RIVER SPRINGS PRESERVE: AN EDUCATIONAL GAME ABOUT LAND MANAGEMENT IN SOUTH FLORIDA

By

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This thesis was prepared under the direction of the candidate's thesis advisor, Professor Jon Moore, and has been approved by the members of her/his supervisory committee. It was submitted to the faculty of The Honors College and was accepted in partial fulfillment of the requirements for the degree of Bachelor of Arts in Liberal Arts and Sciences.

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ABSTRACT

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Title: River Springs Preserve: An Educational Video Game about Land Management in South Florida

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River Springs Preserve is an in-development educational video game that aims to introduce players to the flora and fauna of South Florida and teach them about the struggle between native and invasive species. The concept and game mechanics have been fully planned, the illustrated game assets have been completed, the branching dialogue system has been established, and 40 species have been photographed and categorized to be implemented into the game.

To the devs of all the games that shaped me.

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INTRODUCTION

South Florida's natural ecosystems have been deeply affected by the introduction of invasive species. Though only a fraction of non-native species is considered invasive, those that do meet the criteria can have disastrous results for the native flora and fauna. In order to effectively restore Florida's ecosystems and combat invasive species, the public must be cognizant and supportive of these efforts. One way to raise awareness would be to educate the public both on the effects of the species as well as how to identify them. The ability to recognize particular species and understand their specific roles may help to increase public awareness on an everyday basis.

River Springs Preserve is an in-development educational video game about South Florida ecosystems. The player takes on the task of turning an unmanaged and overrun plot of land into a nature preserve. To do so, the player will make decisions of which flora and fauna to keep and which to remove from the park. The game will teach players to recognize key native and invasive organisms and understand their impacts on the ecosystem. Choices that favor biodiversity and are environmentally appropriate will increase the "health" score of the park, while letting invasive species run wild will decrease the "health". The goal of this game is to educate the player on the importance of the environment, how to identify key species (both native and invasive), and better understand some of the decisions that go into managing land. This paper will explore the process of conceptualizing, researching, and developing River Springs Preserve.

FIELD RESEARCH

Data Collection

The species intended to be featured in River Springs Preserve were selected from species present and easily found in the Martin County and Palm Beach County area. Photographs were taken of each organism for later identification and to be used as game assets. Five locations were visited to collect photographs for this project: Grassy Waters Preserve, Cypress Creek Nature Preserve, Pine Jog Environmental Education Center, Riverbend Park, and Jonathan Dickinson State Park. A total of 40 species were recorded. After photographing these species, the photographs were uploaded to the crowd-sourced species identification website iNaturalist (https://www.inaturalist.org) in order to help ensure proper identification. Doing so also shows that the photographs are sufficient quality for identification and thus can serve their purpose as game assets.

Table 1. Locations visited, date of visit, and species found at location

Location	Date Visited	Species Found
Grassy Waters	1/30/20	Christmas Lichen (*Herpothallon rubrocinctum*) Gray Catbird (*Dumetella carolinensis*) Snail Kite (*Rostrhamus sociabilis*)
Cypress Creek	2/13/20	Eastern Lubber Grasshopper (*Romalea microptera*) Northern Mockingbird (*Mimus polyglottos*)
Pine Jog	2/28/20	Tropical Sage (*Salvia coccinea*) Twisted Airplant (*Tillandsia flexuosa*)
Riverbend	7/10/20	Anchor Stink Bug (*Stiretrus anchorago*) Buttonbush (*Cephalanthus occidentalis*)

		Caesar Weed (*Urena lobata*) Cardinal Airplant (*Tillandsia fasciculata*) Channeled Apple Snail (*Pomacea canaliculata*) Chinese Crown Orchid (*Eulophia graminea*) Florida Strangler Fig (*Ficus aurea*) Golden Polypody (*Phlebodium aureum*) Marlberry (*Ardisia escallonioides*) Monarch (*Danaus plexippus*) Muscadine (*Vitis rotundifolia*) Osprey (*Pandion haliaetus*) Pickerelweed (*Pontederia cordata*) Pond Apple (*Annona glabra*) Queen (*Danaus gilippus*) Shoestring Fern (*Vittaria lineata*) Southern Swamp Crinum (*Crinum americanum*) Tropical Milkweed (*Asclepias curassavica*) Western Honey Bee (*Apis mellifera*)
Jonathan Dickinson	7/25/20	Aloe Yucca (*Yucca aloifolia*) Chapman's Blazing Star (*Liatris chapmanii*) Chapman's Goldenrod (*Solidago odora ssp. chapmanii*) Green Heron (*Butorides virescens*) Largeflower Pusley (*Richardia grandiflora*) Laurel Dodder (a.k.a Love Vine) (*Cassytha filiformis*) Madagascar Periwinkle (*Catharanthus roseus*) Rabbitbells (*Crotalaria rotundifolia)* Red-shouldered Hawk (*Buteo lineatus*) Sand Heath (a.k.a Florida Rosemary) (*Ceratiola ericoides*) Sand Live Oak (*Quercus geminata*) Smooth Rattlepod (*Crotalaria pallida var. obovata*) Whitetop Sedge (*Rhynchospora colorata*) Zebra Swallowtail (*Eurytides marcellus*)

Classification

After identification, the species were divided into two categories: native species and exotic species. Of these 40 species, 32 were native and 8 were exotic.

Table 2. Native and Exotic species

Native	Exotic
Aloe Yucca (*Yucca aloifolia*) Anchor Stink Bug (*Stiretrus anchorago*) Buttonbush (*Cephalanthus occidentalis*) Cardinal Airplant (*Tillandsia fasciculata*) Chapman's Blazing Star (*Liatris chapmanii*) Chapman's Goldenrod (*Solidago odora ssp. chapmanii*) Christmas Lichen (*Herpothallon rubrocinctum*) Eastern Lubber Grasshopper (*Romalea microptera*) Florida Strangler Fig (*Ficus aurea*) Golden Polypody (*Phlebodium aureum*) Gray Catbird (*Dumetella carolinensis*) Green Heron (*Butorides virescens*) Laurel Dodder (*Cassytha filiformis*) Marlberry (*Ardisia escallonioides*) Monarch (*Danaus plexippus*) Muscadine (*Vitis rotundifolia*) Northern Mockingbird (*Mimus polyglottos*) Osprey (*Pandion haliaetus*) Pickerelweed (*Pontederia cordata*) Pond Apple (*Annona glabra*) Queen (*Danaus gilippus*) Rabbitbells (*Crotalaria rotundifolia*) Red-shouldered Hawk (*Buteo lineatus*) Sand Heath (*Ceratiola ericoides*) Sand Live Oak (*Quercus geminata*) Shoestring Fern (*Vittaria lineata*) Snail Kite (*Rostrhamus sociabilis*) Southern Swamp Crinum (*Crinum americanum*) Tropical Sage (*Salvia coccinea*) Twisted Airplant (*Tillandsia flexuosa*) Whitetop Sedge (*Rhynchospora colorata*) Zebra Swallowtail (*Eurytides marcellus*)	Caesar Weed (*Urena lobata*) Channeled Apple Snail (*Pomacea canaliculata*) Chinese Crown Orchid (*Eulophia graminea*) Largeflower Pusley (*Richardia grandiflora*) Madagascar Periwinkle (*Catharanthus roseus*) Smooth Rattlepod (*Crotalaria pallida var. obovata*) Tropical Milkweed (*Asclepias curassavica*) Western Honey Bee (*Apis mellifera*)

As River Springs Preserve intends to emphasize the impact of invasive species, the exotic category has been broken into subcategories based on the severity of the invasive species. Similar to the Florida Exotic Pest Plant Council's List of Invasive Plant Species, the categories of the exotic species here are based on the impact the species has had on native populations. Category 1 species have altered the native ecosystems (FLEPPC, 2019). Category 2 species are at risk of impacting the native ecosystems due to increased abundance (FLEPPC, 2019). Category 3 are exotic, but do not yet pose a known risk to native ecosystems. There is not an equivalent Category 3 in the FLEPPC report.

Caesar Weed is classified in Category 1 because it is considered a Category 1 invasive plant in FLEPPC's 2019 report (FLEPPC, 2019). The Channeled Apple Snail is similarly in Category 1 because of its severe spread and effect on native Florida Apple Snail populations (FWCC, 2020). It was listed as one of the 100 worst invasive species in the world (Lowe et al. 2004). Category 2 is composed of the Chinese Crown Orchid, Largeflower Pusley, and Smooth Rattlepod. All three of these species are classified as Category 2 invasives according to FLEPPC's 2019 report (FLEPPC, 2019). Category 3 consists of Tropical Milkweed and Madagascar Periwinkle, and the Western Honey Bee. Tropical Milkweed is considered minimally invasive (Lamborn, 2015). The Madagascar Periwinkle is non-native (Wunderlin et al. 2020. The Western Honey Bee is also in Category 3 as it is non-native and the severity of its impact on native bee populations is currently unknown (Russo, 2016).

Table 3. Exotic species categorized by level of severity

Category 1	Category 2	Category 3
Caesar Weed (*Urena lobata*) Channeled Apple Snail (*Pomacea canaliculata*)	Chinese Crown Orchid (*Eulophia graminea*) Largeflower Pusley (*Richardia grandiflora*) Smooth Rattlepod (*Crotalaria pallida* var. *obovata*)	Madagascar Periwinkle (*Catharanthus roseus*) Tropical Milkweed (*Asclepias curassavica*) Western Honey Bee (*Apis mellifera*)

GAME DEVELOPMENT

Game Concept

Over the decades, the efficacy of educational gaming has been researched heavily and has been found to be a beneficial teaching tool (De Freitas, 2018). The concept of River Springs Preserve spawned from the ever-present need for environmental education and the importance of making learning enjoyable for all age groups. Oftentimes educational video games are targeted toward very young demographics and are used to teach basic concepts in early learning. Educational tools for older demographics tend to favor gamifying learning rather than educating via gaming. The data on the effectiveness of gamification in education is still unclear, but does have potential (Dichev, et aland Dicheva 2017). This distinction is important in terms of the development of River Springs Preserve.

The term "gamification" refers to "the use of game design elements and game mechanics in non-game contexts" (Deterding, et al, 2011) in order to "increase user experience and engagement with a system" (Domínguez, et al, 2013). Oftentimes this comes in the form of implementing reward systems for completing educational tasks without fundamentally changing the dry nature of the task. For example, the website Khan Academy (https://www.khanacademy.org) hosts a multitude of educational modules geared toward various age groups and covering subjects both in STEM and the humanities. These modules tend to consist of videos explaining the concept in question and activities (often quizzes) to check the student's understanding. The gamification of the site comes in the form of points and badges the students are awarded for engaging with the content such as watching a certain number of videos and answering questions correctly. The inclusion of the reward system is a surface-level game

mechanic added on top of the standard educational modules.

While gamification adds game mechanics to non-game contexts, educational gaming uses video games themselves as a learning tool. The educational content is taught via the game mechanics; to separate the educational content from the game elements would fundamentally change the way in which the content is delivered. For example, the Learning Company game Treasure Cove! is an educational game targeted at young children with the aim of enhancing reasoning, reading, and math ability (Mobygames.com). In order to stop the pollution of the ocean by the Master of Mischief, the player must explore the underwater world and stop the source of the pollution in each level. To do so, the player must answer educational questions about math, reading, and science to get clues as to where the objective is located. The clues themselves also teach the player about counting, color, reasoning, and oceanography. The game mechanics are used to teach the information and encourage further engagement with the content.

Game Engine and packages

This game is currently being developed in the Unity game engine and is using the YarnSpinner package to handle the dialogue options. Unity is an easily accessible game engine with a multitude of tutorials and resources available both from Unity itself and the thriving community of game developers using the engine. YarnSpinner (https://yarnspinner.dev) is an open source tool that allows developers to easily write interactive dialogue in a programming language called Yarn. Yarnspinner uses a node-based dialogue system that allows for branching paths that can be used to handle the player's choices.

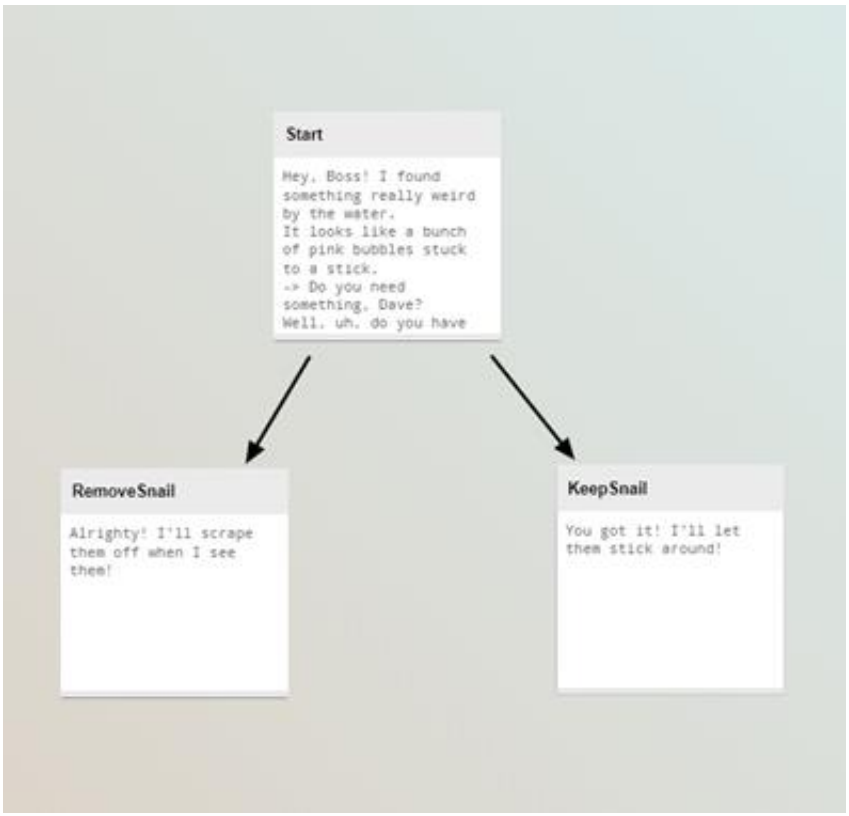

Figure 1. Yarnspinner's web-based editor used to create and visualize dialogue nodes.

Game Mechanics

The game will revolve around the interactions between the player and the singular park ranger, Dave. The player is tasked with making decisions about which species present in the park should be kept and which should be eradicated. These decisions are prompted by Dave who will frequently contact the player to present a species and ask what its fate should be. To assist in these decisions, the player has access to the Index. The Index includes photographs of the species in question along with a short passage that points out key identifying factors of the species as well as its status as native or exotic. What poses the challenge is that the well-meaning Dave is terrible at his job; he cannot identify any of the species living in the park. The player must rely on Dave's descriptions to identify the species and determine whether it should be kept or

removed.

Removing invasive species and keeping native species will increase the player's score which is referred to as the "health" of the park. Allowing invasive species to stay in the park and eradicating native species will lower the health of the park. While the native species all gain or lose a uniform number of points regardless of the species, the point values for the exotic species vary based on their category. Category 1 will have the highest point value, followed by Category 2, then Category 3.

Figure 2. Dave calls the player to ask about a species.

Figure 3. Dave describes the species (invasive apple snail eggs).

Figure 4. Dave prompts the player to choose what to do with the species.

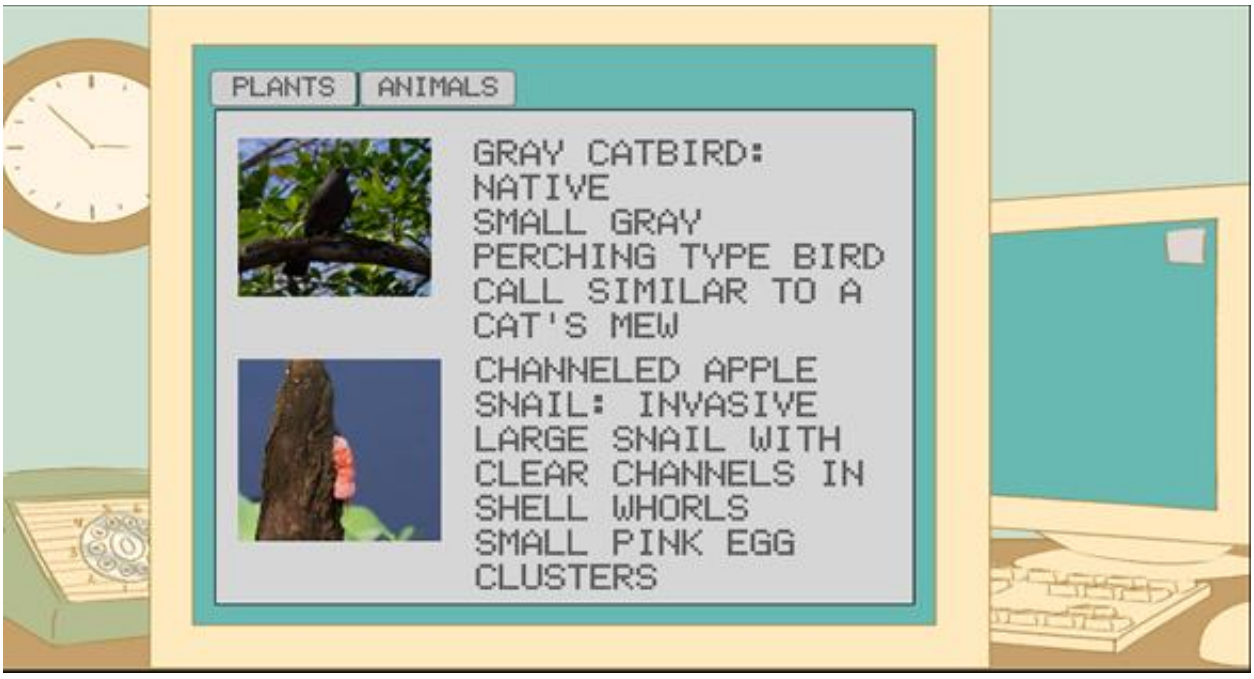

Figure 5. The player accesses the Index to figure out what the species is.

Figure 6. The player is given the option to remove or keep the species.

Figure 7. The player correctly chooses to remove the species.

The game will feature a time system in which a few minutes in reality will be equivalent to an in-game day. Each day, Dave will have a set number of questions for the player to answer. The more quickly the player answers each question, the more questions they are able to access, which can potentially increase their score. This encourages players to get better at recognizing the species and to rely less heavily on the Index upon subsequent playthroughs of the game. At the end of each in-game week, the player will be presented with the report of the park's health. If the park's health drops to zero, the game ends. If the player is able to answer all of Dave's questions before the day ends, they will get additional dialogue with Dave where they are able to learn more about him and engage in humorous conversations. This serves as a motivation for players who are more interested in stories and characters rather than achieving high scores.

Figure 8. Dave shows more personality between questions.

Figure 9. The player is able to banter with Dave.

Figure 10. The player will learn more about Dave's personality through further interaction.

This game is intended to be replayed multiple times in order for players to learn the species. In order to encourage repeated play, the extra banter dialogue with Dave is branching and the choices the player makes affect what the player is able to learn about Dave. Multiple playthroughs are necessary to experience all of the dialogue. This is primarily why the Yarnspinner package was chosen. This system allows branching dialogue options that are able to keep track of previous choices the player made and direct which dialogue should be pulled based on those choices. Gating certain information and conversations behind dialogue options creates more reason to return to the game aside from achieving certain final scores.

Visual Design

While the basic layout and design of the office scene, UI, and character design have not changed significantly from the concept art, the art style, color, and cohesiveness have. The art of

the game is intended to be simple and inviting with a warm color palette. All illustrated game assets were sketched, lined, and colored in Clip Studio Paint. The line art is primarily done using a design pencil brush and the coloring is flat without texture and shading. This is intended to give the game a storybook-like aesthetic. The technology in the park office is outdated to indicate the lack of funds behind the park as well as to reference the plethora of children's educational games that were released in the 1990s. The game UI is built with the Unity UI along with the included TextMeshPro package in order to utilize the chosen font. In order for the players to more easily identify the species, photographs are used in the Index rather than illustrations. These images are cropped to fit the UI and focus on the species.

Figure 11. Park Office concept art includes thick ink-like linework and a cool color scheme.

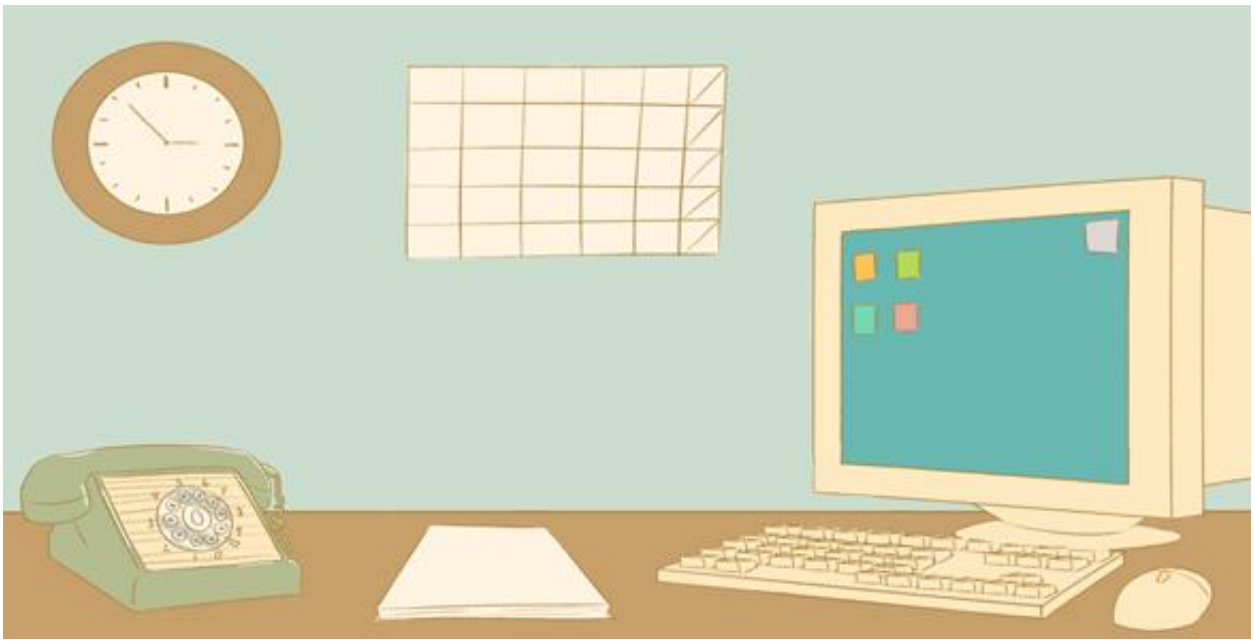

Figure 12. Current Park Office design has a warmer, more cohesive color scheme with softer pencil-like linework.

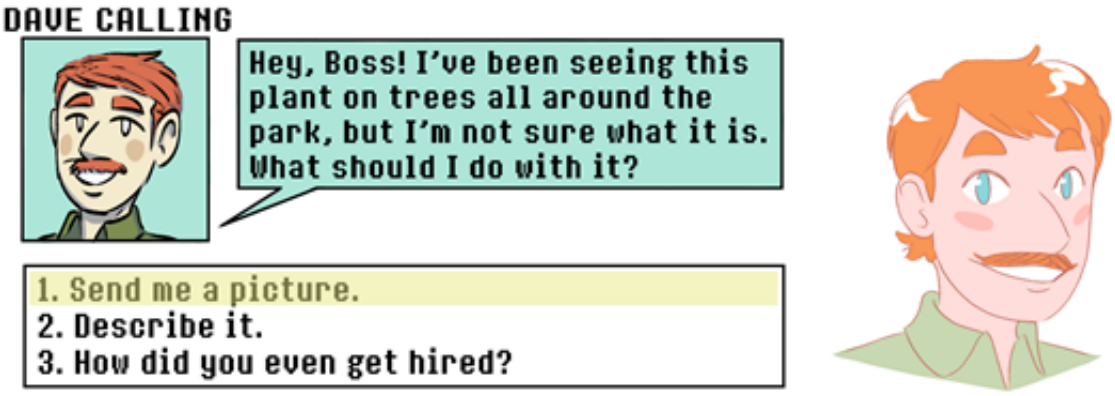

Figure 13. Comparison between the concept art Dave design and the current Dave design that continues the trend of changing from harsh lines and cool colors to a softer aesthetic.

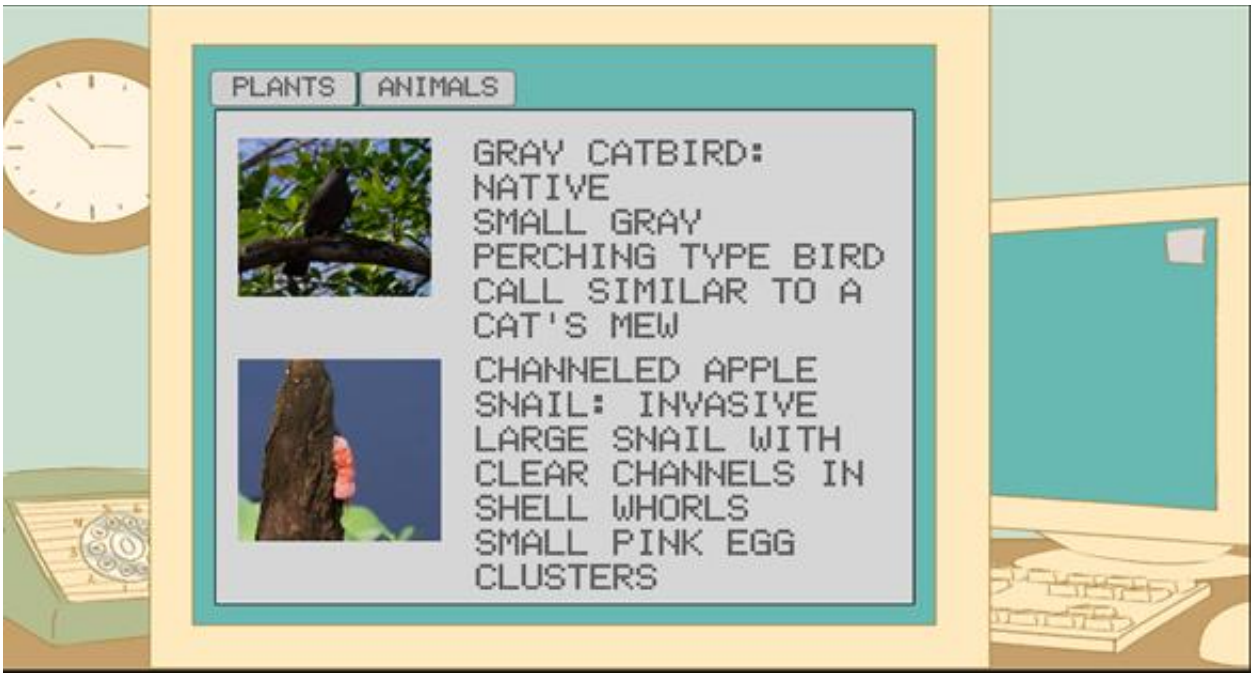

Figure 14. Index features photographs for more accurate identification.

CONCLUSION

River Springs Preserve is intended to be an educational game that will introduce players to the flora and fauna of South Florida while also being an enjoyable experience for all age groups. Developing a game that is entertaining as well as educational is critical to creating an engaging experience that will have a lasting impact on players, but it is also difficult. Achieving this goal requires knowledge of the educational field, programming skills, creative writing ability, proficiency in visual design, and experience as a video game player. River Springs Preserve also integrated field research directly into its development, which is not common among educational games. Although the game is still in development, this project saw the completion of all illustrated art assets, the establishment of the dialogue system, and the photographic collection and categorization of 40 local species for implementation into the game.

Future Research

In the future, native species will be placed into subcategories similar to how the exotic species are. These categories will likely be based on the conservation status of the species with higher point values attributed to the preservation or loss of more vulnerable native species. This change would allow for a more nuanced look at the conservation of native species than the current point system. This game's educational value would also benefit from focusing more on the particular habitats where each species resides. Due to the COVID-19 pandemic, visiting these locations became much more difficult and thus fewer habitats and species were able to be included in this project than originally intended. With the inclusion of more native and invasive species found in each habitat, the game could bring attention to how the preservation or loss of

the species affects the particular ecosystem. This game has the opportunity for many future improvements that will allow it to become a useful tool for environmental education.

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Species Photographs

Aloe Yucca (*Yucca aloifolia*)

Anchor Stink Bug (*Stiretrus anchorago*)

Buttonbush (*Cephalanthus occidentalis*)

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Cardinal Airplant (*Tillandsia fasciculata*)

Channeled Apple Snail (*Pomacea canaliculata*)

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Chapman's Goldenrod (*Solidago odora ssp. chapmanii*)

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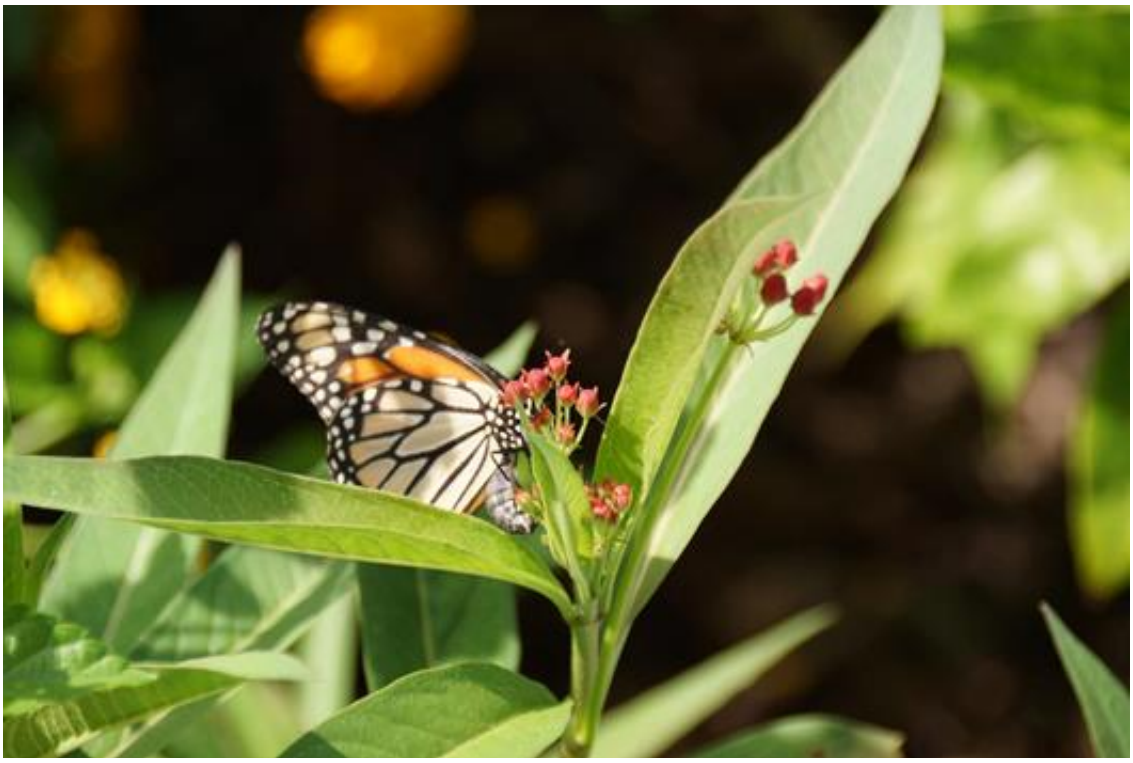

Tropical Milkweed (*Asclepias curassavica*)

Tropical Sage (*Salvia coccinea*)

Twisted Airplant (*Tillandsia flexuosa*)

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