change between two contrasting habitats in an ecosystem, producing a large number of new niches⁵ available for colonization (Cain et al. 2008). The term "*edge effects*" has been coined to

³ **Physical factor**- features of the environment that affect population growth rates that are not consumed or depleted (Cain et al 2008).

⁴ **Community**- an assemblage of species living close enough together for potential interaction (Cain et al. 2008.)

⁵ **Niche**- the physical and biological conditions that the species needs to grow, survive, and reproduce (Cain et al 2008).

describe the biotic and abiotic effects on an ecosystem such as species diversity⁶, species richness⁷, species composition⁸, and overall health following the creation of an abrupt change in habitats (Cain et al 2008). Edges can have a radical effect on natural ecosystems which have been recently disturbed, interrupting the native species ability to re-colonize an area that is in proximity to invasive species by increasing their invasibility (David et al. 2005). The more invisable an environment is means the more incoming propagules⁹ will become established (David et al. 2005). In most circumstances, invasive species out-compete the native populations¹⁰ due to their ability to quickly establish homogeneous populations and form low, light impenetrable canopies that prevent other species from growing (Serbert-Cuvillier 2008). [Supplemental Material Attached on Categorization of Invasive Species]. Florida's ecosystems are naturally dynamic and can adapt to a large variety of disturbance such as wildfire, drought, flooding, and severe weather events that will periodically open new niches and alter community composition (Hobbs and Huenecke 1992). However, invasive species are known to change physical environments, but are of particular concern when they compete with, prey on, or alter endangered species natural habitat (Cain et al. 2008). The latter exemplifies the importance of studying these effects in order to understand how to properly contain and prevent further harm to ecosystems that border urban areas. In many ecosystems, habitat degradation following fragmentation has increased vulnerability to invasion by invasive species, which in turn may lead to ecosystem consequences that further degrade the system (Cain et al 2008).

Our study was created in an attempt to quantify what effects these edges are having on native ecosystems at the University of Central Florida in order to shed light into how to

⁶ **Species diversity**- A measure that combines both the number of species in a community and their relative abundances compared with one another (Cain et al. 2008)

⁷ **Species richness**- number of species in a community (Cain et al. 2008)

⁸ **Species composition**- the identity of th species present in a community (Cain et al. 2008)

⁹ **Propagule**- any part of a plant that can give rise to a new individual and aids in dispersal of the species (National Park Service 2009)

¹⁰ **Population**- A group of individuals of the same species that live within a particular area and interact with eachother (Cain et al. 2008)

appropriately reduce these effects. As a result, we aim to examine certain anthropogenic events such edge creation, habitat fragmentation, species introductions and the modification of natural fire regimes that we hypothesize can influence Florida's indigenous species' natural resilience to invasion and begin a chain of events that leads to irreversible degradation of habitats. This irrevocable degradation of habitats comes with the expense of environmental health, economic costs, and decreased social equity, jeopardizing the needs of future generations and depriving the current generation of the natural richness and productivity nature, thus compromising a sustainable future (Rockstrom et al 2009).

When humans alter landscapes it often fragments whole ecosystems to into discontinuous parcels. This effect is known as habitat fragmentation and refers to the breaking up of one continuous habitat into a complex matrix of habitat patches amid a human dominated landscape (Cain et al. 2008). This fragmentation leads to the increase in edge effects, particularly when the habitat becomes completely isolated with open edges on all sides and leads to a cascade of other consequences (Cain et al 2008). Urban environments such as roads, developments, and fences are a form of habitat fragmentation that inhibits the natural flow of succession¹¹. This can have the consequence of modifying the habitats edge beyond natural variation (Murcia 1995). These modifying factors can affect seed dispersal rates, light penetration and availability due to thinning of foliage, leading to changes in habitat utilization and fire regime¹² patterns (Bowman et al. 1994).

Seed dispersal rates are affected by habitat utilization trends. Studies show direct correlation of size of habitat and time since fragmentation to the number of species within and area (Krauss et al 2010). In a study by Donovan et al. (1997) it was found that birds' nest predation was more prevalent in highly fragmented areas and in edge habitat than in

¹¹ **Succession**- The change in species composition over time as a result of abiotic and biotic agents of change (Cain et al. 2008)

¹² **Fire Regime**- Intensity and frequency of fire (Lodge 2005.)

undisturbed areas and core habitat. Native plant species that rely on animals for seed dispersal are affected by this change in utilization pattern.

Most ecosystems in Florida are dependent on regular burning to cycle nutrients that have been “locked up” in plant tissues during growth (Lodge 2005). Fire plays an important role in shaping Floridian habitats of terrestrial species as noted by the broad correlation of vegetation formation and fire regimes, and can often attribute different ecosystem states in the same climatic zone (Bowman et al. 2009). Fire has the effect of keeping vegetation low while allowing fire dependent plant communities to thrive, such as scrub, marsh and pine flatwoods which cannot exist without fire (Lodge 2005). Once an edge is opened and previously occupied niches become accessible, the physical characteristics such as wind patterns, moisture and light availability change. This has the effect of allowing suppressed saplings better access to light and resources, spurring quick growth (Serbert-Cuvillier 2008). Certain invasive climbing vines create a “fire ladder” by which surface fires ascend and kill trees that would ordinarily survive and prosper from natural fires (Lodge 2005). Forests with open edges make trees more susceptible to wind throw causing greater fuel loads which results in hotter fires, altering soil composition and species diversity (Cain 2008).



social equity. When all three conditions are met a system is considered to be sustainable.

When considering the social aspect, there are intrinsic values to society by preserving the natural lands we have today. We have a right as Floridians to know and preserve our sense of place by keeping invasive species out and preserving the natural beauty of our native flora and fauna. For it is in the uniqueness of a place that helps define its people, just as humanity must preserve its past in order to appreciate how far we have come, we must preserve our natural history in order to guide us sustainably into the future. By studying edge effects in our local systems we can better understand how to manage disrupted lands and

Figure 2

Estimated annual costs associated with some alien species introduction in the United States (see text for details and sources) (×millions of dollars)

Category	Nonindigenous species	Losses and damages	Control costs	Total
<i>Total</i>				
PLANTS	25,000			
Purple loosestrife		–	–	45
Aquatic weeds		10	100	110
Mealeuca tree		NA	3–6	3–6
Crop weeds		24,000	3000	27,000
Weeds in pastures		1000	5000	6000
Weeds in lawns, gardens, golf courses		NA	1500	1500

Source: *Ecological Economics*: Pimental et al. 2005

restore them to their original state, saving that which is unique to a culture. Poorly maintained edges can result in diminished social value due to unattractiveness. We should feel obligated to our future generations to preserve a natural landscape filled with biodiversity, not dominated by a handful of

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the edge effects through better urban s, we can protect natural lands for culture. managing these systems and more more attractive ecosystem will more money flowing into the local central Florida’s Landscape and Natural

“The Department of Landscape & Natural Resources is committed to planning, installing and maintaining a sustainable and inviting outdoor environment for the UCF campus, providing shade, visual interest, and healthy ecosystem function in both the constructed and natural areas...Our watchword is sustainability: appropriate plants, tended with the best management practices, and proper management of greenspace on campus.” – (UCF Landscape and Natural Resources 2010)

Research on how to more effectively manage these lands can be economically beneficial to the University and community by providing enhanced outdoor recreational opportunities, attracting more visitors and students. This research will also promote UCF&LNR to the goals in their mission statement by promoting a healthy ecosystem function and providing visual interest. The information gained will also results in methods that can be used in the future to combat invasive species more cost effectively than before. In 1993 the United States spent 1.5 Billion dollars on managing invasive plant species (Pimentel et al. 2005). This extraordinarily large number could possibly be minimized through proper management techniques that focus on preventing the spread and growth of invasive species rather than just controlling established populations.

The nature of edge effects is a multifaceted issue, scientific research in the past has found it difficult to explain and quantify the direct and indirect consequences of edge effect. It is generally understood in the scientific community that edges have deleterious effects on forest fragments. However, there is uncertainty as to how these results will affect different ecological communities (Murcia 1995). There is no doubt that no matter the size of the forest fragments, the outer edges were are more likely to foster invasive varieties.

Methods

The two plant communities we will be studying will be mesic flatwood and baygall. These communities are distinguished by their soil types, hydrology and thus, species composition. Pine flatwoods are characterized by poorly drained, acidic, sandy soils (LNR 2010). These areas are generally low and flat with an overstory of longleaf, slash, or pond pine,

and a shrub understory of species such as saw palmetto, wax myrtle, gallberry, and wiregrass (LNR 2010). Baygall is an evergreen forested wetland of bay species situated at the base of a slope or in a depression. Species we expect to find here are Loblolly bay, sweetbay, fetterbush, large gallberry, dahoon, myrtle dahoon, titi, black titi, wax myrtle, coastal doghobble, swamp doghobble, red maple, Florida anisetree, and coco plum (Duever 1982). We are studying these areas because they represent natural Florida plant community types and are relatively undeveloped. The only major human alterations should be footpaths and the edges created by the urban interface. It should be mentioned that the mesic flatwood study site has been burnt within ten years. Our study methods will include:

1. Select points on an edge of high, medium and low disturbance levels within specific vegetative communities. High disturbance (**red**) will be categorized by a continual disturbance alongside a highly urbanized edge, such as a roadway with high traffic. Medium disturbance (**yellow**) is categorized by intermittent disturbance on a less defined edge, such as a commonly used foot or bike path. A low disturbance (**blue**) area can be categorized by an edge with little anthropogenic influence, for instance a path with low foot traffic or game trail.
2. We will incorporate 30m transects perpendicular with the vegetative edge of the study area. Each transect will contain (3) plot lines spaced 15m apart, one will bisect the transect, the other two will lie opposite each other perpendicular to the outer edge.
 - a. Following each plot line, starting at 0m, every 10m a 4 sq. m monitoring point (plot) will be established, in accordance with UCF standard for vegetative monitoring.
 - b. Each community will have (3) transects, coinciding with a high, medium and low disturbance level.
 - c. There will be (2) different communities surveyed. Study area (A) will include mesic flatwood habitat. Study area (B) will include Baygall habitat.

3. We will use UCF standard vegetative monitoring form to collect quantitative and qualitative characteristics. [See Attached Form]
 - a. **Ground % Cover**- Measures the percentage of ground covered by vegetation. In our study we sub-divided this into native vs. non native ground cover
 - b. **Species Diversity**- A measure that combines both the number of species in a community and their relative abundances compared with one another (Cain et al. 2008)
 - c. **Tree Diameter Breast Height**- tree diameter is usually measured at 4.5 ft (137 cm) above ground level. DBH can be measured with a specially calibrated tape measure called a diameter tape (Swiecki 2001).
 - d. **Species** – A population or group of populations whose members have similar characteristics and can interbreed with one another, but not with members of other such groups. (Cain et al. 2008)
 - e. **Species richness**- The number of species in a community (Cain et al. 2008)
3. Data analysis will consist of UCF vegetative monitoring form as well as Global Information Systems diagrams, flow charts, and graphs. GIS is an important tool used for a variety of applications, allowing importation and manipulation of data layers, as well as a number of analysis techniques. Today GIS is commonly used for anything from city planning to determine suitable preservation habitat.

Goals and Objectives

The main goal of this study is to determine the effect of edges on established vegetative communities and to quantify any positive or negative effects these edges have. We will determine how urbanization can affect the spread of invasive species into these communities and decrease species diversity. We aim to determine if one habitat type is more susceptible to invasion and which native species tend to be more effective in staving invasion. This information

can be used to determine better remediation and conservation methods to support the triple bottom line.

Potential Barriers

Potential barriers include time and availability of group members to work together in the field gathering data. Natural phenomena such as weather events have potential to disrupt time in the field, as they are unpredictable and difficult to avoid. Access to study materials and the occurrence of landscape maintenance in the study area is a concern. Equipment failure is of concern as well because of the use of electronic devices in our study. Categorizing the specific study areas into high, medium and low disturbance levels also poses a challenge, specifically deciding what criterion qualify the areas for such a label.

Materials

- GIS ArcINFO
 - (UCF Natural Land Shape Files, Vegetative Community Map, Aerials (Laminated))
- GPS Units (2)
- 4 sq. m area hoses
- Flags (one roll)
- Gortex Boots (4)
- Snake Chaps (4)
- DBH Tape (1)
- Stakes (30)
- Adhesive Tape
- Invasive Guide Book and Florida Plant ID Guide Book
- Notebooks (5)
- Machete

Results

In the high disturbance area of Pine Flatwood, plot number one, 3 of 40 total individuals are invasive. All of the individuals happen to be Bahia Grass, they are part of landscaping as the plot was directly along the roadway edge. The most prevalent species present in the area is Live Oak at 10 individuals, followed by Fetterbush and Yellow Button at 5 individuals each. In the second plot, 0 of 16 individuals are invasive, the most prevalent species is Myrtle Oak at 10 individuals followed by Saw Palmetto at 3 individuals. In plot number three 0 of 19 individual plants are non-invasive, the study is dominated by Saw Palmetto at 17 individuals. In plot four of the high disturbance study areas 0 of 15 individuals are invasive, dominated by Fetterbush at 7 individuals followed by Saw Palmetto at 3. It was noted that we see the first occurrence of fungal infections and Gall wasps when collecting data in the high disturbance area of the Pine Flatwood habitat.

In the medium disturbance area of Pine Flatwoods, plot number one, 0 of 67 individuals are invasive. The plot is predominantly covered with low lying miscellaneous unidentifiable grasses, this is evident because the study points are placed directly on the path edge in the first plot. In the second plot 0 of 17 individuals are invasive, with Saw Palmetto as the most predominant species at 9 individuals followed by Wiregrass at 4 individuals. Plot number three shows 0 of 14 individuals as invasive, with Saw palmetto at 8 individuals and miscellaneous unidentifiable grasses at 4. Plot four has 0 of 28 individuals as invasive with Saw Palmetto dominating at 14 followed by Shiny Fetterbush at 8 individuals.

In the low disturbance area of Pine Flatwoods, plot number one, 0 of 132 individuals sampled are invasive species. Chapmann Oak is the most prevalent species at 59 individuals, followed by Wiregrass at 38 individuals. Plot number two has 0 of 93 species recorded as

invasive, with Chapmann Oak at 53 individuals, followed by Wiregrass at 15 individuals. In Plot three 0 of 111 individuals are invasive with Chapmann Oak and Wiregrass both at 34 individuals. Plot four has 0 of 130 individuals counted as invasive, once again dominated by Chapmann Oak at 49 individuals followed by Wiregrass at 35.

In the high disturbance area of Bay Gall community, plot number one, 0 of 34 are invasive species. This area is highly dominated by Beggars Tick at 20 individuals, as it lay on the roadway edge. In plot two 0 of 38 individuals counted are non- native, with a majority of the area populated by Cinnamon Fern at 24 individuals followed by Sweet Bay at 6 individuals. In plot three 1 of 35 species is invasive, this individual was a Chinese Tallow plant. The most common plant found is again Cinnamon Fern at 22 individuals, followed by sweet bay at 9 individuals. 0 of 35 counted are invasive species with Sweet Bay predominant at 12 individuals, and Cinnamon Fern at 11.

In the medium disturbance area of Bay Gall community, plot number one, 9 of 24 individuals counted are considered invasive, 7 of them Cesar weed and 2 of the m Chinese Tallow. Cinnamon Fern is the most prevalent species with 12 individuals present. In plot two, 0 of 13 individuals are invasive, the most common plant is Cinnamon fern with 8 individuals. There are 0 of 22 plants considered invasive in plot number 3 with both Cinnamon Fern and Wild Blueberry most common with 4 individuals. Plot number four exhibits 0 of 29 individuals as invasive, Dominated by Cabbagepalm Fern and Wax Myrtle at 5 individuals each.

In the low disturbance area of Bay Gall community, plot number one, 0 of 43 individuals observed are invasive. The most predominant species present in this plot is Wax Myrtle at 14 individuals, followed by Yellow Button at 10 individuals. In the second plot of low disturbance 0 of 17 individuals are invasive, predominately Fetterbush with 5 counted, followed by Saw Palmetto at 4 individuals. Plot three shows 0 of 13 individuals counted as non-invasive, the most

common species present is Saw Palmetto at 7 individuals. Plot four represents 0 of 19 counted as invasive species, dominated by Saw Palmetto with 14 individuals.

Figure 4 represents compiled data for heavy, medium, and low disturbance levels in the Pine Flatwood community, and aims to show comparison between native and invasive species. The graph shows an increase in individuals as disturbance level decreases. Invasives are present in the heavy disturbance area, but not in medium or low. Figure 5 represents compiled data for heavy, medium, and low disturbance levels in the Baygall community. This graph shows the heavy disturbance area with the greatest number of individuals present. Invasives are present in heavy and medium disturbance areas, though representing only a fraction of the individuals studied. No invasives are present in the low disturbance level study areas.

Outcome

Although our study provided many unforeseen challenges throughout the course we were able to collect all the data necessary to shed some light on the mechanics of edge effects. Most importantly, although the sheer number of invasive species we found was much less than expected, we were able to form a rudimentary correlation between the level of human disturbance, points of invasion, and proximity to an edge. This correlation does appear to support our original hypothesis that high rates of disturbance and human activity can act as a vector for invasives, but due to a number of sampling errors and unavoidable circumstances the data does not accurately represent the total number of invasive species found in study areas. For example, UCF Landscape and Natural Resources Department has been actively eradicating many invasive populations on edges. This activity directly affected our study for a number of reasons. Primarily, our original Baygall heavy disturbance site was so aggressively mechanically treated days before data collection began that we were forced to choose a new site. The site we chose was a Baygall community as well near Lake Claire as opposed near Gemini Blvd. Secondly,

maintenance crews have been chemically treating populations along the roadways. This was evidenced when our group came across large areas of recently dead populations of Cogon Grass and other leafy plants. These practices directly affected the number of invasives we uncovered.

The study sites we chose proved to show a large variety of variation in plant species and spatial arrangements between the two different communities, Baygall and Pine Flatwood. We chose two differing communities to show that invasion by exotics is universal in disturbed ecosystems. The species diversity and richness varied even among disturbances within each community type.

The Pine Flatwood community had study areas located next to a major road, a softball field parking lot, and a hiking trail for heavy, medium and low disturbances respectively. We chose these sites randomly from aerial photos of the campus in places we determined would be areas of correlating disturbance. Interestingly, no invasive species were found in any of the study areas, except for the heavy disturbance along the road. However, the vegetative data plots did not include the majority of these individuals, but they were noted as existing in the area. Upon examination of fauna in the heavy disturbance, it was strikingly apparent that there was a large occurrence of fungal infections and Gall Wasp habitations. These vegetation afflictions were not noticed in any other type of disturbance. We can infer that these afflictions are directly correlated to the disturbance. As noted previously, when an edge is created, hydrology, light availability, and other biotic/abiotic factors are influenced. The fungal infections were most prevalent in the area closest to the road, consequently being the area that would be most affected by temperature changes from the concrete releasing heat at a different rate than the natural vegetation. The fungus was identified as a white mold; a species known to congregate in warm, moist areas with insufficient air flow. We speculate that these areas being warmer longer, near a road can host these molds. The invasive species we identified in the heavy disturbance were Sword fern, Old-

World Climbing Fern, Bahia Grass and Cogon Grass. All of these individuals were found within 30m from the actual edge.

The Flatwood medium and low disturbance sites hosted no exotic invasive species. These sites were in remarkably good health, having high species diversity and richness. The study sites were located in a burn unit that had been burnt within the last 6 years. We attribute the health of these sites to the burning itself, which reduces competition between organisms and allows a wide variety of species to flourish, as well as to a lack of regular disturbances. The majority of the numbers of individuals were sapling oaks beginning to sprout. This is characteristic of Flatwood communities which have not been burnt in some years. These communities depend on regular burning to maintain a true Pine Flatwood community

The Baygall community study sites were located off Gemini Blvd, Lake Claire recreation site, and a wide hiking path along Lake Claire for heavy, medium, and low disturbances respectively. We found invasive species in the high and medium disturbance zones in this community, but again none in the low disturbances. This is not surprising since these communities flood regularly and therefore invasives species in nearby area have a higher rate aquatic mobility, particularly the heavy disturbance which was located near a culvert. It is curious that the group found more invasive plants in the medium area than the heavy disturbance. We infer that this is due to the medium site being located near an area of higher human foot traffic (Lake Claire Recreation Area) than the medium site in the Pine Flatwoods or heavy in the Baygall communities. We conclude this because the majority of the invasive plants we found in the medium transect were Caesar's Weed. This plant uses Velcro like seed pods to attach to fur or clothes as a means of dispersal and hence, it is likely to be found in areas where there is high animal or human foot traffic. The Chinese Tallow was present only in the Baygall area and was found the deepest in the transect of all the invasives we found. Clearly, even in highly vegetated areas, some species can still manage to gain foothold without disturbance. It's possible that this

is a rare case due to Chinese Tallow's affinity for moisture rich soils in which it thrives, and the proximity to the culvert. However, this data shows that no matter what type of habitat, there is an invasive species capable of becoming established and founding a population. The Baygall low disturbance did not acquire any invasive species and had heavy tree canopy. In effect, there was very low species diversity in general due to low light availability and heavy competition in the more mature ecosystems.

As in the Pine Flatwood community, our study suffered sampling errors due to our data collection process. Although exotics were included in our vegetative plots, it should be noted that these were not the full extent of invasive species in the area. Many times exotics were found just outside our plot. These species included a Camphor tree in the heavy disturbance, Old-world climbing fern in the medium, as well as an additional Chinese Tallow tree in the medium. It was noted that directly adjacent to the road in the heavy disturbance a large patch of Cogon Grass had recently been treated by LNR staff.

Another reason that we believe there wasn't as many invasive species was due to the seasonal fluctuations. It is known that air potato and other tropical plants cannot survive in colder temperatures and most go dormant in the fall. Consequently, die back was not recorded as a viable population.

Actual vs. Ideal Study Methods

In our study we chose to select 30 x30m transects with random plot point generation within, in order to eliminate selection bias. Though this method may be suitable for non-specific observation of local flora, it was not the most suitable for the research we were conducting. We found that the point plot study method was too specific to accurately measure the occurrence of invasive species in our study areas. Instead of this method, we propose that it would be beneficial to use observational study methods.

Observational study methods, though more suitable for our particular study can have some drawbacks. One of major concern is that of observer bias, because of the less structured nature of the study method it is possible for one to include data that influences the outcome of the study. For this reason, much greater attention to detail must be kept in order to provide scientifically sound results. An observational study may also turn out to be incredibly time consuming in comparison to other techniques due to the immense amount of potential data there is to be collected.

We propose that observational study methods would have been more suitable in our research because it would have allowed us to better represent the invasive populations present in the study area. We encountered a number of invasives just outside our plot points but were unable to include them in our concrete data, though note was taken of their existence.

Barriers Encountered and Solutions

We encountered a number of barriers throughout the project, specifically in conducting our research. Working as a group has its benefits and flaws, unfortunately one of the drawbacks we experienced was conflicting schedules, because of this we often only had one day a week that we could meet entirely as a group to conduct research. We were all interested in the data collection process and made the sacrifices necessary to get out in the field and work with the team. We managed to coordinate and achieve our goal, but an obvious solution is to work as teams of 2 rather than an entire group in doing research.

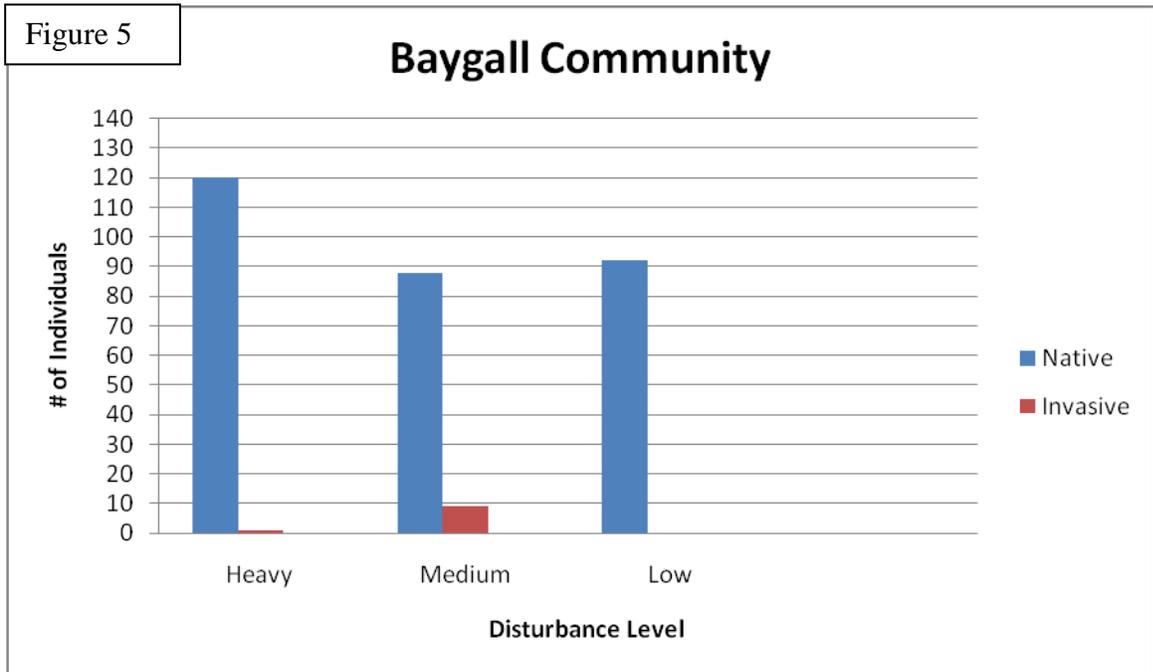
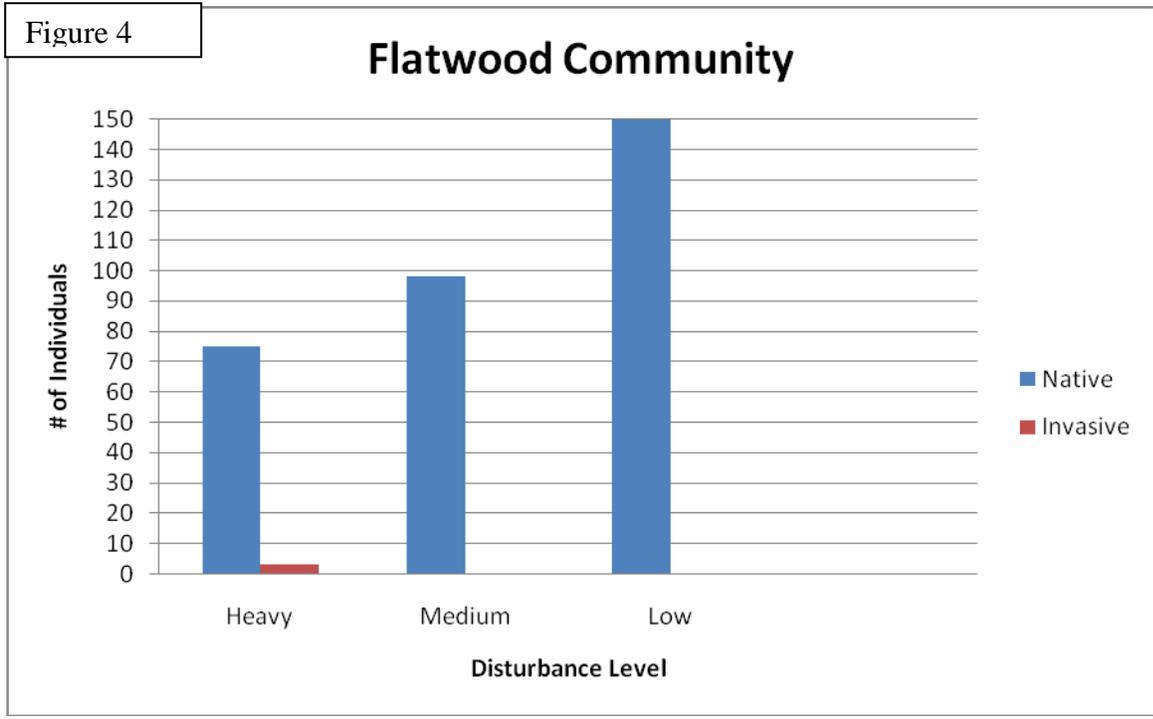
While working in the field we encountered some frustrating repeated equipment failure in relation to the GPS devices we used. This caused us to lose countless hours of valuable time in the field and put extra pressure on the group as far as deadlines go. A possible solution, though not accessible to us due to funding is the use of newer, more accurate technology. It would have been useful to be accurate down to a fraction of a meter in locating study points. A device that

could relay a stronger signal would have also been beneficial, as we were conducting research in areas where the canopy more frequently than not caused us to lose satellite signal.

The other most prevalent problem we came across was that of communication, not only with other group members but with organizations such as LNR. When conducting a research experiment it is important for all bodies involved to be on the same page in order to help ensure smooth operation as well as sound study methods. We encountered some confusion in the first week of data collection when one of our projected study sights had been subjected to mechanical maintenance processes, rendering it unusable. We were forced to choose another study sight, which in turn cost the group some time. We found that communication between group members throughout the project became more natural and straightforward, aiding in expression of ideas and concepts. Realization of the difficulties we encountered during the project has ended up aiding us in the long run, next time around we will be less likely to encounter these types of barriers.

Project Improvements

During the course of this study we saw the potential for the betterment of several key areas within the project. Communication played a large role in this study. We realized this after our Pond Pine site was mechanically controlled by LNR contractors. If we worked alongside LNR, we could prevent future miscommunications. Then, shortly after continuing with our surveying, we quickly learned the importance of adequate equipment. When standing in the middle of a Baygall community, reception becomes spotty due to the density of overhanging trees. So, we would suggest a more reliable and accurate device be used. Finally, from the outcome of our data, we could see that randomized plots may not be the best method to measure invasive species. Instead, we propose an observational study to enhance the outcomes of our results, since in several instances we found invasives right outside our plots.

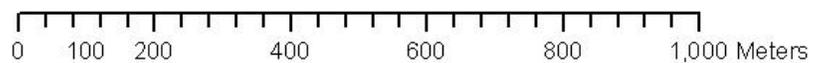


Edge Effect Study Areas



Legend

-  Med Disturbance Study Area
-  Low Disturbance Study Area
-  High Disturbance Study Area



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	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Brandon	After 3pm	N/A	After 3pm	N/A	After 1:30pm	All Day	N/A
Cory	After 4:30pm	Before 1:30pm	After 4:30pm	Before 3pm	After 2:30	N/A	All Day
Douglas	12-4pm, After 5pm	After 2pm	12-4pm, After 5pm	After 2pm	After 12pm	Variable	Variable
Jason	12pm- 2:30 After 4pm	After 2pm	12pm- 2:30 After 4pm	After 2pm	After 12pm	Variable	Variable