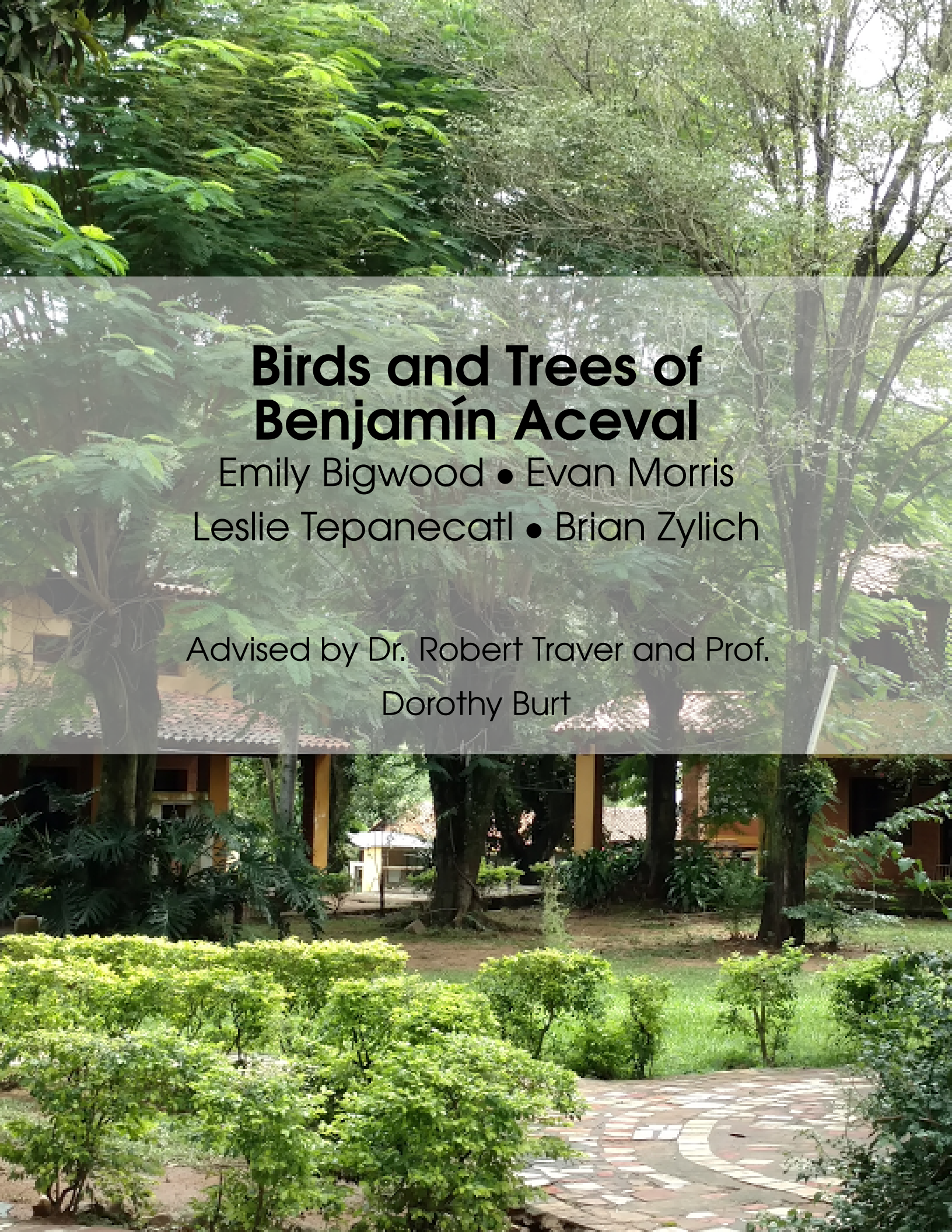

Birds and Trees of Benjamín Aceval

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An Interdisciplinary Qualifying Project
Submitted to the Faculty of
Worcester Polytechnic Institute, Worcester, MA

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WPI

fundación paraguaya

Abstract

This project developed ecotourism in Benjamín Aceval in order to benefit Hotel Cerrito at Escuela Agrícola San Francisco. Potential ecotourism attractions were investigated through consultation with experts, observations *in situ*, and independent research. The group cataloged 45 tree species (accessible by QR code), created a self-guided tour of 10 signature trees, produced 1 interpretive sign for bird observation that doubles as a model, and delivered an application that profiles 50 birds. These deliverables are first steps to transform Benjamín Aceval into an ecotourism destination. Recommendations include: finish the tree inventory and bird tour, increase the number of tree tours, and expand the application.

Acknowledgments

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In addition, we would like to express our gratitude to Dorothy Wolf for all of her patience, time, and advice. Her help and recommendations were essential in shaping our project. Doctor Robert Traver, the project's advisor, provided us with invaluable feedback and instruction as well. We appreciate his guidance and helpful ideas that contributed to making our project a success. We also recognize Worcester Polytechnic Institute, the local government of Benjamín Aceval, and Fundación Paraguaya. Finally, thank you to all other parties not mentioned above that provided us with suggestions, criticism, and feedback during our project. All of this helped us improve and develop our final products.

Executive Summary

Paraguay's biodiversity gives the country potential as an ecotourism destination. In Benjamin Aceval, a rural city in Paraguay, nature tourism is underdeveloped. Hotel Cerrito is an ideal place to stay for tourists interested in the flora and fauna of the Paraguayan Chaco. The hotel is managed by students of the Escuela Agricola San Francisco. Hotel Cerrito hopes to provide nature activities for guests as well as attract more visitors to gain revenue.

The group worked with Hotel Cerrito, a local wetlands conservation group, and the municipality of Benjamin Aceval to improve ecotourism opportunities. The group conducted *in situ* observations, consulted experts, and reviewed relevant literature to create four informational deliverables.

For the birds of the Benjamín wetlands, the team designed interpretive signage and developed an Android application. The signs enhance the bird observation sites while educating locals and visitors about common bird species. The Android application complements the signs and observation sites, enriching the experience of visitors by allowing them to listen to bird calls and track the species they have seen.

For the trees found on the campus of Escuela Agricola in Benjamín Aceval, the team created an inventory and self-guided tour. The inventory contains tree species found on the school grounds, along with scientific and interesting facts. The self-guided tour consists of a pamphlet that features the most interesting trees on campus.

This project represents the beginning of an ongoing series of projects that will transform Benjamín Aceval into a major ecotourism destination. In the future, Benjamín Aceval and Hotel Cerrito will enjoy economic benefits while also promoting nature conservation.

Authorship

Emily Bigwood, Evan Morris, Leslie Tepanecatl, and Brian Zylich all contributed to the creation of this report. Below is a breakdown of each author's contributions.

Emily and Leslie each wrote half of the tree profiles, one-third of the bird profiles, and half of the tree pamphlet; and did half of the tree inventory. Evan designed the interpretive signs for the bird walk, and wrote one-third of the bird profiles. Brian developed, tested, and published the Android application.

Contents

1. Introduction

Poverty, a prevalent issue worldwide, affects some countries more than others. In Paraguay, significant income inequality exists between the rich and poor. High debts, low income, and lack of opportunities make it difficult for the working class to improve their economic position. Many countries create jobs and increase opportunities for impoverished communities through the development of tourism.

Tourism generates significant revenue around the world. People travel for many reasons, including to experience nature. Diverse landscapes and wildlife present opportunities for Paraguay's tourism industry. Despite underdevelopment of tourism infrastructure and the former instability of the nation, Paraguayan ecotourism is projected to grow. In particular, less-visited rural areas have ecotourism potential.

In the rural town of Benjamín Aceval, Escuela Agrícola is a school that helps students escape poverty. The school teaches practical skills that allow graduates to become entrepreneurs. Students receive hands-on experience and fund their education through the operation of a hotel on campus, Hotel Cerrito.

With the help of WPI students, the operating procedures of Hotel Cerrito have improved (Borges, Kasi, Santos, & Wagner, 2016). Other WPI projects include the development of historical tours of Villa Hayes and the creation of brochures to advertise tourist activities (Burton, Munderville, Navarro, & Orton, 2016). However, the area nearby Escuela Agrícola still lacks ecotourism infrastructure despite its rustic landscapes and high biodiversity. Surprisingly, even many locals do not know about the flora and fauna of their community.

This project increases the ecotourism opportunities offered near Escuela Agrícola. The group developed interpretive signage and an Android application for bird observation, identified and tagged trees, and developed a self-guided tree tour. Through these deliverables, the hotel will offer more activities to its guests and become an attraction for nature enthusiasts.

2. Background

2.1 Overview

Tourists seek a variety of experiences including adventure, cultural interactions, and eco-tourism when visiting Latin American countries. Paraguay is a country with a developing tourism industry and a wealth of potential. In particular, Paraguay's biodiversity makes it an ideal destination for nature enthusiasts and birding tourists.

Just outside of Asunción, the nation's capital, is the city of Villa Hayes and the town of Benjamín Aceval. This section reviews the existing infrastructure for ecotourism in Villa Hayes and Benjamín Aceval. Additionally, it examines Hotel Cerrito, located in Benjamín Aceval, and the current opportunities for guests who stay at the hotel. Lastly, the section utilizes similar projects on bird observation posts, tree inventories, and self-guided tours as relevant examples.

2.2 Nature Tourism and Birdwatching in Latin America

Nature-related tourism makes up a significant subset of the tourism industry within Latin America. A large number of companies operate in this industry, offering dozens of itineraries

to tourists looking for activities such as birdwatching (Tours in Central & South America, 2017) (Tours, 2017). Current popular birding destinations in Latin America have a wealth of information available for tourists. For instance, companies in Ecuador offer specialized birding tours for many different regions including the Galapagos, as well as the east and west slopes of the Andes (Ecuador Nature Expeditions, 2017).

Birdwatching, a major component of nature tourism worldwide, encompasses three million international trips annually (*Market analysis of bird-based tourism*, 2015). Latin America's wealth of biodiversity (over 3,100 native species) makes it an appealing birding destination (Areta et al., 2017). Birders from the United States, in particular, follow the many North American species that winter in and migrate to South America. In fact, birding enthusiasts are typically among the first to open up new destinations such as Paraguay to international tourism (*Market analysis of bird-based tourism*, 2015).

2.3 Paraguay

Landlocked within central South America lies the country of Paraguay. Most Paraguayans are mestizos, descendants of both Europeans and natives (*Paraguay*, 2016). For this reason, Spanish and Guaraní are the official spoken languages in Paraguay.

Paraguay spans an area of 406,752 km^2, approximately the size of California (The world factbook: PARAGUAY, 2017). More than half of that land is used for agricultural purposes (The world factbook: PARAGUAY.2017). Paraguayans residing in rural areas often make a living from agricultural activity. However, more than a third of the population lives below the poverty line (The world factbook: PARAGUAY, 2017).

Paraguayans have endured political, social, and economic instability. Low income and high debts frustrate the attempts by the working class to surpass their economic condition (Zavattiero, 2016). However, with the growth of ecotourism in the country, disadvantaged

Paraguayan families will benefit economically. In fact, an increase in tourism will provide entrepreneurs with more income and opportunities due to an influx of customers.

2.4 Tourism in Paraguay

Paraguay's tourism industry is underdeveloped. As of 2015, Paraguay invested less in tourism than Argentina, Brazil, and Chile. Not surprisingly, tourism's contribution to employment in Paraguay is lower than in nearby countries. Paraguay ranked 134 out of 184 countries for tourism's contribution to the GDP (World Travel and Tourism Council, 2015).

Although Paraguay's tourism industry is less profitable than that of surrounding countries, experts predict that it will grow. Paraguay's current economic standing and political stability support this projection (Travel in paraguay.2016). In fact, the predicted growth rate for the tourism industry in Paraguay surpasses that of Argentina, Brazil, and Chile (World Travel and Tourism Council, 2015). However, for tourism to grow, the government must work together with the people to produce tangible results.

Paraguay's official tourism department, SENATUR, plans to strengthen tourism in three main ways. SENATUR's plan involves digital marketing to attract international tourists, enhancement of Paraguay's image and brand, and accurate representation of Paraguayan landmarks. (Senatur presented the tourism marketing plan of paraguay developed by THR. 2016).

Paraguay's biodiversity and many exotic species give the country potential as an ecotourism destination. The rich flora and fauna of Paraguay captivate tourists upon their arrival. Forests make up forty-three percent of Paraguay. Many species of birds and other animals inhabit these regions (The world factbook: PARAGUAY, 2017). Fifty-four percent of overnight tourists and thirteen percent of day visitors choose Paraguay for its natural attractions (Bird tourism market for paraguay. 2016). Hence, improved marketing of Paraguay's natural beauty has the potential to attract more tourists.

While the potential for nature tourism in Paraguay is high, current offerings by established tour operators are scarce. (Paraguay, 2017) (South America, 2017). Without published travel itineraries, tourists often hesitate to visit unfamiliar locations. By providing published tour information, Paraguayan non-governmental organizations (NGOs), such as Guyra Paraguay, can help create opportunities for ecotourism.

Guyra is an NGO committed to preserving the biological diversity that makes Paraguay an ecotourism destination. A group of Paraguayans concerned with the rapid disappearance of Paraguay's natural habitats established the organization in 1997. Volunteers and community involvement are essential to Guyra. The organization pursues public policies that help preserve the environment in a meaningful way. Government contacts and allies promote protective laws while campaigning against environmentally harmful policies. Sustainable development and the responsible use of natural resources are among the organization's key goals. Although Guyra strives to preserve all Paraguayan biological diversity, it focuses specifically on birds and their habitats. Guyra has fifty-six conservation sites in cities around Paraguay.

Karagua ha'e Tekove is an interdisciplinary group devoted to protecting the wetlands in the town of Benjamín Aceval. The group visits schools, works with the town's mayor, and raises awareness through social media. Its members want to educate the community on the value of the wetlands and the birds that inhabit them. One of the organization's founding members, José Petters, is a birding expert and strives to spread awareness about wetlands conservation in the areas surrounding Benjamín Aceval.

2.5 Benjamín Aceval

Benjamín Aceval is an agricultural city with a population of 16,000. The city contains the only sugar mill in the Chaco. Additionally, Benjamín Aceval has the most agricultural activity and livestock in the department of President Hayes. The western region of Benjamín

Aceval accounts for thirty-five percent of the country's production of cattle. The city also has dairy and poultry farms. Dairy products are sold locally and include pasteurized milk, yogurt, dulce de leche, and cheese. Meanwhile, poultry farmers are largely focused on breeding chickens for sale in Asunción.

Only forty-two kilometers from Asunción, Benjamín Aceval's rich culture and history offer a variety of activities for tourists. Tourist attractions include historical buildings, the sugar mill, and local artisan craftsmanship. Visitors to Benjamín Aceval can stay at the hotel operated by students of Escuela Agrícola San Francisco, a school managed by Fundación Paraguaya.

2.6 Fundación Paraguaya

Fundación Paraguaya is an NGO that was created in 1985 to fight poverty (Fundación paraguaya: About us). To accomplish this goal, the organization develops and implements practical, innovative, and sustainable solutions. Solutions include programs that foster entrepreneurship, provide financial education, and establish self-sustainable schools.

Education drives Fundación Paraguaya's goal to end poverty. The organization educates young children so that they can obtain employment and help their families escape poverty. The sustainable-school program attacks poverty at its roots rather than wait for the problem to become ingrained and grow exponentially. Much like WPI, students learn theoretical knowledge and practical application. When students graduate they receive two diplomas: one for agriculture and livestock management and the other for tourism and hotel management (Fundación paraguaya: Self-sustainable schools). The degree requirements ensure that all graduates can be employed or start their own microbusiness.

Additionally, the school sustains itself. Students and teachers produce income through agricultural production and the tourism industry (Fundación paraguaya: Self-sustainable schools). Students participate in the entire business cycle of the food industry. They tend

crops and care for animals, harvest and prepare the products for market, sell their goods, and reinvest the profits to improve their business. Similarly, students are responsible for running the hotel and interacting with tourists. This practical experience prepares students to become successful entrepreneurs and to make a living wage for themselves and their family after graduating.

2.6.1 Escuela Agrícola San Francisco

Today, Escuela Agrícola exemplifies Fundación Paraguaya's self-sustainable school model. Escuela Agrícola's hands-on curriculum ensures graduates are one hundred percent employable (Fundación paraguaya: Self-sustainable schools) The school has approximately 7000 square meters of buildings and 153 acres of land (Escuela agrícola abandonada por el estado es modelo de autogestión, 2011). These grounds support both indigenous and non-native species of plants and animals. Although there is a rich variety of nature, the school's hotel does not offer tours or information about the surrounding flora and fauna to guests.

2.7 Hotel Cerrito

Fundación Paraguay operates Hotel Cerrito through Escuela Agrícola San Francisco. Through the management of Hotel Cerrito, students gain the skills required to work in the hospitality industry. By observing hotel practices, students have the opportunity to learn and grow into individual entrepreneurs. Not only does the hotel enterprise serve as a hands-on experience for students, it also generates revenue for Escuela Agrícola.

Hotel Cerrito offers multiple activities for guests including a park for children, a pool, Paraguayan hamacas (hammocks), and student-led campus tours (Hotel cerrito.). Because the hotel did not offer a formal nature tour prior to this project, visitors overlooked the flora and fauna of Paraguay.

2.8 Nature Education at Escuela Agrícola

While the nature education curriculum at Escuela Agrícola is underdeveloped, the campus can serve as a base for exploring the local fauna and flora. Students escort visitors around the farm to learn about the school's self-sustainable model. The implementation of a tree inventory and self-guided tours have increased the opportunity to appreciate and study nature. Moreover, by generating awareness through education, students provide guests a pleasant encounter with the natural beauty of Paraguay.

2.8.1 Bird Observation

An informal birdwatching site is located in Benjamín Aceval, near Escuela Agrícola. It extends from a lagoon to a municipal park over a distance of 2.69 km and surrounds the wetlands. The observation area includes a path that connects thirteen points of bird observation. The final point includes benches and an open pavilion, as seen in Figure 2.1. A renovated site will provide guests and local citizens a place to learn about the wildlife they are observing. While there was already space for birdwatching, there was a lack of information about bird species that are common in the area. Interpretive signage now allows guests to identify the birds they see as they wander the grounds.

Figure 2.1: Two people sit under the pavilion at the bird observation site.

2.8.2 Case Study on Tree Inventory at WPI

A study in 2016 led by Leonela Vega, resulted in the inventory of the trees and shrubs found on the campus of Worcester Polytechnic Institute (WPI). Vega's deliverables include a tree brochure and a customized Google Map. Bartlett Tree experts aided Vega by tagging approximately 700 trees on campus with small metal disks containing identification numbers. Vega's deliverables facilitate the identification and location of the trees and shrubs on campus as part of a self-guided tree tour at WPI.

2.8.3 Self-guided Tours

Upon arriving at Hotel Cerrito, tourists are enticed by the surrounding region. A self-guided tour provides visitors with an opportunity to explore the most noteworthy trees on campus at their own pace. Presently, some of the most interesting species include Lapacho negro, Palo borracho, and Mango. Caranday trees and aquatic plants found in the wetlands can be seen in Figure 2.2. A wide variety of other species can be spotted on the grounds of the Escuela Agricola. However, to many of the school's residents, their locations and uses remain unknown.

Figure 2.2: View across the wetlands, with aquatic plants in the foreground and coco trees (caranday) in the background.

3. Methodology

3.1 Overview

The methodology section details the approaches and techniques used to gather information about the birds and trees of Benjamín Aceval and how to deliver this information to hotel guests and tourists. These include consultations with experts and project stakeholders, site visits and observations, and research of relevant information.

3.2 Bird Deliverables

For the bird component of the project, the team conducted observations *in situ*, consulted specialists and reviewed relevant documentation.

3.2.1 Interpretive Signage

Upon arriving in Paraguay, the team used observation and consultation with experts to learn about the birdwatching site and clarify project objectives. The team met (19 Mar. 2017) with José Petters for a guided tour of the bird observation site. For guidance with the design and installation of the sign, the team consulted Mayor Oscár Duarte (22 Mar. 2017, 6 Apr.

2017, and 26 Apr. 2017). To gather information on the birds detailed in the interpretive signage, the team reviewed relevant documentation. The primary source consulted was the birding guide, *Aves de Paraguay*, written by Tito Narosky and Dario Yzurieta. Information from the Cornell Lab of Ornithology was used to complement the information gathered from the bird guide.

3.2.2 Android Application

To determine what features the application should contain, the team conducted focus groups. Focus groups were conducted with members of Karugua ha'e Tekove to determine what features were most important. To obtain content for the application, site observation was conducted. The team visited the wetlands to mark observation point locations and take pictures. Additionally, the team investigated relevant sources to get resources for app development. The website Xeno-canto was consulted to get the bird calls used in the application. Throughout the development process, the application was tested and shown to key stakeholders to ensure the desired product would be delivered.

3.3 Tree Deliverables

For the tree component of the project, the team conducted a case study, made observations *in situ*, consulted specialists and reviewed relevant documentation.

3.3.1 Inventory

To inventory the trees around the campus of the school, observations *in situ* were conducted with assistance from Dr. Perez (20-21 March 2017) and Dr. Kubota (27 March 2017). Following the consultation with both experts, the identified tree species were researched using books and online sources.

To support the tree inventory, the trees on campus were tagged for unique identification. To determine the type of tags to use, key stakeholders, such as Escuela Agrícola Director Luis Cateura, were consulted (20 Mar 2017).

3.3.2 Self-guided Tour

Prior to departing for Paraguay, the team considered a case study (08 Feb. 2017) involving a project by Leonela Vega. Vega is a WPI student who inventoried the trees on WPI's campus and created an informational pamphlet. Additionally, Wachusett Meadow Wildlife Sanctuary assistant site director Cindy Dunn provided the group with expert advice on the development of a self-guided tour (18 Feb. 2017).

Tree Pamphlet

To create an informative brochure about the trees on the campus of Escuela Agricola San Francisco (EASF), the team conducted observations with the guidance of experts. After arriving at Escuela Agrícola, tree specialists, Dr. Lidia Perez and Dr. Victoria Kubota, advised the team during the identification of the most interesting trees on the school grounds. Primary and secondary sources including *Arboles Comunes de Paraguay*, a publication by the Peace Corps, and *100 Árboles Argentinos* by Eduardo Haene and Gustavo Aparicio were examined to collect information for the tree descriptions.

3.4 Approximate Timeline

Legend	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Tour school grounds, bird observatory							
Bird surveying							
Consultation with experts							
Tree surveying							
Create content delivery system							

4. Results

4.1 Overview

The project consists of four deliverables. In support of the bird observation site, the team created interpretive signage and an Android application. For the tree component of the project, the team conducted a tree inventory and designed a self-guided tour. Both components of the project will make Hotel Cerrito a more attractive tourist destination by offering more activities to its guests.

4.2 Birds

Following the initial meeting with Karugua ha'e Tekove, the team opted to supplement the existing bird observation trail with interpretive signage and an Android application. As a result of this meeting and site observation, the group decided that a tower and a boardwalk would also improve the bird observation site in the future.

4.2.1 Interpretive Signage

A sign was printed and prepared for installation at one of thirteen bird observation points in the wetlands of Benjamín Aceval (Figure 8.2). The sign provides a map with the layout of the thirteen points forming a bird observation trail within the Benjamín Aceval wetlands (Figure 8.1). The map gives visitors a reference point of their location with respect to the trail. In addition to the map, each sign displays profiles of three birds commonly seen at that site. Each bird profile contains scientific information and interesting facts. The bird profiles are accompanied by written bird calls and a photo for identification. Lastly, acknowledgments at the bottom of the sign recognize those stakeholders that played a key role in the sign's design. These groups include Karugua ha'e Tekove, Hotel Cerrito, and the Municipality of Benjamín Aceval.

After multiple meetings with Mayor Duarte (22 March 2017, 6 April 2017, 26 April 2017), the team finalized plans for the municipality to install the sign. Furthermore, designs for additional signs were entrusted to Karugua ha'e Tekove to be printed and installed in cooperation with Mayor Duarte.

4.2.2 Android Application

To complement the installed signage, an Android application for bird observation was created[1]. As a result of the focus groups conducted with Karugua ha'e Tekove, the team determined which features to include in the application. The application showcases profiles of the most commonly seen birds. Each bird has a detailed description and a picture, and users can listen to the bird's song (Figure 8.7). A checklist enables the user to track the birds seen during visits (Figure 8.8). Users are awarded achievement medals based on the number of birds they encounter (Figure 8.10). Competing for medals will motivate residents and tourists to visit the wetlands and learn about birds. When a new bird species is seen, the

[1] "Birds of Benjamín Aceval" is available on Google Play

user can take a photo and email the developer to maintain the application database (Figure 8.9). Another key feature is an embedded map that displays the thirteen observation points with Hotel Cerrito as a reference (Figure 8.4). Each point has a brief description and a photo (Figure 8.5). In addition, the application is available in both English and Spanish.

4.3 Trees

Meetings with Director Luis Cateura and Professor Marysabel Aquino confirmed their desire to develop an inventory and self-guided tree tour. (15 March, 2017) Consultations and field visits of the campus with Drs. Lidia Perez 20-21 March 2017) and Victoria Kubota (27 March 2017), assisted in identification of species and selection of the most interesting species for visitors.

4.3.1 Inventory

The team created a personalized map through Google My Maps (Figure 8.11). This map functions as an inventory of the 45 tree species found on the campus. Each marker on the map indicates geographic coordinates and contains a tree profile. Each profile contains scientific information and interesting facts. The map can be found using a QR code or by URL (Figure 8.16).

To support the inventory, at least one of each tree species on campus was tagged for identification (Figure 8.12). Based on advice from Leonela Vega, the team chose numbered metal tags. After meeting with Director Cateura, a second hole was drilled for additional security.

4.3.2 Self-guided Tour

The team created a self-guided tree tour for visitors at Hotel Cerrito. In order to facilitate the tour a two-sided pamphlet was designed. The team decided to create a pamphlet after

interviewing Cindy Dunn and talking with key stakeholders. On the front of the pamphlet, there is a brief introduction with instructions for the tour and information about Hotel Cerrito (Figure 8.13). The pamphlet also includes a map of the hotel grounds with the ten most interesting trees labeled along a marked route. These trees were selected based on the suggestions of tree expert Professor Victoria Kubota. The back side of the pamphlet provides descriptions and a picture of each tree (Figure 8.14). As a result of discussions with Director Cateura and Professor Aquino, the descriptions include information on each tree's uses, physical appearance, and facts specific to Paraguay.

At the recommendation of Director Cateura and Professor Aquino, the ten featured trees are marked with numbered posts to facilitate identification and clarify the walking route (Figure 8.15). The team selected a route based on advice from expert Cindy Dunn and on site observations. The route was designed as a loop in order to avoid repetitiveness. Additionally, the route is short enough that it is accessible to families while long enough to showcase a variety of trees on campus.

5. Recommendations

5.1 Birds

The team recommends that additional sign designs be printed and installed to complete the bird walk. The signs enhance the bird observation points and provide the locals with access to more knowledge about the avian life of the wetlands. To further improve the observation points, based on Karugua's vision for the site, the team recommends constructing an observation tower in point thirteen of the wetlands and a boardwalk in point two (Figure 8.1). The tower would be a better vantage point, offering a view of the entire wetland. The boardwalk would enable visitors to see the birds' habitat firsthand, enhancing the visitor experience.

The team suggests hosting an event that uses the bird application to self-advertise and generate public interest in birding. An example of an event that could be organized is a competition to see who can find the most species of birds in the shortest amount of time. Such a competition would generate interest, especially in the youth and young adults in the area surrounding Benjamín Aceval. The event would also allow Karugua ha'e Tekove to

educate the public on the importance of wetland preservation while promoting and growing their organization.

5.2 Trees

The group recommends continuing to inventory and tag all the trees on campus to maintain a comprehensive and accurate database, along with expanding the range of tour options.

The vast flora found on campus has the potential to be a great attraction to visitors. The team also suggests the development of a variety of specialized plant tours to target a wide-range of guests. At the moment there is only one path to take on the self-guided tour. Offering more routes will satisfy beginners and experts in botany.

5.3 Ecotourism

Finally, the team proposes that Benjamín Aceval be promoted as an ecotourism destination using the resources developed. The hotel's proximity to the wetlands makes it an optimal place for nature tourists to stay. Attracting more visitors will increase revenue for Hotel Cerrito and promote the importance of this biologically diverse area.

6. Conclusion

Consultation with local organizations and specialists, site observations, and independent research revealed that the ecotourism sector is underexploited in Benjamín Aceval. With a wealth of biodiversity, the city has the potential to become a major attraction for birding and nature enthusiasts. The team developed deliverables to begin bridging this gap. The deliverables will make Benjamín Aceval a more appealing destination for tourists. As a result, Hotel Cerrito will benefit, since tourists will likely stay at the hotel overnight. This project represents the beginning of an ongoing series of projects that will transform Benjamín Aceval into a major ecotourism destination. In the future, Benjamín Aceval and Hotel Cerrito will enjoy economic benefits while simultaneously promoting nature conservation.

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8. Appendix

8.1 Bird Deliverables

Figure 8.1: This map shows the 13 points that make up the Bird Observation Trail at the wetlands in Benjamín Aceval.

8.1.1 Interpretive Signage for Bird Observation

Figure 8.2: This figure shows the design of the sign that was printed and installed in the wetlands at point 13 of the bird observation trail.

Letreros de Observación de Aves	
1 Letrero terminado	270.000 Gs.
12 Letreros a terminar	12 x 270.000 = 3.240.000 Gs.
Total	3.510.000 Gs.

Figure 8.3: This table displays the production cost for one sign and a total of 13.

8.1.2 Android Application for Bird Observation

Figure 8.4: The map feature of the app displays the 13 observation points while offering directions to the points from the user's current location, directions to and from Hotel Cerrito, and detailed information about each site.

Figure 8.5: This screenshot shows the detailed view of point 13. Here, the user can see images of the informational signs to be located at each site, as well as images of the site itself. There is also a short description of what makes the site interesting.

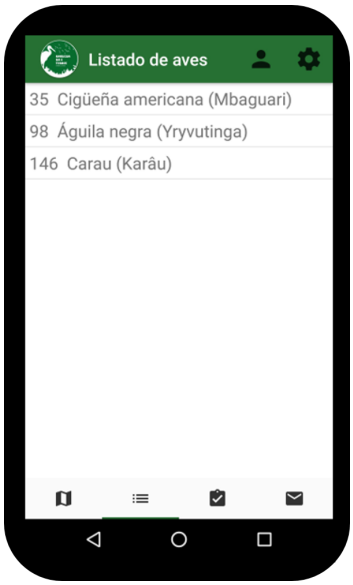

Figure 8.6: This feature of allows users to browse the list of birds in the application in order to view their detailed profile.

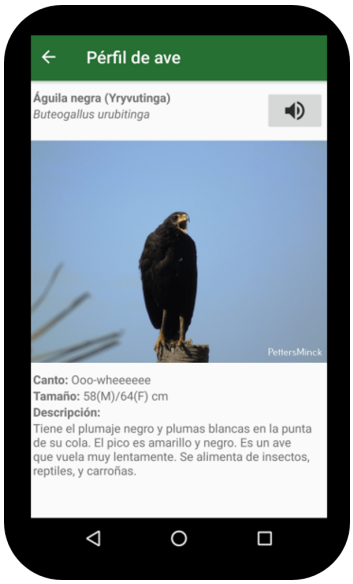

Figure 8.7: This screenshot shows an example of a bird profile. The profile includes common and scientific names, images of the bird, scientific details of the bird, a short description, and the opportunity to listen to the bird's call.

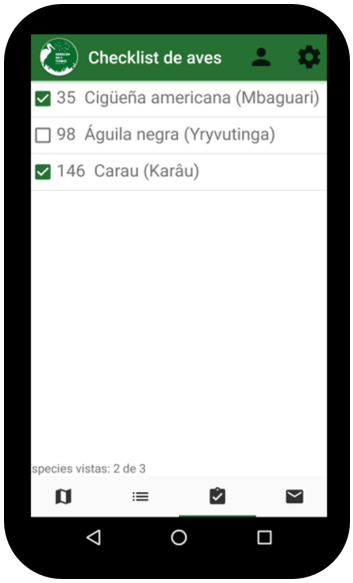

Figure 8.8: The checklist feature of the app allows users to track the birds they have seen.

Figure 8.9: Users can report sightings of birds that are not included in the app through the use of this feature. Users can attach a picture, provide a short description, and give the report a title before emailing it to the application administrator.

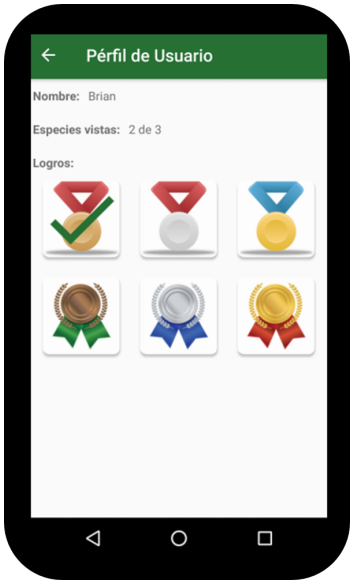

Figure 8.10: This figure shows the user profile. This page includes a count of the number of birds seen by the user. An achievement system motivates users to learn more about the birds of the wetlands.

8.2 Tree Deliverables

8.2.1 Inventory

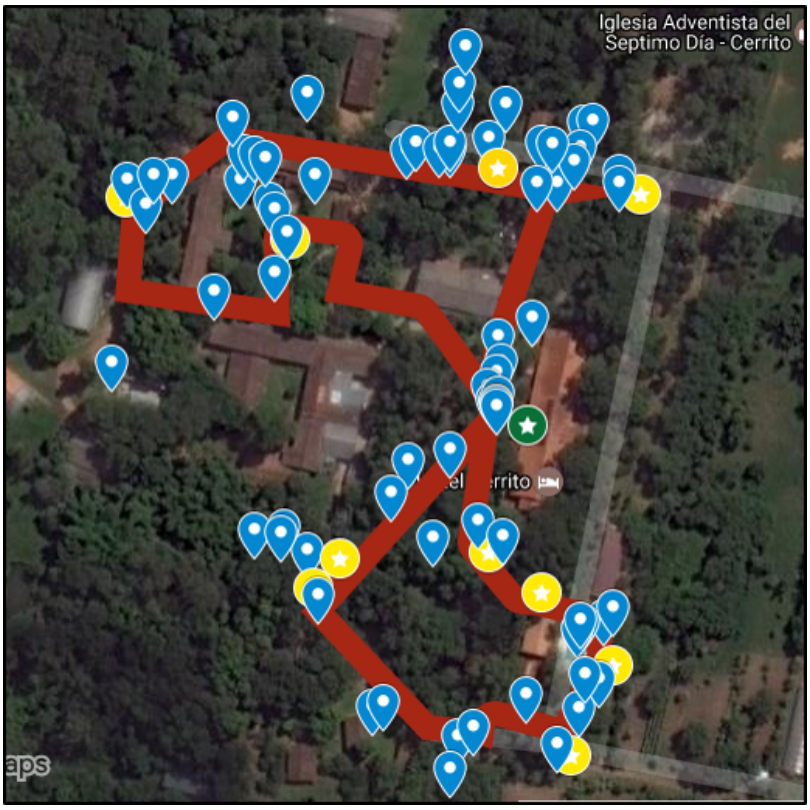

Figure 8.11: This image shows the tree inventory as a Google Map. Each marker represents a tree. The trees that are featured on the tour are starred in yellow. A green star marks the front entrance of Hotel Cerrito. The red line is the route used in the self-guided tour.

Figure 8.12: Metal tree tags mark the inventoried trees.

8.2.2 Self-guided Tour

Figure 8.13: This image shows the front of the tree brochure. There is a map, a description of the hotel, an introduction to the self-guided tour, and a QR code for the tree inventory.

Figure 8.14: This image shows the back of the tree brochure. The back describes each tree on the tour.

Figure 8.15: Posts mark the 10 signature trees. The posts increase visibility, facilitating navigation.

Figure 8.16: The tree inventory can be accessed with this QR code or by going to this URL: https://tinyurl.com/arbolesdehotelcerrito