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Framework to Develop a North Atlantic Right Whale Video Game

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ABSTRACT

North Atlantic right whales are critically endangered with a population of about 500 whales. We worked with our sponsors at the New England Aquarium to produce a right whale video game framework. The purpose of a right whale video game was to raise awareness about right whales and how we as a community can support right whale conservation efforts. Our framework and recommendations laid the foundation for the development of a video game that WPI student game developers will prototype.

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EXECUTIVE SUMMARY

About the Project

We worked in collaboration with the New England Aquarium (NEAq) to develop a framework for the NEAq to make informed decisions about the production of a North Atlantic right whale video game. This framework includes information to inform choices about intended audience, location, platform, content, and narrative for the right whale video game. This project was the first step in the video game development process where WPI student game developers will create the prototype of the North Atlantic right whale video game.

Introduction to the Problem

Historically the right whale was hunted to the verge of extinction (Kraus & Rolland, 2007). Right whales are one of the most critically endangered whales in the world with a population of about 500 whales remaining (North Atlantic Right Whale Consortium, 2013). Today, they live along the coast of the United States and parts of Canada. Their close proximity to commercial seaports and fishing areas leaves them vulnerable to entanglement in fishing gear and ship strikes (North Atlantic Right Whale Consortium, 2013). Because so few right whales remain, losing even one whale can jeopardize the population (NEAq, 2014).

Project Goal

The purpose of a North Atlantic right whale video game will be to raise awareness about right whales, why they are endangered, and how people can support efforts to create a safer and healthier ocean for right whales. The goal of our project was to deliver a framework to inform NEAq decisions about the design and production of the video game that will be prototyped by WPI student game developers.

Methodology

This project was the first step in the video game development process. Through our literature review we identified several elements of video games that must be considered in design: intended audience, location, platform, content, and narrative. Our framework includes each of

these elements, and information for how they might be defined for the right whale video game. To develop the information for each element in the framework we had the following three objectives:

1. Determine the potential locations, audiences, and platforms for the video game

We narrowed a list of potential locations, platforms, and audiences based on proximity to our project center location, interviews and visitor demographics. Due to time constraints, our methods were limited to assessing three locations, considering three platforms, and defining one audience.

2. Identify factual content details for the video game

Factual content for the video game was chosen based on our selection of right whales, researching detailed information on the selected right whales, and compiling all the information into tables, which we call "content detail tables." A limitation of this method was that is we had to choose only the most commonly found species in the right whale environment because the North Atlantic Ocean contains a large variety of marine life,

3. Develop a storyline for the video game through meetings with the WPI student game developers and NEAq experts

Content for right whales were turned into example storylines by following criteria created from interviews with industry and field experts. This set of criteria are meant to guide the WPI student game developers in designing the video game.

Findings

1. The WPI student game developers listed four project requirements.
2. The video game can be exposed to the most visitors at the NEAq main visitor building.
3. Most visitors at the NEAq main visitor building are children ages seven to nine years old and adults thirty-five to forty-one years old.
4. The primary reasons people visit the NEAq main visitor building are to bring children and to be entertained.
5. The NEAq main visitor building visitors spend two to three minutes at each exhibit.
6. Live animal exhibits are the main attraction for visitors at the NEAq main building.
7. A video game museum exhibit could simulate a live experience to accompany the right whale skeleton at the NEAq.

8. The NEAq has a list of criteria for evaluating exhibits.
9. A mobile app is not suitable for the NEAq main visitor building.
10. BHC whale watching tours lead naturalist and staff members are interested in a multi-language mobile app on right whales to be available during tours.
11. BHC whale watching visitors have no significant interest in a mobile app.
12. Accuracy of the video game educational content is a priority of the NEAq.
13. There are several types people involved in right whale conservation that can be included as characters in the right whale video game.
14. Maine lobstermen are negatively impacted by the new whale regulations.
15. A video game with a hopeful tone is a priority of the NEAq.
16. The NEAq identified four main messages to convey in the right whale video game.
17. There are three specific actions the NEAq hopes people will be empowered to take to help in right whale conservation efforts.
18. The NEAq prioritizes design criteria to consider for the right whale video game.
19. A framework is the clearest method of presenting the right whale video game options to the NEAq and WPI student game developers.

Recommendations

Based on our findings we recommended the following to the NEAq:

- the NEAq should create a right whale video game in the NEAq main visitor building.
- the NEAq should display the video game as a video game museum exhibit.
- the NEAq should use the proposed framework to support informed decisions about the design and production of the video game.

Based on our findings and NEAq preferences for the video game, we recommend the following to the WPI Student game developers:

- the WPI student game developers should use the sample narratives compiled in the framework as a guideline when designing the video game prototype.
- the WPI student game developers should use the North Atlantic Right Whale Video Game Content document provided to them to accurately depict the environment of the video game.

- the WPI student game developers should convey the main messages and concrete actions as outlined in the framework.

The following recommendations are for both the NEAq and WPI student game developers:

- They should design a video game appropriate for all audiences with the content geared towards children.
- They should convey the video game content in a hopeful tone.

  They should create a role playing game.

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CHAPTER ONE: INTRODUCTION

In 2013, the U.S. Fish and Wildlife Service estimated that 2,054 species worldwide are at immediate risk of extinction and thus are listed as threatened or endangered (U.S. Fish and Wildlife Service, 2013). Of those species, 1,436 are located in the United States (U.S. Fish and Wildlife Service, 2013). Losing any of these species may result in unpredictable effects and may cause other species to be at risk of extinction (U.S. Fish and Wildlife Service, 2013). Endangered species are part of the larger ecosystems that people interact with every day. The choices people make as consumers, such as where they buy their seafood and material goods, impact the environment shared by all living things.

Right whales are especially endangered with a population of about 500 whales remaining in the world (North Atlantic Right Whale Consortium, 2013). They are affected by human decisions perhaps more so than any other species because they live in a highly industrialized area of the United States and parts of Canada (Kraus and Rolland, 2007). They are called the "urban whale" because of their close proximity to commercial seaports and fishing areas (Kraus and Rolland, 2007). The high level of activity in these commercial areas lead to accidental ship strikes and entanglement in fishing gear, leaving right whales that survive the initial impact with restricted movement, deep wounds from propeller cuts or entanglement, and energetic depletion (Kraus and Rolland, 2007). Because there are already so few right whales, losing just one whale can jeopardize the population (NEAq, 2014). The conservation of right whales depends on preventing entanglements, minimizing ship strikes, reducing pollutants in the ocean, and continuing current research on their slow population regrowth (NEAq, 2014).

Organizations such as the National Oceanic and Atmospheric Administration (NOAA), Consortium for Wildlife Bycatch Reduction, and Maine Department of Inland Fisheries and Wildlife work to educate the public about right whales. The consortium develops and tests fishing gear modifications that have the potential to reduce the risk and severity of right whale entanglement. One group at the forefront of right whale research and conservation is the researchers at the New England Aquarium (NEAq) located in Boston, Massachusetts. NEAq right whale researchers work with government officials to develop policy changes aimed at reducing right whale entanglements and ship strikes (NEAq, 2014).

As part of their mission, the NEAq also works to educate the public on the conservation and protection of endangered species like right whales (NEAq, 2014). The NEAq maintains interactive exhibits, websites, and outreach programs to inform their participants on becoming "stewards" for the "Blue Planet" (NEAq, 2014).

As part of their education program, the NEAq shows people how they are connected to the ocean and how their actions impact the overall ecosystem, including the environment of right whales. The NEAq's extensive research on right whale entanglements and ship strikes places them at the forefront of developing recommendations for minimizing impacts from these activities (NEAq, 2014). The NEAq was interested in depicting the life of a right whale and the threats they face in a video game.

The current video game industry is estimated to bring in $40.8 billion in revenue this year (Kahn, 2014). The industry expanded by ten percent from 2012 to 2013, and continues to grow, surpassing the music groups and artists in the music industry in size and popularity (Giraldo, 2014). To take advantage of this growing market, we worked with our sponsors at the NEAq to assess the feasibility of a video game at the NEAq to raise awareness for the conservation of North Atlantic right whales. The goal of our project was to deliver a framework to the NEAq to make informed decisions about the production of a North Atlantic right whale video game that will be prototyped by a group of WPI student game developers. We identified locations, platforms, and audiences, game content, and narratives, which are some of the essential components necessary to create a video game. Information about each of these components was compiled into a single document that we called a framework. For the NEAq, this framework is the first step towards the development of a right whale video game.

The framework was presented to the NEAq and the WPI student game developers who will prototype the video game. Our recommendations intend to guide the development of a video game on right whales as well as educating the public about right whales and how to support efforts in creating a safer and healthier ocean.

Chapter Two: Right Whale Conservation in a Video Game

In this chapter, we cover topics that are important for understanding the scope of our project, which includes threats right whales face, conservation efforts, the role of conservation behavior in educating the public, and how video games can be used as a tool for education.

2.1 Humans Endanger Right Whales

Historically and currently, North Atlantic right whales face many threats caused by humans (NEAq, 2014). Historically, whalers nearly hunted right whales to the verge of extinction (Kraus & Rolland, 2007, p.21). Although hunting right whales is no longer allowed, the species remains endangered due to threats imposed by humans like entanglements in fishing gear, ship strikes, and pollution. These threats to right whales are explained later in the chapter.

2.1.1 The Whaling Era Endangered Right Whales

Before the end of the Whaling Era, the right whale was an easy target and almost hunted to extinction, leaving their population in jeopardy (Kraus & Rolland, 2007, p.21). They were prized for their thick layer of blubber, which frequently measures about twenty centimeters thick. Right whales were dubbed the "right" whale to kill because of their inability to dive quickly. Moreover, their high blubber content resulted in positive buoyancy making it easier for hunters to collect upon the whales' death (Braham & Rice, 1984, p.42).

The first culture to hunt right whales was the Basque culture along the coasts of Spain and France. They hunted 25,000 to 41,000 right whales in the fourteenth and fifteenth centuries (Kraus & Rolland, 2007, p.26) before whale fisheries became established in America and Japan (Braham & Rice, 1984, p.42). By the end of the whaling industry in 1935, the population was estimated at less than a hundred whales remaining in the world (Reeves et al., 1992). The North Atlantic right whale population never fully recovered from the impact of whaling, leaving them more vulnerable to the human threats they face today (Kraus & Rolland, 2007, p.5).

2.1.2 Fishing Entanglements and Ship Strikes Endanger Right Whales

Today, about sixty-seven percent of right whale deaths are caused by humans through entanglement in fishing gear and ship strikes (Van der Hoop et al., 2013a). Fishing gear entanglements, as shown in Figure 1, continues to be one of the major threats right whales face (Van der Hoop et al., 2013a).

Figure 1: Entangled North Atlantic Right Whale
Florida Fish and Wildlife Commission (taken under NOAA permit #594-1759)

A recent study showed that about eighty-three percent of right whales are entangled during their lifetimes (Knowlton et al., 2012). Many right whales are "seriously entangled" each year. "Serious entanglements" are reported when right whales are seen entangled or wounded in fishing gear (Knowlton et al., 2012). These entanglements can lead to difficulty in swimming, breathing, feeding, and reproducing (Knowlton et al., 2012). Entanglements can cause tissue damage, infection, or force right whales to drag fishing gear. The massive amount of energy spent dragging fisher gear can lead to starvation and exhaustion, or trap right whales underwater leading to asphyxiation (Van der Hoop et al., 2013b).

Although right whales are endangered due to entanglement in fishing gear, another major threat that they face is ship strikes (NEAq, 2014). According to Kraus and Rolland (2007), reports of ship strikes account for about thirty-eight percent of reported right whale deaths. Large cargo ships, 1,000-1,200 feet in length, vastly surpass right whales in size and speed. All right whales, but especially pregnant females or females caring for a calf, are unable to avoid these large cargo ships (Kraus & Rolland, 2007, p.23). Besides immediate death, ship strikes cause internal trauma, scarring, and tissue damage such as vertical lacerations from propeller strikes as shown in Figure 2 (Knowlton et al., 2012).

Figure 2: Result of a Propeller Strike, NEAq 2014
Used by permission of the New England Aquarium

2.1.3 Noise Pollution May Endanger Right Whales

Noise pollution maybe another contributing factor to right whale endangerment. There is developing research suggesting that noise pollution created by ship may play a role in right whale endangerment. Noise pollution may inhibit the ability of right whales to hear, reducing their hearing radius from ten miles to two miles (NEAq, 2014). Noise pollution can contribute to accidental ship strikes and entanglements in fishing gear (NEAq, 2014). The impact of these factors on the future of right whales is unclear and continues to remain an active field of research (World Wildlife Foundation, 2014).

2.2 Efforts to Protect North Atlantic Right Whales

Strategies have been developed to address the major threats right whales face (NEAq, 2014). These strategies include: banning right whale hunting, modifying fishing gear, and regulating shipping in the North Atlantic Ocean. Even with these strategies in place, right whales continue to be endangered (NEAq, 2014). These strategies will be discussed in the chapter in more detail.

2.2.1 Strategies Banning Right Whale Hunting

In 1935, an international treaty, *The Convention for the Regulation of Whaling* was signed by fifteen nations including the United States, to regulate whale hunting activities to protect whales like right whales from being hunted to the verge of extinction (NOAA Fisheries,

2014). *The International Convention for the Regulation of Whaling* was signed in 1949 to protect right whales from commercial whaling industries (NOAA Fisheries, 2014).

Right whales were listed in the U.S. as endangered as of 1970 and in need of immediate conservation efforts under the Endangered Species Conservation Act (NOAA Fisheries, 2014). The Endangered Species Act and the Marine Mammal Protection Act required the federal government to pass regulations to prevent the population of right whales from falling below a minimum threshold of sustainability (NOAA Fisheries, 2014). These whale hunting regulations prevented right whales from being hunted but populations continued to decline because of other threats present (NOAA Fisheries, 2014).

2.2.2 Strategies for Fishing Gear Modifications

Fishing gear modifications have been introduced to reduce the risk of right whales entangled in fishing gear. Some of these modifications include instructions on the number of buoy lines used, the number of traps per trawl, how to mark buoy lines, and the requirement of using sinking lines and weak links in between the buoy and the hauling line while fishing (Whale Rules, 2014).

For example, the National Marine Fisheries Service (NMFS) established a regulation requiring lobster fishermen to replace floating ground lines with sinking lines between traps in 2009. These sinking ground lines are mandatory in the Gulf of Maine and intended to prevent bycatch of North Atlantic right whales, humpback whales, fin whales, minke whales, and other organisms (Right Whale News, 2008). Breakaway links, as shown in Figure 3, are required in gillnet panels and at the top of the vertical buoy line in lobster gear to allow entangled right whales or other whales to break free. These links break if a force greater than 600 pounds is applied. In proportion a right whale is about 40,000 pounds (NOAA Fisheries, 2014). Another measure that has been initiated to reduce right whale entanglement is the requirement enforced by law to reduce the number of buoy lines in the water column (Whale Rules, 2014).

Figure 3: Breakaway Line, Photo Credit: Kady Ferguson, 2014

As part of this new regulation taking effect on June 1, 2015, modifications in fishing gear have been specialized for lobster fishermen who fish in close proximity to right whales. These regulations reduce the number of interactions with right whales by reducing the number of vertical lines. This new "trawling up" requirement states that each lobster fishermen can have a minimum number of traps per trawl based on the different fishing zones in Maine to reduce the number of buoy lines in the water. Lobster buoy lines in the Gulf of Maine now must be marked three times with three 12-inch red marks rather than only one 4-inch red mark in regulated waters. Each region of the U.S. coast will have different colored gear markings. Under the final rule for "pocket waters" in Maine, lobster fishermen are allowed to fish a minimum of two traps per trawl instead of three (Whale Rules, 2014). These federal regulations will be enforced starting in 2015 (Maine Department of Inland Fisheries and Wildlife, 2014). To identify other changes that can be made in fishing practices, the Maine Lobstermen's Association (MLA) actively works in collaboration with the Consortium for Wildlife Bycatch Reduction to implement fishing gear modifications to reduce the risk of right whale entanglements. (Consortium for Wildlife Bycatch Reduction, 2014).

2.2.3 Regulating Shipping in the North Atlantic Ocean

Besides fishing gear modifications, shipping regulations in the North Atlantic Ocean have been introduced to address the problem of right whale ship strikes (NOAA Fisheries, 2014). The U.S. government established a ship strike reduction law that requires ships sixty-five feet or

greater in length to travel at speeds of ten knots or less. This ship strike reduction law only applies to ships entering or departing port entrances and certain areas where right whales reproduce, feed and migrate along the East Coast (NOAA Fisheries, 2014).

NOAA Fisheries and Transport Canada, in partnership with the International Maritime Organization, also created "areas to be avoided" where right whales feed and mate. Vessels traveling over sixty-five feet in length are requested not to travel through these "areas to be avoided" (NOAA Fisheries, 2014). In 1997, a U.S. federal law was passed prohibiting any interaction with right whales within 500 yards of a vessel unless special permission has been granted by NOAA Fisheries (NOAA Fisheries, 1997). These laws were designed to help reduce right whale ship strike incidents (NOAA Fisheries, 2014).

In 2003, shipping lanes in the Bay of Fundy in Canada were shifted four nautical miles east to reduce right whale ship strikes. Changes in these shipping lanes resulted in the reduction of right whale ship strikes in Canadian waters by up to eighty percent. Although these changes in shipping lane have been successful in reducing right whale mortalities, ship strikes in the U.S. and other regions of Canadian waters remain a major problem (World Wildlife Foundation, 2014).

2.3 Conservation Behavior and Its Role in Educating the Public About Right Whales

Government officials have the power to regulate fishing gear and shipping practices, but the general public has the ability to change how society views conservation as a whole (Schultz, 2011). By combining research on right whales and conservation behavior there is potential for the general public to see their connection with the ocean, and right whales. This section describes how museums educate the public and how to motivate people to change their behavior.

2.3.1 Educating the Public about Right Whale Conservation

To aid in right whale conservation efforts, museums such as the Smithsonian Museum, the New Bedford Whaling Museum, the National Museum of Natural History, and the NEAq educate the public about what right whales are and why they are endangered.

The Smithsonian Museum, one of the world's largest museums, has created a life-sized right whale exhibit based on an actual right whale called Phoenix. Scientists have monitored

Phoenix since it was born off the coast of Georgia in 1987 (The Smithsonian Museum, 2014). The New Bedford Whaling Museum has a skeleton of a mother and her fetus. The pregnant female died from a ship strike, and the skeletons are used to teach visitors about endangered right whales and how they appear (New Bedford Whaling Museum, 2014). The National Museum of Natural History located in Paris, France has a massive right whale exhibit that they use as an educational tool to spread awareness about endangered right whales (National Museum of Natural History, 2014).

The NEAq is one organization at the forefront of right whale research and conservation. The NEAq works in collaboration with government officials to develop policy changes that are aimed to address threats right whales face like entanglement in fishing gear and ship strikes. The NEAq right whale experts continually investigate new ways to fish that are safer for right whales and minimize impacting the livelihood of lobster fishermen significantly. Experts at the NEAq also keep track of each individual right whale. To monitor the regrowth of the population of right whales, the NEAq uses the right whale catalog with more than 67,000 sightings of ~650 whales that have been identified (NEAq, 2014).

The NEAq also works to educate the public on the conservation and protection of endangered species like right whales (NEAq, 2014). As part of their education program, the NEAq shows people how they are connected to the ocean and how their actions impact right whales. A video game capturing the life of a right whale can be used as a tool to raise awareness about their endangerment status.

2.3.2 Conservation Behavior

Behavioral scientists suggest that solely educating the public will not help conservation unless a motivational element is provided (Schultz, 2011). Motivational elements give people a reason to change their behaviors (Stern, 2000). Such reasons include self-interest and social responsibility. To act on this social responsibility, the NEAq shows how protecting the environment not only helps right whales, but helps create a safer and healthier ocean for people as well (NEAq, 2014). Scientists agree by suggesting, “individuals who perceive a higher degree of connectedness between themselves and nature are more likely to engage in conservation behaviors” (Schultz, 2001; Mayer & Frantz, 2004; Gosling & Williams, 2010). Behavioral changes are key to conservation (Schultz, 2011).

The general public has the power to spread awareness about the endangerment of right whales to induce behavioral changes in the form of "positive behavior alternatives" (Costanzo et al. 1986). Scientists suggest that these positive behavior alternatives are "single, achievable, and specific actions" that the public can do to change the social norm regarding how people view the environment and the animals within the environment (Costanzo et al. 1986; Schultz, 2011). The NEAq adopted this method by providing their visitors with concrete actions they can take to protect the environment of right whales, which will in turn protect right whales, such as eating ocean-friendly fish and knowing where their seafood comes from (NEAq, 2014). The NEAq School and Community Programs Manager warns against the idea of promoting "single actions" because they can create a single-action bias. This means when a person does one good deed for right whales, they feel as if they have done their part, although they have not actually changed their behavior in any significant way to continuously help create a safer and healthier environment for right whales (NEAq, 2014).

A video game informing people about right whales, showing how people are connected to the ocean, and providing concrete actions they can take will create the necessary behavioral changes to help conserve right whales.

2.4 Video Games for Education

The NEAq wants a video game to raise awareness about what right whales are, why they are endangered and how we as a community can support efforts to create a safer and healthier ocean for right whales. In this section, we will explore the current video game industry, the people who play video games, and how organizations have taken advantage of this booming industry.

2.4.1 What is a video game?

Since 1972, video games have been a source of entertainment for people of all backgrounds (Friedmann, 2014). Video games are electronic versions of games where everything in the game is projected to an electronic display. Like card games and board games, these games typically have goals and rewards for the player to achieve (Brown, 2008). Early arcade games were dedicated machines equipped with a screen and control buttons for the user to interact with

the game (Kent, 2010). Video games have much evolved since then, expanding onto many other types of hardware mediums called platforms. Today, there are many platforms that video games can be played on, such as consoles, computers, smartphones, portable systems and other dedicated devices. Consumers highlight the qualities they desire in a platform, such as portability and performance (Galameau, 2014). For example, a survey conducted by Big Fish found that in a sample of over 1,000 respondents, fifty-one percent of the people preferred playing games on desktop computers for the performance (Galameau, 2014). More "casual" gamers may prefer mobile devices such as smartphones because it does not require additional game hardware to be bought (Galameau, 2014). Everything in and related to a video game, including the platform a video game is played on, "adds value to the player experience" (Rabin, 2010).

2.4.2 Why choose a video game?

The key to learning, researchers found, is what they call "engagement." When engaged, a person is engulfed in their video game with an immense amount of excitement (Csikszentmihalyi, 1995). This suggests that the ability of a video game to engulf, immerse, excite, and therefore engage players is an important factor in education outreach.

One exciting way to engulf a person in a learning activity is through video games. The current video game industry is estimated to bring in $40.8 billion in revenue this year (Kahn, 2014). 195 million people identify themselves as gamers in North America alone which suggests that video game popularity is still increasing (Statista, 2014). Why is this industry increasing at such a rapid rate? Part of the answer is due to the rapid increase of video game development, especially in the mobile gaming sector (Kahn, 2014). Fifty-eight percent of Americans over eighteen own a smartphone, which leads to an increase in demand for applications such as games and tools to accompany smartphones (Pew Research, 2014). The development of mobile games require only a small group of people because of the ease of publishing games on Apple's, Google's, or Microsoft's app stores (Kahn, 2014).

2.4.3 Video Games and Behavior

Games have the potential to affect behaviors such as learning by creating the excitement necessary to engage players (Chen, 2007). By balancing frustration and boredom, video games can engage players into a "flow zone", a state of mind where the player is completely immersed in a topic and have the highest learning potential (Chen, 2007). A survey conducted by Bowen

Research in 2011 quantified how video games affect behavior by measuring the emotional powerfulness of games sorted by genre. A summary of the 535 responses is shown in Table 1.

Table 1: Percentage of gamers describing games as emotionally powerful, categorized by genre. Adapted from Bowen Research, published in Game Informer Magazine, 2011.

Genres in order of the percentage of gamers who ranked them as emotionally powerful	
Roleplaying games	78%
First person shooters	52%
Action	49%
Adventure	48%
Fighting	39%
Sports	34%
MMOs	32%
Racing	31%
Real time strategy	24%
General strategy/puzzle	15%
Flight simulators	8%
Flying	8%

Based on the survey, the most emotionally powerful games are roleplaying games. In games of this genre, players take on the role of a character and view the world through the character's eyes. The depth of the character interactions is realistic and they parallel what can happen in the real world.

A follow-up question to the same responders asked what emotions players feel while playing a game. The top responses were the following: competitiveness, accomplishment, beauty, delight, compassion for others, frustration and the want to overcome frustration, (Bowen Research, 2011). These emotions are similar to those found from a questionnaire conducted by educational psychologists in 2002. They used an Academic Emotions Questionnaire (AEQ) that measured the emotions of a formal learning environment and studied academic emotions in the classroom (Pekrun, R , Goetz, T., Titz, W., & Perry, R.P., 2002). Among other emotions, the

AEQ measured students' enjoyment, hope, pride, anger, anxiety, and relief. Comparing the findings from the AEQ and Bowen Research survey, competitiveness in gaming is similar to enjoyment and pride in academics. Anger, anxiety, and relief from academic stress are akin to frustration, the want to overcome frustration, and accomplishment after completing a challenge in a video game. The results suggested "that academic emotions are significantly related to students' motivation, learning strategies, cognitive resources, self-regulation, and academic achievement" (Pekrun, R , Goetz, T., Titz, W., & Perry, R.P., 2002).

2.4.4 Serious Games

The bridge between education and video games is what professionals call serious games. According to Chen and Michael in *Serious Games (2005)*, "a serious game is a game in which education is the primary goal, rather than entertainment" (Chen & Michael, 2005). A few examples are described below.

WolfQuest

Games such as Wolfquest, explore the behavior of a wolf and ecology through an immersive and interactive three-dimensional experience. In this game, the player plays the role of a wild wolf in Yellowstone National Park. In single player mode, the player can explore the alpine wilderness, hunt elk, establish territory, and raise a wolf family. Included in the game is also a multiplayer aspect where players can form packs, explore, and survive in the environment together. The game supports online driven communities by establishing forums and blogs where players can interact with developers as well as other players. This community fosters behaviors outside of the game, intending for the public to better understand wolves as a whole (Koepfler, D. et. al., 2009).

Peacemaker

Published by ImpactGames, Peacemaker is inspired by the current Israeli-Palestinian conflict in the Middle East. One can play from either perspective and the player's goal in the game is to be a leader and make decisions that will result in minimal violence and conflict. The goal of this game, according to one of its developers Asi Burak, is to empathize with both sides and to understand the reasoning behind decisions made (ImpactGames, 2010; Burak, 2014).

Hopelab's Re-mission

Another serious game, Hopelab's Re-mission series, puts players inside a character's body to defeat cancer, using weapons like chemotherapy, antibiotics and the body's immune cells. These weapons parallel real-world medical treatments used to fight cancer. The game series is designed "specifically for teens and young adults who are at risk of adverse cancer outcomes due to poor treatment adherence" (HopeLab Inc, 2014).

Large Whale Entanglement Simulator

The Large Whale Entanglement Simulator is a virtual simulation of large whale entanglements created by experts at BelleQuant Engineering working in collaboration with the NEAq. Dr. Laurens Howle leads the team in creating an interactive "game-style" computer program to better understand whale behavior when encountering fishing gear (Howle, 2012). Because little is known of how a whale actually behaves during entanglement, the simulator models scenarios based on algorithms involving the physical properties of fishing gear, whale anatomy, etc. The computer simulation approach allows the user to play the role of the whale and examine the "what-if" scenarios. This allows the experts to compare documented outcomes of entangled right whales with the computer simulated models in order to reverse engineer whale behavior. This current simulation models whale behavior to experts, but it lacks the capability to be introduced to public. This simulator is the idea behind our object. There is a research gap between have the simulator and implementing it as an educational video game for the NEAq.

2.5 Summary

Now that we have explained why a video game was chosen to raise awareness about what right whales are, why they are endangered, and how we as a community can support efforts to create a safer and healthier ocean, we can describe how we developed our framework to support the video game design process. We will explore how information such as the audience targeted by the video game, the location and platforms that host the video game, the content of the video game, and the storyline of the video game are details gathered that help the video game design process.

CHAPTER THREE: METHODOLOGY

The goal of this project was to deliver a framework to the NEAq to make informed decisions about the production of a North Atlantic right whale video game that will be prototyped by WPI student game developers. We adapted the components from Friedmann's *Seven-Step Method to Develop a Creative Concept* in Appendix C . These adapted components are: design criteria, locations, audiences, platforms, types of games, narratives and content details. Combined, these components form the framework to be delivered to the NEAq and WPI student game developers to make informed decisions about the details needed to begin the design process. To accomplish our project goal, we:

1. Determine potential locations, platforms and audiences for the video game framework
2. Identify factual content details for the video game framework
3. Develope a storyline for the video game framework

Each objective fulfills at least one of the components required for the video game framework. We combine research on locations, platforms, and audiences, with right whale content and storylining techniques to produce a framework for the development of a right whale video game. The methods used to complete each objective are described in this chapter.

In the first objective we identified potential locations, platforms, and audiences for the video game and how we evaluated each item to make our recommendations for the NEAq. With our second objective, we compiled information on right whales and their environment that the WPI student game developers can use to create the video game design.

3.1 Determine potential locations, platforms and audiences for the video game framework

This objective was focused on determining the locations, platforms, and audiences for a right whale video game. This information was identified so this can be passed on to the WPI student game developers in form of a framework. We investigated the platforms and audiences based on our chosen locations. We intended to find the demographic of the audience by observing these locations and interviewing experts who frequently work with the people in these areas. This section discusses methods used to narrow down our list of potential locations, platforms and audiences, .

3.1.1 Choosing Location

We brainstormed a list of locations similar to the NEAq such as aquariums, museums, harbor cruises and virtual locations. The following is a list of considered locations:

1. Aquarium/museum
    - New England Aquarium
    - Mystic Aquarium
    - Boston Museum of Science
2. Supplement to nature tours
    - Boston Harbor Cruises whale watching
    - Cruise ships
3. Other
    - Websites
    - Fishing boats

We narrowed the list of potential locations to three based on the NEAq's interest of targetingaudiences who care about marine life. We considered each location, and the potential for the audience present at each location. Due to the time constraint on our project our choices favored proximity to our project location and ease of access for us: the NEAq main visitor building, the Boston Harbor Cruises (BHC) whale watching tour boats, and the NEAq website. These locations will not only be included in the framework for the WPI student game developers to help make informed decisions, but will also be useful for us to make informed decisions about assessing the potential platforms and audiences at each location.

3.1.2 Assessing Potential Platforms at chosen locations

To determine the video game platforms for the right whale video game, we toured the NEAq main visitor building, attended two BHC whale watching expeditions, and examined the NEAq website. We examined current hardware resources available at each location to verify the hardware capabilities at each location.

A semi-structured interview with the NEAq Vice President of Programs, Exhibits, and Planning was held to determine the platforms for the NEAq main visitor building. We discussed the exhibit planning process, hardware and physical space limitations, and previously successful or unsuccessful exhibits and programs. We discussed the ease of implementing each platform at the NEAq. All four members of our group were present for this interview. One member led the interview by following the interview guide shown in Appendix E, while the other members wrote down notes in a notebook.

On the BHC whale watching tours, we held semi-structured interviews with lead naturalists to determine the platforms for the BHC whale watching tours. Following the interview guide in Appendix F, we interviewed two lead naturalists and the BHC Director of Marine Education and Conservation. One of our team members led the interview while the other three recorded the responses. We learned from their experience what activities are on the whale watching tours, and the hardware and space limitations of the boats. We also interviewed ten groups of whale watchers to determine their viewpoint of the available platforms.

We based the platforms for the NEAq website on whether each platform could access the website, and if it could, whether the location could support the platform. Because mobile apps based in the NEAq main visitor building would require advertisement, we determined the feasibility of a mobile app there based on a formal email inquiry to the NEAq webmaster. Because the webmaster has access to the data regarding the popularity of the NEAq website and QR code downloads, which were questions we specifically asked to find out whether the website would bring audience exposure to our video game.

Similarly During our tour of each of the chosen locations, we observed the whether the available hardware capable of hosting a video game was present at each location. These hardware options include: desktop computers, mobile devices such as a smart phone or tablet, interactive electronic museum exhibits, retail gaming consoles such as Microsoft's Xbox or Sony Playstation, and other handheld devices capable of being used to play a video game. By following the guide shown in Table 2, each member of our group recorded whether or not the hardware resource was present in the location. The hardware capabilities were assessed based on current presence in each location because we required a simple method for assessing the capabilities of each location to accommodate the platform.

Table 2: Locations of Platforms

Platform	Is this platform present at this location? Yes or No
Console (Xbox)	
Kiosk Exhibit	
Mobile Device (phone or tablet)	
Desktop	
Handheld Device (Gameboy)	

We used this data to determine which platforms were present at each location. Because we collected data from the three locations we determined earlier in this objective, we selected the three platforms which were more readily available at each location.

3.1.3 Defining Audiences

The audience is one of the important components to our video game framework. This is important to the WPI student game developers because it allows them to gear their content towards audiences. Without this component, the WPI student game developers risk presenting visual content which is not suitable to the audience, such as children. Another example is that gearing the content towards children may bore older audiences. For this reason, age is defined as an important trait of the audience.

To determine the ages of visitors at the NEAq main visitor building, we performed observed the visitors by observing and estimating a visitor's age. Because of the subjectivity in estimating, we recorded age ranges rather than specific ages. Each member of our group recorded the age of visitors observed on a designated floor.

To determine the ages of whale watchers at the BHC whale watching tours, we performed observations in a similar way. We simply observed our perceived age ranges of each visitor. These observations were performed on a different whale watching trip than the trip we used to conduct interviews.

We did not attempt to determine the ages of those who use the NEAq website because of the difficulty in gathering the information. Each visitor of the website would have to fill out a survey, and our group decided that this would be bothersome. We instead assume that the NEAq website must contain content which is suitable for all ages, because of the wide availability of the internet.

3.1.4 Determining What Engages the Audience

To identify the visitor demographics at the NEAq and their reason for visiting, we gathered information that is already available to the NEAq. From correspondence with our sponsors, we were lead to contacting the BHC Director of Marketing at the aquarium for visitor information regarding to the main aquarium building. The following questions were asked in an email:

- What are the visitor ages?
- Did the visitors come as part of a group/organization?
- Why did they choose to visit the aquarium?
- What exhibits are most popular among visitors?

The visitor age ranges were separated into two categories based on tickets sold: adults and children. The first question directly asks for the age of the visitors at the NEAq, while the other three questions give context to the numeric response. To analyze the data, we viewed each response and made real-world connections between them. For example, data on group visits shows the average group to have two adults and one child. We can extrapolate that the group consists of two parents with their child. We then toured the NEAq main visitor building once more, making observations of visitor age, group size, and interactions with the exhibit.

Since the visitor information obtained from the Director of Marketing only includes those who physically visit the aquarium, we needed to also take into consideration the audience on BHC whale watching tours. This was done by surveying ten participants following the guide shown in Appendix G. Our group was divided into two groups of two, with one interviewer and one note taker. The note taker also wrote down an estimate for the participant's age.

3.1.5 Formulating the NEAq's Design Criteria for the Video Game Framework

We formulated what design criteria should be included in the framework for the WPI student game developers. This design criteria represent the characteristics of the video game that the NEAq would like and that the WPI student game developers can follow. These criteria are based on our interview with the NEAq Vice President of Exhibits, Programs, and Planning and during meetings with our sponsors and advisors.

The NEAq Vice President of Exhibits, Programs, and Planning has many years of experience in planning engaging exhibits for visitors of the NEAq. By interviewing him, we hoped to learn what criteria would be important for the WPI student game developers to consider in their design, based on what has been implemented as exhibits in the NEAq main visitor building. We included these criteria in the video game framework. These criteria were initially based on our interview with the NEAq Vice President of Exhibits, Programs, and Planning, but they were refined based our meetings attended by our advisors and our sponsors.

The purpose of our interview with the NEAq Vice President of Exhibits, Programs, and Planning was to gather specific criteria that the NEAq uses when planning exhibits. We asked questions regarding the general exhibit-planning process, criteria used for engaging visitors, and suggestions for our project. One team memberconducted the interview, while the rest of our team took notes and asked clarifying questions.

In our meetings with our advisors and sponsors, we aimed to formulate the criteria based on the criteria identified in our interview with the NEAq Vice President of Exhibits, Programs, and Planning. Many other ideas for the criteria were introduced by our sponsors or advisors as we discussed our project each week. Over the course of six weekly meetings, we had discussions about what criteria would allow the WPI student game developers to suit the needs of the NEAq.

3.2 Identify Factual Content Details for the Video Game Framework

The purpose of this objective was to collect factual content to help the WPI student game developers design the characters and environment in the video game. The WPI student game developers agreed that this information will be helpful especially in the form of tables that display the images and descriptions of this content. The accuracy of the video game relies on the visual accuracy and the behavioral accuracy of each piece of content in the game, so our

information with regards to the appearances and behaviors of each piece of content in the game will be shared through these content detail tables.

We filled these content tables with knowledge of right whale behaviors and the roles of humans, ships, tools, and marine life in the environment of right whales. This previous research contained no guidance about which right whales should be the focus of archival research. This previous research also yielded little information about the viewpoint of lobster fishermen on right whale conservation, environmental roles and behaviors of fishermen, fishing vessels, and fishing tools.

To address these research gaps in our previous research, the following methods describe how we selected the right whales using an interview with a NEAq research scientist, collected details about specific right whales using the NARWC, and implemented the viewpoint of lobster fishermen. All of this content supplemented previous research to create the factual content detail tables for the video game framework.

3.2.1 Compiling the Content Tables

These content tables are important to the WPI student game developers so they can ensure they are portraying the roles of each content item accurately. Besides the benefits that the content tables create for the WPI student game developers, the content tables also aided in the development of our video game storyline. A blank sample table is illustrated below to demonstrate the layout of the content tables.

Table 3: Sample Content Table Template

Name of Content	Image of Content	Behavior of Content
Right Whales		
People Involved in Conservation Efforts		
Ocean Vessels		
Tools that People Use		
Marine Life		

Specifically, these tables include images and descriptions of specific right whale stories, right whale behaviors, people involved in conservation efforts, ocean vessels present in the habitat of right whales, tools that people use and marine wildlife and plants present in the habitat of right whales. We include each of these types of content because these represent people, objects, and other animals present in the right whale environment. The actual content tables were made with the modifications of additional or fewer columns based on the information available and useful for the WPI student game developers. A partially-filled example of one of the tables shown in Table 4.

Table 4: Example of Content Included in Storyline

Name of Content Item *(Ocean life, people, and objects for the game)*	**Appearance** *(What the item looks like and images)*	**Behavior** *(How the item acts in its environment)*	**Environmental Role** *(How the item connects to the environment)*	**Impact on Right Whales** *(How the item connects to right whales)*
Right whales	Callosities, v-shaped spout, no dorsal fin, thick build, size, color	Slow-moving relatively. Surface active groups Breaching Vocal calls Diving to the bottom of the ocean to scrape mud on their heads…	Consume copepods, stores carbon, fertilizes the ocean…	N/A
People				
Ship example: Lobster Fishing Boat	Usually 36' to 60' long	Speed restrictions of 10 knots (11.5 mph)…	Potentially travel through whale habitat	Lays lobster traps which entangle whales
Tools (that humans use to fish or disentangle whales)				
Marine Animals				
Marine Plants				

For the accurate design of the game, the appearance and behavior columns are the most important. The first column states the name of the content. The column titled “appearance” illustrates each content item with an image and supporting captions.

The behavior column explains the movement patterns and apparent tendencies of each content item. For example, right whales move by pushing their flukes vertically, rather than horizontally.

The environmental role column and the impact on right whales columns are present in this table to increase the understanding of the WPI student game developers of interactions between the content items, the environment, and right whales. For example, fishermen affect the environment and right whales by catching fish and setting lobster traps. Therefore, the WPI student game developers may not want to depict the fishing boats colliding with right whales, because this is not how the lobster vessels behave.

Other columns are included where additional information can be useful for the WPI student game developers. For example, our Specific Right Whale Stories Table has columns for NARWC catalog number and the gender and age of the whale. This table is also explained later in the objective.

Table 5: Sample Specific Right Whale Stories Table

Whale Name	Catalog Number	Appearance	Brief Description of Whale	Gender/Age
Whale 1				
Whale 2				
Whale 3				

These columns are added for easy reference purposes. The NARWC catalog number allows the WPI student game developers to check the NARWC for more information about each whale. The gender and age allow the developers to quickly understand this information, in case this information can affect the story. For example, male whales do not become pregnant and would likely not be portrayed as pregnant in the game. The WPI student game developers can check easily whether a particular whale is male or female using this column.

Sometimes columns are removed from the content table, because there is no information or the information required is not applicable to the content. For example, lobster traps and other

tools do not have behaviors. Therefore, the column titled “behavior” is not included in the Tools Used by People Involved Table.

3.2.2 Selecting Right Whales

The NEAq’s Ocean Center Research Department is dedicated to right whale conservation. Many within this department have years of experience observing right whales in their natural habitat. an NEAq right whale expert volunteered to give us the opportunity to learn about specific right whale stories through a phone interview. A phone interview was chosen because for most of our project duration, the NEAq right whale researcher was on a research trip in a remote location.

The purpose of our interview was to select specific right whales to include in the content detail tables. The stories of right whales that interested us were well-documented whales which have a history of tragedy, a history of entanglement or ship strike injury, memorable scars or appearance features, special nicknames, or mysterious sighting locations. We required whales with these traits so that real-life struggles that right whales face can be accurately portrayed in the video game by the WPI student game developers.

Since the features listed above are details about right whale’s history that NEAq right whale researchers would probably not remember, we decided to ask questions which appealed more to emotion. We asked interview questions regarding her favorite right whales, right whales which emotionally affect her, or any notable specific stories. The interview guide we used can be found in Appendix H.

Limitations of this method include that we only interviewed one right whale researcher. If we could have interviewed all right whale researchers, we would have been able to gather more right whale stories with more details. Another limiting factor was that although these researchers have years of experience, sightings of each specific whale are rare. Some whales are not seen for years at a time. This makes formulation of right whale stories difficult because of the mystery of the events between each sighting.

After we interviewed the NEAq right whale researcher, she provided guidance of where right whale stories can be found so that we could research more details as part of the next task. We selected all of the whales that the NEAq right whale researcher suggested because we wanted to include several whales in the content detail tables.

3.2.3 Collecting Detailed Information about Selected Right Whales

The NEAq Right Whale Catalog (NARWC) is the largest database of North Atlantic right whales, with research contributed by the NEAq and other research organizations. It includes information that can be directly compiled from the NARWC of each whale: the nicknames, catalog numbers, images, specific feature diagrams, sighting history, and family information. We had the opportunity to use this public online database to research these key kinds of information about the right whales we selected in the previous task.

The details that we found about each right whale were included in our content tables to aid the WPI student game developers in character development. We outlined these details into one of our content tables, which is labeled Specific Right Whale Stories. Table 5 shows a blank version of the content table.

Table 5: Specific Right Whale Stories Table

Whale Name	**Catalog Number**	**Appearance**	**Brief Description**	**Gender/Age**
Whale 1				
Whale 2				
Whale 3				

We included the whale name and catalog number to ensure the WPI student game developers can properly reference the correct whale. The appearance category was filled with images to aid in character modeling and visual design. The gender and age category was provided so that the WPI student game developers can quickly reference this information. The brief description of each right whale was found on the NEAq's right whale sponsorship web page, which explains each right whale's notable characteristics. It was included so that the WPI student game developers can ensure their final characters are consistent with the current understanding of these specific right whales. All other information for the table was found through archival research of the NARWC with prior guidance from our right whale expert.

3.2.4 Addressing the Lobster Fisherman Research Gap

As stated in the introduction to this objective, previous research yielded little information about the viewpoint of lobster fishermen on right whale conservation, environmental roles and behaviors of fishermen, fishing vessels, and fishing tools. Because many regulations for the protection of right whales are targeted at the lobster industry, lobster fishermen are an important component of our content tables. One lobster fisherman volunteered to take us on his boat for a day, which gave us the opportunity to investigate the roles and behaviors of lobster fishermen, fishing tools, and fishing boats.

We spent about nine hours on the lobster boat, doing a combination of natural observations, taking pictures, and having interviews with the lobster fisherman as according to Appendix I. We asked interview questions regarding the economic and safety impact of regulations on the lobster fisherman, and their perspective on the right whale conservation effort so we could learn more about the role of lobster fishermen in right whale conservation.

Information we gathered from observations were used for our Ocean Vessels table and Human Equipment table. The information we gathered while interviewing the lobster fisherman were compiled into the table of People Involved in Right Whale Conversation, which is highlighted in Table 6.

Table 6: The information gathered on lobster fishermen will address role in the environment, impact on right whales, and behavior

Individual	Appearance	Role in the Environment	Impact on Right Whales	Behavior
Lobster Fisherman				
Ship Captain				
Whale Researcher				
Disentanglement Team Member				
Members of the public				

We filled the areas shown highlighted after our interview but while also taking into account that interviewing a lobster fisherman about his viewpoints on right whales has its limitations. His responses may have been affected by his personal feelings and perceptions. If the

lobster fisherman perceived us to be biased towards right whales, then he may have overstated his considerations for the right whales. More importantly, we are only interviewing one lobster fisherman on one day of the year. The lobster fisherman has his own biases, which are unknown to us. The information we obtained about the vessel and his equipment are not affected by these limitations.

While it may have been beneficial to the accuracy of our content tables to observe and interview a disentanglement team and a cargo ship captain, our project had time constraints which make it difficult to arrange that research, so online research was conducted instead for those roles.

3.3 Develop a Storyline for the Video Game Framework

We decided to implement a storyline as one of the components of the framework. This storyline will provide the WPI student developers with a suggested base storyline for the video game. This storyline will be based on previous research about right whales and formulating video game storylines. However, while there is much information on writing the storyline of games, there is no information regarding writing stories specifically for a right whale video game. With experts from the WPI Interactive Media and Game Development (IMGD) department and members of the NEAq staff, we discussed what content should be included a video game. From these discussions, we created criteria for deciding whether or not certain details of right whales should be included in a video game storyline. We then created example storylines from these criteria for future project teams to reference.

3.3.1 Formulating the Video Game Storyline

As part of the framework, we created a storyline that includes the narrative portion and the supporting information that the video game developers require to create the game. Using the information in the content tables and a designed outline, we wrote one extensive storyline using an outline that was created based on our background research as shown in Figure 4.

The outline represents a nonlinear, multidimensional narrative that allows the video game developers to decide what approach they want to take, and how they want to depict the story. The narrative includes plot, setting, theme, and characters.

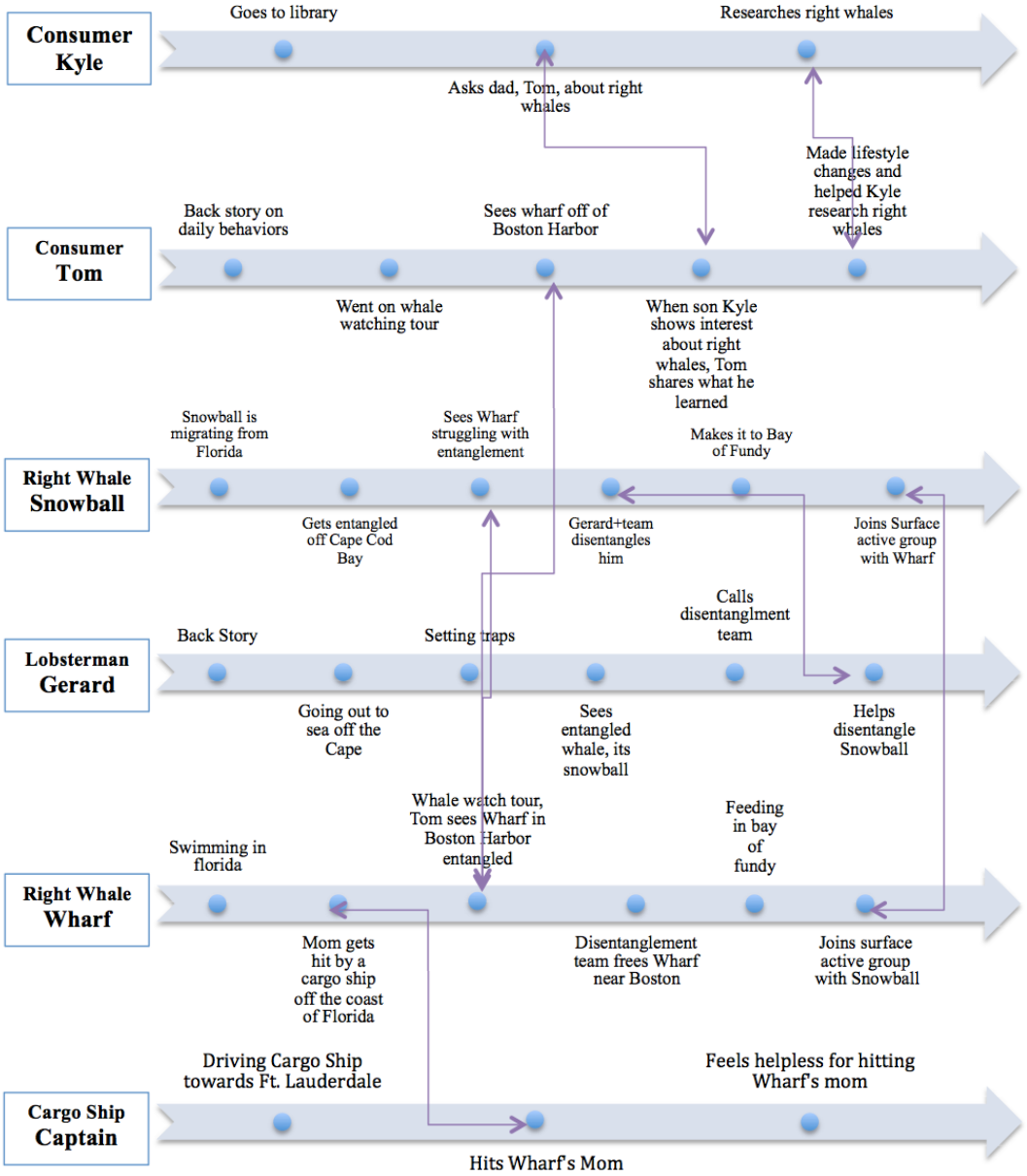

Figure 4: Storyline Outline for Right Whale Video Game

We organized the flowchart into interconnected timelines of the characters in our storyline. Each timeline highlights milestones during the character's lifespan, based on the choices that are made by the real-life people they represent. These characters are based on the real life roles of people involved in the conservation efforts of right whales. Events in each timeline connect one character to another, similarly to how humans are connected to North Atlantic right whales. This

method of creating the storyline follows a modular design, allowing more characters to be easily added in the future. There are many characters that can be included in a storyline; therefore we concentrated our efforts into four specific characters to fit our deliverable within the time restraint of this project.

3.4 Summary of Methods

Completion of all objectives was necessary to come to a conclusion about the location, platform, audience, content to include in the video game, and storylines as a basis of the game. These components make up the framework that will be delivered to the WPI student game developers. Evaluation, assessment, observation, and research methods were all used to lead us to the development of framework for a right whale video game. In the next section the results from following this methodology are described in detail.

CHAPTER FOUR: RESULTS AND FINDINGS

After completing our research and conducting our methods, we analyzed our results and findings relating to the NEAq's exhibit strategy, our audience and their engagement, educational and behavioral messages, and presentation of the right whale video game content portrayed in an empathetic and action-encouraging way. By illustrating how each decision by the player in the video game affects how the messages are conveyed to the audience, they also reflect an important relationship—each step in the development of our video game technology will affect the public's perception of conservation, and therefore have an effect in conservation of the right whale.

Our findings relating to the informational needs of the NEAq and the WPI student game developers to utilize our project are explained first, before we examine how we found each of those pieces of information. Lastly, we explain how we decided on the formatting of our information for the NEAq and WPI student game developers.

Finding 1: The WPI student game developers listed four project requirements.

The WPI student game developers would like the following four requirements to be presented in our framework deliverable to allow them to expand upon our project and create a video game prototype for the NEAq:

1. Audience
2. Platform / Estimated playtime
3. Specific right whale stories and other content
4. Sample storylines

Knowing the audience would allow the WPI student game developers to design a game that is appropriate to the target audience. Art styles, font choices, and wording are among the many considerations when designing a game for a specific audience. The estimated playtime, which is also decided by the platform, gives the WPI student game developers a sense of how long and how detailed to make each level or stage of the game. The details put into each level or stage would require accurate portrayals of the scenery and ocean life in the virtual environment.

Finding 2: The video game can be exposed to the most visitors at the NEAq main visitor building.

We researched three locations for the right whale video: the NEAq main visitor building, the NEAq website, and the BHC whale watching tours. Our meetings with the NEAq staff lead to the discovery that to raise awareness about right whale endangerment we need to reach the most people at the locations where people show interest in aquatic life. Because people at each location showed interest in aquatic life, we narrowed the focus to one location by examining the number of people who visit each location. According to the visitor profile the NEAq main building had about 1.3 million visitors last year whereas the BHC whale watching tours had 120,000. The NEAq website had 7.7 million visitors last year, but the most frequented page was the homepage for approximately two minutes which does not ensure the visitor would have enough time to locate and play the right whale video game. The NEAq main visitor building is the location that has the most visitors who can be exposed to the right whale video game.

Finding 3: The visitors at the NEAq main visitor building are children ages seven to nine years old and adults thirty-five to forty-one years old.

The 2014 summer visitor profile from the Director of Marketing at the NEAq indicates the average age ranges that visit the NEAq are children seven to nine years old and adults thirty-five to forty-one years old. Based on observations at the NEAq most of the exhibits reflect this result by gearing exhibits to attract children with colorful and pictured information boards at their height, and inform adults by providing in-depth content information at their eye-level. A limitation is that by averaging age ranges there will be many visitors not represented by the data. We performed our own observations at the main visitor building and found they have a wide variety of age ranges present.

Finding 4: The primary reasons to visit the NEAq main visitor building are to bring children and to be entertained.

The visitor profile that we obtained from the Director of Marketing at the NEAq indicated that the primary reasons people visit the aquarium are to bring their children and to be entertained. Table 7 displays all the reasons people visit the aquarium by percentage.

Reason to Visit the Aquarium	Percent
To bring children	60%
To be entertained	53%
To sightsee	36%
To spend time with friends/family	29%
To be educated	28%
Are interested in marine life	27%
To bring out-of-town guests	12%
Other reasons	4%

Table 7: Reason to Visit the Aquarium

Respondents were allowed to choose multiple answers, therefore the percentages do not add to 100%. There is a significant difference in the percentage of people who cite entertainment as the reason to visit the aquarium, rather than education. Education is a main priority at the NEAq

suggesting an educational video game can meet the needs to satisfy the visitors with an entertaining and fun video game, while also satisfying the NEAq with the educational content and main messages. The limitations of this finding are that the profile was from the summer of 2014 and may not reflect the visitor demographics year-round.

Finding 5: The NEAq main visitor building visitors spend two to three minutes at each exhibit.

Based on our observations at the NEAq main visitor building, the visitors tend to spend two to three minutes at each exhibit. They would often move on to the next exhibit after viewing the live animal, or a family member would often bring their attention to another exhibit. Very few visitors took time to read the display boards at each exhibit. This includes both live exhibits and interactive exhibits. Our observations were limited to a single day at the aquarium and may not reflect the visitor behaviors for the entire year.

Finding 6: Live animal exhibits are the main attraction for visitors at the NEAq main building.

According to the visitor survey results conducted in the summer of 2014, the guests who visit the NEAq main visitor building primarily come to view the live animal exhibits. Among the visitors that came to view specific exhibits, penguins were the most popular. Table 8 shows the percentage of popularity among the 42% of visitors who came to see a specific exhibit.

NEAq Exhibit	Percentage
Penguins Exhibit	62%
Giant Ocean Tank	50%
Shark & Ray Touch Tank	26%
Sharks	19%

Table 8: Popular Exhibits at the NEAq

In addition to the visitor survey results, our own observations at the aquarium showed that most of the visitor interest was in live exhibits. Many of exhibits that did not feature live animals were left unattended. This adds to the finding that live animal exhibits are the main

attraction at the NEAq main building. The limitation to the finding is that our findings are based on the summer of 2014 and does not reflect what may occur in the year-round.

Finding 7: A video game museum exhibit could simulate a live experience to accompany the right whale skeleton at the NEAq.

Based on the finding that people visit the NEAq for the live museum exhibit, we researched how a video game can provide a live experience for right whales because they cannot be kept in captivity. Our research suggested that roleplaying games could simulate a real-life experience when playing from the perspective of a character. The WPI student game developers can use this finding when designing the type of game for the right whale video game that can be implemented as a museum exhibit to supplement the right whale skeleton at the NEAq main visitor building. However, according to our interview with the NEAq Vice President of Programs, Exhibits, and Planning, the space at the NEAq main visitor building is limited and a video game museum exhibit may not be feasible.

Finding 8: The NEAq has a list of criteria for evaluating exhibits.

Our interview with the NEAq Vice President of Programs, Exhibits and Planning explained that the NEAq has specific standards for exhibits. Because of the limited space in the aquarium, exhibits are only changed when building renovations are necessary. This makes the exhibit-selection process very selective. Our interviewee also explained that a video game that is appealing, has levels, has some challenges, gives a quick result, and is kid friendly are qualities that the NEAq looks for in the exhibit deciding process. For example, the *Shark and Ray Touch Tank* is an exhibit that is visually appealing through its curved tank design and painted walls. The tank is situated low to be kid-friendly. A video game with levels, challenges, and quick results coincide with our research on what video game qualities immerse a player in the "Flow Zone" where they are the most engaged (Chen, 2007). These are requirements of the NEAq when considering different exhibits.

Finding 9: A mobile app is not suitable for the NEAq main visitor building.

Through observations and an interview with the NEAq Vice President of Programs, Exhibits, and Planning, we found that people come to the aquarium to enjoy being with their

families and shy away from phone usage. During our observations, people in the aquarium enjoyed walking around the aquarium with their friends and family discussing exhibits as they appeared.

The School and Community Programs Manager stated that a QR code linking to the mobile app would not be visible and would not attract visitors if it were present in the main visitor building on a poster. The NEAq Webmaster also confirmed by stating that between October 2013 and October 2014, the QR code was only downloaded ninety-two times the entire year. This suggests that people are unable to find the poster linking to the QR code in the aquarium because it is dark and visitors who are quickly viewing exhibits do not see the poster. The limitation to this claim is that our time observing visitors in the aquarium was limited resulting in a sample size of an estimated one hundred visitors.

Finding 10: BHC whale watching tours lead naturalist and staff members are interested in a multi-language mobile app on right whales to be present during tours.

BHC whale watching tours appeared interested in having a mobile app right whale video game as an educational and fun learning tool for their visitors based on the interview we had with the lead naturalist of BHC. Our observations of the BHC whale watch activities showed they have many activities related to whale watching for visitors including right whale pamphlets, journal writing about your visit, and a whale tale identification game. The lead naturalist informed us that these activities tend to get stolen and are costly to replace. A mobile app that can be downloaded before a whale watching tour on the visitor's phone would not face the same problem because the BHC tours would not need to provide the materials. The lead naturalist indicated that visitors frequently have their phones out throughout the whale watching tour. She stated that during whale watches, people usually do not like to hear naturalists talk for long periods of time and like to relax and enjoy the tour.

We also interviewed the NEAq Vice President of Programs, Exhibits and Planning, who suggested that having a mobile app available on BHC tours would be a good tool to allow the visitors to reflect on their experiences on the tours. A limitation of our interviews is that these interviews may not reflect the viewpoints of all BHC staff involved in the whale watching tours.

During the fall season, the lead naturalist informed us and we observed that many international visitors are present on BHC tours. The lead naturalist suggested that a game with

multiple languages would be a very attractive tool to accommodate visitors who do not speak English.

Finding 11: BHC whale watching visitors have no significant interest in a mobile app.

When we interviewed BHC visitors on a whale watch, we observed that most participants are international tourists and are visiting for a limited time in Boston. They stated that they did not care for a mobile app on right whales because of their limited time in the area. This claim is based on interviews of ten groups of BHC visitors performed during the tours. A limitation to our claim is that we did not have enough time to collect more data from BHC visitors because the sample size was one whale watching tour and does not consider the other demographics present during other seasons of the year. The data collected from the whale watchers conflicts with the previous claim that a mobile app is suitable for a whale watching tour. Despite this conflict, this may be less credible because the BHC tour lead naturalists have more experience with entertaining visitors.

Finding 12: Accuracy of the video game educational content is a priority of the NEAq.

The sponsors indicated in our meetings that the basis of the characters and environment in the game must be factually accurate. For the WPI student game developers to meet the factually accurate criteria, they suggested the material be presented in the form of pictures and descriptions. Through research and interviews with the NEAq research scientist and lobster fisherman, we created a North Atlantic Right Whale Video Game Content document consisting of specific right whale stories, right whale behaviors, people involved in conservation efforts, ocean vessels present in the North Atlantic Ocean, human tools used, and specific regions where marine wildlife and plants are present in the environment of right whales. A limitation to the accuracy is that we limited the document to only the commonly found marine life in the North Atlantic Ocean because of the vast amount of content.

After speaking with the NEAq research scientist and using information from the North Atlantic Right Whale Catalog, we compiled a variety of real right whale stories for use in the video game. The interview with the NEAq research scientist guided us to online resources that highlighted the lives of several famous whales. The North Atlantic Right Whale Catalog has over 200,000 photos of right whales. However, sightings of right whales can be years apart creating a

lot of speculation about their daily lives. This is a limitation to the accuracy of the right whale stories in the video game.

Finding 13: There are several types of people involved in right whale conservation that can be included as characters in the right whale video game.

Our research on right whale endangerment and conservation efforts showed everyone is a part of right whale conservation through their direct or indirect actions. The NEAq sponsors discussed specific people and their decisions that impact the right whale, or the environment of the right whale. Based on our research on right whale conservation and our sponsor meetings we focused on including the following people as potential characters for the right whale video game: right whales, lobster fishermen, government officials, ship captains, environmentalists, researchers, disentanglement teams, educators, and consumers. The limitation of this is that there may be more players to the conservation issue than is focused on in our sources.

Finding 14: Maine lobstermen are negatively impacted by the new whale regulations.

Through our interview with a Maine lobster fisherman it was discovered that new fishing regulations are having a major impact on lobster fishermen in terms of safety and financial detriment. Lobster fishermen are obligated by law to use sinking lines instead of ground lines which are almost double the price. These sinking lines are dangerous to use because they can explode and cause traps to be lost causing financial consequences. The lobster fisherman we visited explained that sinking lines are easily breakable and contribute to high gear loss incidents that pollute the ocean floor with “ghost gear”. These sinking lines are also safety hazards because they get caught on anything on the ocean floor, which creates pressure when pulling the traps up causing the pulley to snap. The lobster fisherman believed that eventually these sinking lines could hurt the whales because it affects their habitat. Sinking lines also hurt the lobster fishermen, costing them more time, money and safety.

Finding 15: A video game with a hopeful tone is a priority of the NEAq.

The NEAq School and Community Programs Manager discussed that conveying our video game main messages and content in a hopeful tone would provoke a stronger response from the audience for right whale conservation. This finding helps both our project group and

WPI student game developers to focus our word choices to convey a more positive tone when speaking of the conservation of North Atlantic right whales. For example, instead of focusing on right whales being entangled, we should focus on disentanglement or researching fishing gear modifications to help reduce entanglements. In doing so, the audience will still understand entanglement is a threat, but also understand there is hope for right whales.

Finding 16: The NEAq identified four main messages to convey in the right whale video game.

To apply the NEAq mission of conservation and education of the Blue Planet, we developed four main messages for the video game based on our interviews with the NEAq staff and meetings with the School and Community Programs Manager. The following four main messages were developed:

1. *North Atlantic right whales are endangered baleen whales.* Right whales became critically endangered due to the whaling era that brought their population from a thriving 10,000 whales to about 500 today. Today they live in close proximity to commercial seaports and fishing areas along the east coast of the United States and parts of Canada where ship strikes and entanglements in fishing gear exacerbate their endangerment status.
2. *Personal decisions can reduce our impact on right whales.* We are always connecting with the ocean and many of our choices can impact aquatic life.
3. *Conservation research and regulations can make a difference in the conservation of right whales.* To diminish the effects of right whales living along an urban coast, conservation efforts, like changes in shipping lanes and speed restrictions, have resulted in the reduction of right whale deaths. Researchers and lobster fishermen are working in collaboration to improve fishing techniques and materials to reduce entanglements.
4. *As a community we can support efforts to create a safer and healthier ocean.* We can help preserve the biodiversity of the ecosystem by taking action. People like you can give right whales a chance to survive by eating ocean friendly fish and learning more about where your seafood comes from.

These are appropriate messages for all audiences that can help people understand how they can help right whales.

Finding 17: There are three specific actions the NEAq hopes people will be empowered to take to help in right whale conservation efforts.

Based on our research and discussion with the School and Community Programs Manager, our video game will raise awareness how as a community we can support efforts to create a healthier and safer environment for right whales. Our research indicated to that conservation of animals relies on behavioral changes that are presented to the audience as concrete actions or life style changes. Some lifestyle changes that we hope people will consider include: eating ocean friendly fish, knowing where seafood comes from, and raising awareness about what right whales are and why they are endangered. These concrete actions can be presented in the video game to provide the audience with something they can do to be a part of right whale conservation.

Finding 18: The NEAq prioritizes design criteria to consider for the right whale video game.

We developed a set of seven criteria for the video game design based on researching video game design criteria and receiving suggestions from our NEAq sponsors. These criteria were chosen because they can promote the design of a full right whale experience that is not only captivating, but educational as well. The design criteria is posed as questions for the WPI student game developers to ask when designing and testing the video game:

- Is the game factually accurate?
- Visually appealing?
- Does it create empathy?
- Is it fun to play?
- Does it feel like a live experience?
- Does it convey the main messages?
- Does it excite the player?

These design criteria are described in detail on what is included in each criteria, and how the WPI student game developers can meet that criteria in Appendix J.

Finding 19: A framework is the clearest method of presenting the right whale video game options to the NEAq and WPI student game developers.

Through meetings with our project sponsors at the NEAq, we decided that presenting our deliverable in the form of a framework would be the clearest method of presenting the vast number of options and information to the NEAq and the WPI student game developers. The compartmentalization of the potential audiences, educational content, main messages, platforms, character decisions, and narratives in a single document allows the NEAq to make informed decisions about the implantation of the right whale video game.

4.1 Conclusion

Through our research, we found the video game design and implementation requirements of the NEAq and the WPI student game developers. From our interviews and observations, we found preferences for types of games, feasibility, as well as game design suggestions. We used these findings to develop recommendations for the NEAq to decide on options for a video game and WPI student game developers to create the right whale video game.

CHAPTER FIVE: RECOMMENDATIONS AND CONCLUSIONS

Based on our findings and research, we suggest the following recommendations for the right whale video game. These recommendations are intended to guide the NEAq and the WPI student game developers to use our framework for considering their options for locations, intended audiences, platforms, narratives, and content details.

Recommendation 1: We recommend for the NEAq to have a right whale video game in the NEAq main visitor building.

We recommend the location of the right whale video game to be at the NEAq main visitor building to ensure that the video game gains the most exposure to people interested in aquatic life. This is based on the finding from the visitor profiles that the NEAq main visitor building has

more visitors than BHC whale watching tours. Although the NEAq website has more visitors than the main visitor building, visitors spend minimal time on the website according to the NEAq website statistics. Gaining the most exposure of the right whale video game is important to the NEAq to raise awareness about right whales.

Recommendation 2: We recommend for the NEAq to display the video game as a video game museum exhibit.

We examined different platform options and recommend a video game museum exhibit based on hardware availability at the NEAq main visitor building. The NEAq has a right whale skeleton that we observed but it does not provide visitors with the live experience they are looking for according to the visitor profile. Right whales cannot be held in captivity, therefore to give visitors the live viewing experience a video game museum exhibit would be suitable to capture the life of a right whale and the struggles they face. We recommend that the NEAq display the video game as a video game museum exhibit.

Recommendation 3: We recommend for the NEAq and WPI student game developers to create a role playing game.

We recommend a role playing game for the right whale video game. According to a research survey done by Bowen Research, role playing games are the most emotionally powerful in the sense that they allow the player to feel connected to the character (Bowen, 2011). A role playing game would allow the player to feel compassionate about right whales.

Recommendation 4: We recommend for WPI student game developers to use the sample narratives compiled in the framework as a guideline when designing the video game prototype

When developing the right whale video game, we recommend that the WPI student game developers use the sample narratives in the framework as a guideline to design the video game prototype. These narratives were developed by examining the North Atlantic Right Whale Catalog, interviewing a lobster fisherman, and interviewing the NEAq right whale expert. Each story offers a different character perspective on right whale conservation efforts. Our character

perspectives are limited to consumers, right whales, lobster fishermen, and ship captains involved with right whales. Due to time constraints we did not have the ability to brainstorm and develop other narratives in the perspectives of government officials, right whale researchers, and disentanglement team members.

Recommendation 5: We recommend for WPI student game developers to use the North Atlantic Right Whale Video Game Content document provided to them to accurately depict the environment of the video game.

To maintain the factually accurate priority of the NEAq, we recommend that the WPI student game developers use the North Atlantic Right Whale Video Game Content document to develop the environment of the video game. By interviewing the NEAq School and Community Programs Manager and the NEAq right whale expert we compiled a list of details in the form of a table to include for the WPI student game developers to have for reference before beginning the prototyping of the video game.

These content tables were provided because our finding that accuracy is a priority of the NEAq. By providing these content tables to the WPI student game developers as references for the visual design and programming, they can maintain accurate content in the video game.

Recommendation 6: We recommend for the NEAq and WPI student game developers to design a video game appropriate for all audiences with the content geared towards children.

We recommend that the WPI student game developers design a video game for all age ranges but gear the content towards children. This recommendation is based on our examination of the NEAq visitor profile that showed that there is a wide age range of people who visit the aquarium to bring their children. Therefore the video game is recommended to be for all audiences but the content be geared towards children. We also observed that a majority of the exhibits present in the NEAq main visitor building are designed for children based on the height and the visuals.

Recommendation 7: We recommend for the NEAq and WPI student game developers to convey the video game content in a hopeful tone.

We recommend that the WPI student game developers convey the video game content in a hopeful tone. This recommendation is based on an interview conducted with the NEAq School and Community Programs Manager who indicated that the NEAq does not want to traumatize their visitors with gory details of right whale entanglements and ship strikes. The NEAq would rather provide their visitors with a hopeful outlook on the future of right whales.

Recommendation 8: We recommend for the NEAq to make informed decisions about the production of the video game by using the framework.

For our sponsors to consider their options for developing a right whale video game, we created a framework. Our framework includes video game design criteria, locations, audiences, platforms, types of games, narratives, and content details.

We recommend using the framework to make informed decisions that will fulfill the first steps to create a video game. This is based on our meetings with our sponsors to give them options to consider along with our recommendations. The variety of information presented by our research was suggested to be presented in this framework. The framework can be found in Appendix J.

Recommendation 9: We recommend for the WPI student game developers to convey the main messages and concrete actions as outlined in the framework.

Our main messages and concrete actions were developed from speaking with our NEAq sponsors. These main messages and concrete actions follow the purpose of the video game to raise awareness about what right whales are, how they are endangered, and how we as a community can support efforts to create a safer and healthier ocean for right whales. Our research on conservation behavior verifies that providing concrete actions is the most effective way to create behavioral change.

5.1 Recommendations for Future Projects

We recommended both video game design suggestions and future projects for the right whale video game.

5.1.1 Video Game Design Suggestions from the "Brown Bag"

We presented our framework to NEAq staff who wanted to learn about our project and provide their input for the future game design. We compiled a list of their recommendations for the WPI student game developers to consider when designing the video game:

- Use a web-based game that is non-platform specific so it could be placed in many different locations.
- Have the game be multiplayer (probably an MMO, massively multiplayer online game) where there is one ocean and each player choses their character that affects other characters. For example, one player could be a fisherman setting the buoys, and another player could be playing as a whale that then encounters those buoys and gets entangled. This will show how the player's actions affect others living in the ocean.
- If the game characters are built in a high-quality and modular way, it may be easier to incorporate more characters as the game is expanded (by possibly multiple groups).
- It is important to end with concrete actions the players can do to help the whales. i.e. know where your seafood comes from, know if a lobster fishermen sells you sustainably caught lobster.
- Be careful of always having a happy ending. Find a balance between not wanting to traumatize the audience, and showing that there are real threats to right whales.
- Future projects could be to use the video game in the classrooms or at the NEAq education outreach programs.
- Start the home screen off with the whale skeleton as seen at the NEAq and then make it come to life in the video game for the exhibit, since it will be located under the skeleton.
- Make people leave the game feeling excited about right whales so that they will spread the word about right whales.
- Show the connection between consumers and the seafood they eat, emphasize eating sustainably caught seafood. Which helps reduce bycatch.
- Inspire change in consumer's choices.
- Important to show that even if you can't always see the ocean, you are still connected to the ocean through the actions you take.

- Have a game where you chose your role and then show how your actions directly impact other role options to create a sense of empathy for your character and sympathy for the other characters.
- Different take on entanglement is that boats get entangled too.
- Show the idea that if there is lots of gear in the ocean then the number of entanglements increase.
- Also add small vessels into the game to show that families can also take action and obey the speed restrictions in right whale habitats.
- It's a misconception that only large boats hit right whales.
- Have the game on the whale sponsor site to get the word about the game out.
- Advertise the game on the NEAq whale day program.
- Add game to tablet as a learning tool for teachers in their resource packet available to them at the NEAq.

5.1.2 Future projects to consider for the right whale video game

- For future projects, we recommend further research on the implementation of a mobile application for the whale watching tours and the NEAq main visitor building.
- For future projects, we recommend doing further research on putting a right whale video game on the NEAq website.
- A video game with multiple language options to accommodate international visitors at the NEAq.
- Once a video game prototype is complete, another project can be created to assess the success of the video game. This can be done by surveying users for their experience or observing number of plays or downloads.

CHAPTER SIX: CONCLUSION

North Atlantic right whales used to thrive along the east coast of the United States and Canada with a population estimating over 10,000 whales. Currently right whales are on the critically endangered species list with only around 500 individuals alive in the North Atlantic Ocean. Various organizations such as the National Oceanic and Atmospheric Administration,

Maine Lobstermen's Association, and the NEAq, are all working towards the conservation of right whales. The NEAq wants to make the public more aware of the endangerment status of North Atlantic right whales. The goal of our project is to address this need by assessing the feasibility and desirability of the implementation of a right whale video game. Through findings from our background research, field research, and analysis of the acquired data, we developed a framework to present to the NEAq and future project teams looking to create and implement such a video game. Each option in the framework reflects the impact of the video game technology on society's perception of right whale conservation. There are two outcomes we hope for. The first anticipated result is for the NEAq to use our framework and make an informed decision on whether and how best to implement the application of a right whale video game. The second result is for the WPI student game developers to use our guidelines in the creation of the right whale video game recommended by the sponsor. The combination of these two outcomes will hopefully help in the overall conservation efforts of the North Atlantic right whale.

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APPENDIX A: NORTH ATLANTIC RIGHT WHALE BIOLOGY

Information regarding the biology of right whales and the usual fishing methods practiced in the habitat of right whales are two key areas of information to be examined in the design of the video game.

Habitat

North Atlantic right whale habitat is along the eastern coast of the United States, including coastal areas such as Cape Cod Bay, Great South Channel east of Cape Cod, the Bay of Fundy, the Roseway Basin, and the area along the coast of Florida near Jacksonville. These are feeding and calving areas for right whales (Kraus & Rolland, 2007, p.18). Figure 5 depicts the right whale habitat.

Unfortunately for right whales, the areas with the highest food concentrations also have the highest concentration of pollutants. The name "urban whale" has been adopted for right whales because of the proximity of these areas to many nearby urban environments in the United States. The habitat of right whales tends to have high levels of pollution and contaminants. Studies have also shown that the northern parts of their rangealso has large amounts of calanoid copepods (Braham & Rice, 1984, 41).

Figure 5: Habitat of the North Atlantic Right Whale by Alex Helderman (2014)

Niche in the Food Chain

Right whales have evolved to fit into the role of the consumer of *calanoid copepods*, as shown in Figure 6, along with euphausiids and cyprids. *Calanoid copepods* are a small, transparent, type of zooplankton. In samples taken of ocean plankton, these are the most common type found (Calanoida, 2013).

Figure 6: Calanoid copepod from Begin, 2010

To consume them, right whales use their senses of salinity, water velocity, and temperature to detect where the highest concentrations of zooplankton congregate. Taking advantage of their specially-developed baleen, right whales can skim the surface of the seas or feed below the surface in order to consume massive amounts of prey. Right whales simply open their mouths and allow the millions of zooplankton to be filtered from the water by the baleen plates and become consumed. Right whale consumption of the population of *calanoid copepods* regulates the populations *calanoid copepods* (Baumgartner, Mayo, & Kenney, 2007, p.140).

Right whales have almost no natural predators, except for orcas and white sharks, who can attack calves (Braham & Rice, 1984, p.42). This may be due to the adult right whale's lethal size and strength. While humans are not natural predators of right whales, humans still cause most right whale deaths (Kraus & Rolland, 2007, p.23) due to entanglements, ship strikes, pollution, and climate change, which is explained in later sections. Adult right whales do not need to face any natural predators in a videogame, but they will have to protect their young from these dangers.

Life Cycle of Right Whale

Right whales begin their life relatively large in size, at about 12-14 feet long (Braham & Rice, 1984, p.39). This is the most dangerous part of a right whale's life, when the mortality rate

is between five to twenty-four percent. This is most likely due to natural predators, like sharks and orcas, who tend to prey on wandering calves (Kraus & Rolland, 2007, p.22-23). Juveniles become weaned within a year, at about twenty-six feet of length (Braham & Rice, 1984, p.39). Juveniles are also more susceptible to mortality from entanglement because they cannot break through the strongest ropes (see recent study by Knowlton, Hamilton, Marx, Pettis & Kraus, 2012).

Right whales spend their lives repeatedly diving to depths of up to 700 feet to feed on tiny copepods. Reaching this depth in the Bay of Fundy, many right whales tend to resurface with mud still on their heads. Right whales can live to an estimated 100 years of age if they can avoid death from human impacts. The oldest whale recorded was only about seventy years old but she had been struck by a ship and had a mortal wound when last sighted (Kraus & Rolland, 2007, p.22).

Carbon Storage Efficiency and the Whale Pump

Carbon storage are natural or artificial methods of storing carbon matter, important to the regulation of carbon dioxide in the atmosphere. Carbon storage is most efficiently done by large animals like right whales. According to a research article by Pershing et al, the populations of the baleen whales, such as right whales, historically stored about 9×10^6 tons more carbon before the whaling era compared to current times. Specifically, right whales are estimated to have exported over a thousand tons of carbon per year before the whaling era, while only exporting about 127 tons of carbon in the year 2001. Large whales are an efficient method storing carbon compared to smaller animals. If large whales were replaced by their less-efficient competitors, there would be a decrease in the biomass of the ocean community by thirty percent (The Impact of Whaling, 2010).

Another study in 2010 supports a phenomenon called the “whale pump”. The study explains the whale pump as the process by which whales fertilize the surface of the ocean. The data proposes that marine mammals are a major contributory factor in replenishing the nitrogen supply at the surface layer of the ocean, and that they were most likely an even greater factor in this cycle before the whaling era. Today in the Gulf of Maine and presumably other regions, this nitrogen is often the limiting factor in the growth of phytoplankton, the foundation of life in the

ocean. Therefore, the whale pump is important to phytoplankton growth, as shown in Figure 7 (The Whale Pump, 2010).

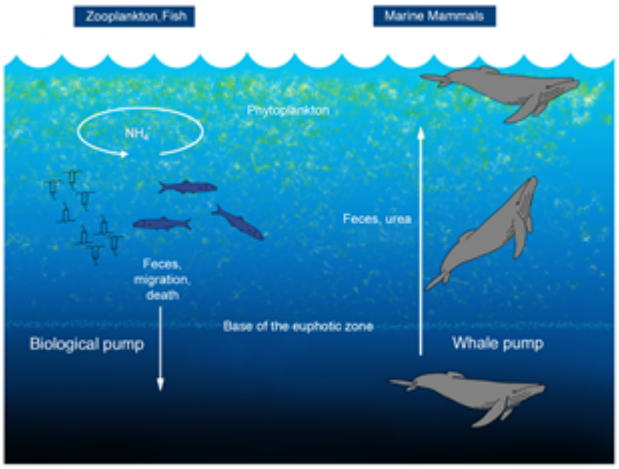


Figure 7: Proposed cycle of the whale pump from The Whale Pump, 2010

Characteristics of Right Whales

Besides serving an important role in the food chain, right whales also represent the biodiversity of its habitat. There are three species of right whales—the North Atlantic, North Pacific, and Southern right whale within the genus *Eubalaena* (Braham & Rice, 1984, p. 39-40). Right whales have unique stocky form and bowed lower lips. Unlike other whales, right whales also have no dorsal fin. They have lice-infested callosities (roughened skin patches) upon its head and jaw region. Right whales are the only whales to sometimes "skim" zooplankton from the surface of the water (NOAA Fisheries, 2014). These are features that make the appearance of right whales unique.

APPENDIX B: COMMON FISHING PRACTICES IN THE NORTH ATLANTIC OCEAN

According to the Food and Agriculture Organization of the United Nations, which collects statistics relating to worldwide fisheries, there are several types of vessels common to the North Atlantic. The vessels most pertinent to the project are the trap setters and the netters (CWP, 2002). Other vessels listed include:

- trawlers
- seiners
- dredgers
- gillnetters
- lift netters
- line vessels
- trap setters
- handliners

These vessels are operated in the same regions that right whales inhabit. Each has its own special advantages or target fish. For example, trawlers are commonly used to fish for shrimp by dragging a trawl (a kind of net) through the water. Seiners create an enclosing net to capture schools of fish, and dredgers drag metal gear along the floor to gather mollusks. More information about each type of vessel and frequently used gear are found in the appendix. Of all the vessels listed above, the most relevant kind of vessel in the entanglement of right whales is the trap setter (CWP, 2002).

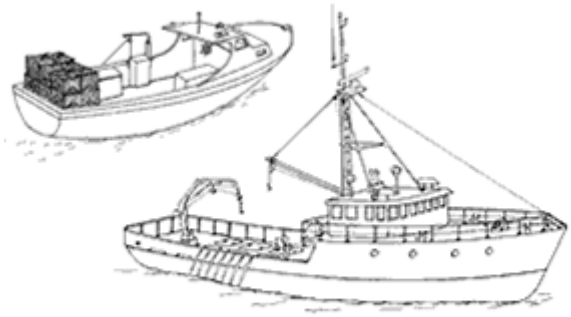


Figure 8: Two variations of trap setter from CWP, 2002

Trap setters are vessels commonly used to fish for lobster, although they are also used to trap crabs and other kinds of fish. They come in a variety of sizes and usually have some on-board deck equipment specialized for bringing up traps, such as cranes or simple mechanical or hydraulic blocks. The trap setters navigate according to the captain's knowledge of the locations

of their target fish, before stopping and setting the traps into the water. Several hours, or even days later, the vessel returns to check the traps before releasing the traps again nearby (CWP, 2002).

Lobster fishing is accomplished using a lobster boat. The process can be done using a single warp or a multi-trapped trawl. In the case of a single trawl, the cage is tied by long rope to the buoy, which has been painted or marked (CWP, 2002). The configuration for a multi-trap trawl is shown below:

Figure 9: The method of deploying lobster traps, Photo Credit: Kady Ferguson, 2014

The above figure illustrates one method of lobster trapping, using multiple pots. In this configuration, many pots are connected via ground line to the main buoy line, also called the trawl line. These buoy lines and the ground lines connecting to the cages are the primary cause of entanglement in right whales (Galiano, 2008).

APPENDIX C: SEVEN-STEP METHOD TO DEVELOP A CREATIVE CONCEPT

Adapted from Friedmann (2014) *Writing for Visual Media,* the Seven-Step Method to Develop a Creative Concept was used to guide what was needed in our framework to allow the NEAq and WPI student game developers to produce a right whale video game.

Table 9: Adapted from Friedmann, (2014) Writing for Visual Media

Seven-Step Method to Develop a Creative Concept
Define the Communication Problem: What is the need? Have you stated a problem for the potential target audience in terms of something they do not understand, don't know, don't want to know, or could not know until you tell them with your video or other communication?
Define the Target Audience: Who is the message for Have you stated all the demographic characteristics of your audience such as age, gender, race and ethnic origin, education, and income?
Define the Objective: Have you stated a communication objective that is informational, motivational, and behavioral, or some combination of those?
Define the Strategy: How is the message going to be communicated? Does it grab the audience's attention? Does the idea achieve the objective?
Define the Content: What goes into the concept? Is the content about the objective?
Define the Appropriate Medium: On what is the concept being communicated on?
Create the Concept: Does the concept answer questions raised in the previous steps?

APPENDIX D: STORIES OF SPECIFIC WHALES: WART, SHACKLETON & CALVIN

The NEAq's right whale catalog will be used to decide which right whales have emotional and intriguing stories to be used in the video game storyline. For example: "Wart" (Catalog No. 1140), a female right whale, first appeared in 1981 and began to help scientists understand just how far these whales can travel in a short amount of time. She has birthed at least six calves, one of which is a young male named "Shackleton" who traveled around to historical feeding places with his mother. Being quite the adventurer, young Shackleton traveled up the Delaware River more than 100 miles away from the ocean only to encounter a maze of piers and pens at the Hess Oil Corporation in Pennsauken, New Jersey along with several vessels he had to maneuver around. Shackleton was unfortunately hit by a tug leaving a large propeller scar on his left shoulder, and for a year and a half scientists wondered if he ever survived, until he was spotted a year and a half after the incident (North Atlantic Right Whale Catalog, 2014).

Another right whale, Calvin, fittingly named after the character in *Calvin and Hobbes,* is known for her unlikely survival as she escaped death numerous times. As a young calf Calvin was orphaned when her mother, Delilah, was killed by a ship strike in the Bay of Fundy. Because of how young Calvin was, many did not think she would survive without her mother. Remarkably, Calvin survived but her struggles were not over quite yet. In 2000 she was faced with entanglement by fishing gear. Fortunately, the Provincetown Center for Coastal Studies disentangled her in 2001, but she was left with scars on her head and body. Calvin has been sighted several times since then, and now has a new addition. In 2005, Calvin had her first calf, and brought her youngling to the Bay of Fundy just as her mother had done many years earlier. Calvin's story is one of the reasons why shipping lanes in the Bay of Fundy have been moved to prevent future strikes with the local whales (NEAq, 2014).

Wart, Shackleton, and Calvin's stories are just one of many examples found in the right whale catalog that can be used in the educational video game storyline to demonstrate right whale interactions with humans.

APPENDIX E: INTERVIEW GUIDE THE NEAQ VICE PRESIDENT OF PROGRAMS, EXHIBITS AND PLANNING

Activity	Comments/Questions	Approx. Time
Introduction	Introduce Self: Hello, my name is _____, and this is _____. As you may know, the goal of our project is to plan a video game storyline to raise hope for the conservation of right whales. With your permission we would like to conduct a confidential interview in order to learn about exhibit planning and how it relates to our project. This would help us in planning out an engaging video game about right whales. Your identity will be kept confidential as we are not taking names from our participants. We will not share your personal information. Goal of interview: To understand the exhibit-planning process, what makes an exhibit engaging, and to find suggestions for our project	5 min
Structured topics	Topic 1: Exhibit-Planning Background What does the exhibit-planning process look like at the aquarium? How long in advance are exhibits planned? How do you decide whether an exhibit should be implemented? How much space is available at the aquarium, and where? What are qualities of the most engaging exhibits? Are there specific exhibits geared towards specific audiences? Which exhibit do you think is the most engaging? Why do you think this exhibit is engaging to the visitors? Which exhibit do you think is the least engaging? Are there any exhibits you expected would get more attention from visitors? Topic 2: Connecting to our Project How familiar are you with our project? What would you suggest for an interactive right whale exhibit like ours? What platform do you recommend? Would a poster linking to an app be feasible? What are our chances of getting an exhibit for right whales in the aquarium?	30 min
General questions		10 min

Closing comments	Thank you for taking the time to share your opinions and experiences with us. Would you like to be updated on our project? Since we are only in the planning phase, it may be a while until the actual game is launched. A different group will be taking this project over, but we can still keep you in the loop.	5 min

APPENDIX F: INTERVIEW GUIDE WITH LEAD NATURALIST AT BOSTON HARBOR CRUISES (BHC)

Activity	Comments/Questions	Approx. Time
Introduction	Introduce Self: Hi My name is _____, and I am a student from WPI (Worcester Polytechnic Institute) and this is _____.We are currently working on a research project for the New England Aquarium in order to raise awareness about the endangerment status of the right whale. The goal of our project is to plan an empathetic video game storyline in order to raise hope for the conservation effort of right whales. With your permission we would like to conduct a 5 minute confidential interview in order to get your opinions about how to create an engaging atmosphere during the downtime for whale watchers. This would help us in planning out an engaging video game about right whales. Your identity will be kept confidential and we will not share your personal information. Goals of interview: get opinions about how to create an engaging atmosphere during the downtime for whale watchers. Brief, semi-structured interview Not all questions listed below may be asked.	1 min
Structured topics	Topic 1: Background on BHC Tours: How long have you been with BHC? How can we obtain a visitor profile for the whale watching tours? Topic 2: Engagement Level on Whale Watching Tours How do you try and engage the customers during the tour? What techniques work for them? What do they like or dislike? Topic 3: App for Whale Watching Tour Is there internet service aboard the ship? Do people usually have their phones out when they are going whale watching? Do you think people would like an app to play while there is downtime aboard the ship? Any questions?	5 min

APPENDIX G: INTERVIEW GUIDE FOR BHC WHALE WATCHING TOURS

Activity	Comments/Questions	Approx. Time
Introduction	Introduce Self: Hi, my name is _____, and I am a student from WPI (Worcester Polytechnic Institute) and this is _____. We are currently working on a research project for the New England Aquarium in order to raise awareness about the endangerment status of the right whale. The goal of our project is to plan an empathetic video game storyline in order to raise hope for the conservation effort of right whales. With your permission we would like to conduct a 5 minute confidential interview in order to get your opinions about how to create an engaging atmosphere during the downtime for whale watchers. This would help us in planning out an engaging video game about right whales. Your identity will be kept confidential, as we are not taking names from our participants. We will not share your personal information. Goal of interview: To find out if whale watchers would be interested in an app to play during downtime on the tour.	30 sec.
Structured topics	Topic 1: Background on Participant • Is this your first time going whale watching? Are you excited? • Why did you choose to go whale watching today? • If you have been on a whale watching tour before, did they provide you with something to do during the downtime going out to the ocean, or coming back to shore? Topic 2: Activities on the Whale Watching Tour: • Would you be interested in having something to do while there is downtime on the tour?	3 min
General questions	Open dialogue with participant if they wish to elaborate on past whale sighting experiences.	1 min
Closing comments	Thank you for taking the time to share your knowledge.	30 sec.

APPENDIX H: INTERVIEW GUIDE FOR THE NEAQ RIGHT WHALE EXPERT

Activity	Comments/Questions	Approx. Time
Introduction	Introduce Self. Goals of interview: to understand the right whale's ecosystem and discovering the most appealing stories of right whales. Semi-structured interview. Information recorded from this interview will be used to develop right whale content for the video game (See Objective 4).	5 min
Structured topics	Topic 1: Background How long have you been working with right whales? What does the environment of the right whale look like? Is it rocky, sandy, or filled with coral reefs? What sort of ocean life does the right whale encounter or interact with? Topic 2: Context of Work Which right whale is your favorite? Which right whale story seems the most touching to you? Do you have any other specific stories about right whales? Topic 3: Specific to our Projects Do you believe that right whale story would be a suitable basis for our video game storyline? What would you like to see in our video game storyline? How do you believe an average person could help in the whale efforts?	30 min
General questions	Open dialogue with participant: right whale stories, content information useful for the video game	20 min
Closing comments	Thank you for taking the time to share your knowledge. Would you like to be updated on our project?	5 min

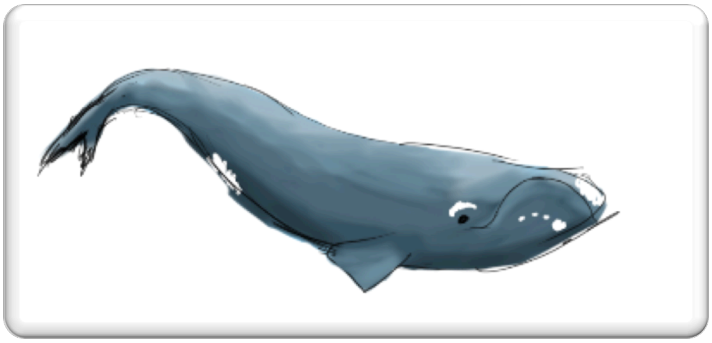
APPENDIX I: INTERVIEW GUIDE FOR MAINE LOBSTERMEN

Activity	Comments/Questions	Approx. Time
Introduction	Introduce Self. Goals of interview: open-ended, opinion based questions to get a better understanding of lobstermen's attitude towards whales. Semi-structured interview. Information recorded from this interview will be used to develop accurate depictions of a modern day lobster fisherman ideals specifically towards whales	5 min
Structured topics	Topic 1: Background How long have you been a lobster fisherman? What do you like about your work? What don't you like? What do you do as a Lobster fisherman? What gear do you use? Topic 2: Context of Work In the years that you have been a lobster fisherman, have you encountered any whales or any other large marine mammal? What was it like? How has is affect your work? Business? Equipment? What would you do if you ever encountered a whale (again)? How will it make you feel? If encountered before, what would you do differently the next time? What would you like people to know about lobstermen? (as a character) Topic 3: Effects of Current Laws Can we ask you a few questions on how you feel about current laws? How do you feel about them? How do they change your work? Do the new laws change how you interact with whales?	30 min
General questions	Open dialogue with participant	20 min

Closing comments	Thank you for taking the time to share your opinions and experiences with us. Would you like to be updated on our project? Since we are only in the planning phase, it may be a while until the actual game is launched. A different group will be taking this project over, but we can still keep you in the loop.	5 min

APPENDIX J: FINAL DELIVERABLE TO THE NEAQ

A FRAMEWORK TO DEVELOP A NORTH ATLANTIC RIGHT WHALE VIDEO GAME



"Right Whale Drawing" by Alex Helderman

Date: October 16, 2014

Submitted by:

Elior Anina
Kady Ferguson
Alex Helderman
Ray Wang

Approved by:

Professor Jennifer McWeeny
Professor Seth Tuler

What is in this Guide:

I. Document Overview

In partial fulfillment of the requirements for the our undergraduate degree, we worked with the New England Aquarium (NEAq) as a sponsor to develop a framework to help the NEAq make informed decisions for the North Atlantic right whale video game. The purpose of the video game is to raise awareness about what right whales are, why they are endangered and how we as a community can support efforts to create a safer and healthier ocean for right whales. We researched the essential components on how to make a video game that include (Friedmann, 2014):

1. Idea
2. Audience
3. Location
4. Platform
5. Content
6. Storyline
7. Visual Design
8. Programming
9. Prototype
10. Testing
11. Distributing

The initial idea behind the video game is a virtual simulation of large whale entanglements created by experts at BelleQuant Engineering. Dr. Laurens Howle leads the team in creating an interactive "game-style" computer program in order to better understand whale behavior when encountering fishing gear (Howle, 2012). The scope of our project was to complete the first six steps, then WPI student game developers majoring in Interactive Media and Game Design (IMGD) and Computer Science (CS) will create the visual design and produce a video game prototype for the NEAq. We worked on the background details of recommending an audience, location, platform, content, and storyline. These were delivered to the NEAq in this report. We also provided content tables that will help the WPI student game developers make the visual design for the video game. Our recommendations are intended to help the NEAq make informed decisions about the video game design, and help the WPI student game developers prototype the right whale video game.

II. Why a Video Game?

The key to learning, researchers found, is what they call "engagement." When engaged, a person is engulfed in their activity with an immense amount of excitement (Csikszentmihalyi, 1995). This suggests that the ability of an activity to engulf, immerse, excite, and therefore engage the audience is an important factor in their education. One exciting way to engulf a person in a learning activity is through video games (Bowen, 2011). Through balancing challenges and abilities, video games can create the excitement necessary to engage all audiences into a "flow zone" where they are completely immersed in a topic and have the highest learning potential (Chen, 2007).

The current video game industry is estimated to bring in $40.8 billion in revenue in 2014 (Kahn, 2014). With 195 million people identifying themselves as gamers in North America alone and a ten percent increase in market value from 2012 to 2013 suggest that video game popularity is still increasing (Statista, 2013). We want to take advantage of this current booming industry. Games in general produce a lot of excitement: 78% of gamers ranked role-playing games as

"emotionally powerful" (Bowen, 2011). Video games create the excitement necessary to engage the audience, and help them learn valuable lessons. We can use the excitement and engagement video games create to help raise awareness about the threats right whales face

III. Video Game Audiences and Locations

Video games exist in a virtual world and can be played just about anywhere. To narrow the scope of our project we focused the potential locations for the video game to where our project sponsor is located: Boston, MA. Before deeply assessing several museum options and websites we decided based on an interview with the NEAq Vice President of Exhibits, Programs, and Planning to focus our investigation on the locations where people are interested in learning about the ocean and sea creatures. From this focus, we narrowed down a set of options for the NEAq to consider. These locations include: the NEAq main visitor building in Boston, MA, the NEAq website, and the whale watching tour boats presented by Boston Harbor Cruises. Our meetings with the NEAq staff lead to the discovery that to raise awareness about right whale endangerment we need to reach the most people at these locations where people show interest in aquatic life. To best narrow down the focus to one location we examined the number of people who visit each location. According to the visitor profile the NEAq main building had about 1.3 million visitors last year whereas the BHC whale watching tours had 120,000. The NEAq website had 7.7 million visitors last year, but the most frequented page was the homepage for approximately two minutes which does not ensure the visitor would have enough time to locate and play the right whale video game. The NEAq main visitor building is the location that has the most visitors who can be exposed to the right whale video game.

After assessing the locations, we researched and observed the audience age ranges that visit the physical sites. Based on the observations and visitor profiles from the NEAq we found that people of all ages visit the three locations and that the video game must be suitable for a general audience in terms of visual design, language, and content..

IV. Main Messages for the Video Game

We discussed the main messages for the video game with the sponsors at the NEAq. Through the use of visual displays and video game activities, we suggest that the following messages be presented to the audience:

1. Right whales are endangered baleen whales.

Right whales became critically endangered due to the whaling era that brought their population from a thriving 10,000 whales to about 500 today. Today they live in close proximity to commercial seaports and fishing areas along the east coast of the United States and parts of Canada where ship strikes and entanglements in fishing gear exacerbate their endangerment status.

2. Personal decisions can reduce our impact on right whales.

We are always connecting with the ocean and many of our choices can impact aquatic life.

3. Conservation research and regulations can make a difference in the conservation of right whales.

To diminish the effects of right whales living along an urban coast, conservation efforts, like changes in shipping lanes and speed restrictions, have resulted in the reduction of right whale deaths. Researchers and lobster fishermen are working in collaboration to improve fishing techniques and materials to reduce entanglements.

4. As a community we can support efforts to create a safer and healthier ocean.

We can help preserve the biodiversity of the ecosystem by taking action. People like you can give right whales a chance to survive by eating ocean friendly fish and learning more about where your seafood comes from.

V. Educational Content for the Video Game

We recommend the video game storyline should show the following educational content in Figure 1 by either having the objects in the background visually, or directly describing the object to the viewer through text.

Figure 10: Educational Content

Right Whale Facts
• Appearance • Physical size • Feeding habits • Reproductive cycle • Surface active groups • Migratory patterns • Habitat • Carbon storage • Lifespan • Vocal calls • Whale relationships

Right Whale Vulnerabilities
• Slow reproduction rates • Live in an urban area making them susceptible to entanglement in fishing gear, and noise pollution • They are slow relative to cargo ships, making them susceptible to lethal ship strikes • Positive buoyancy

Actions the Public Can Do to Help Right Whales
• Raise awareness and hope for the conservation of right whales. • Eat ocean friendly seafood. • Learn more about where seafood comes from. • Follow current research on right whales.

Atlantic Ocean Facts
• Appearance • Location of right whales • Sea creatures • Activities (ships + boats)

Right Whale Threats
• Endangered Species • Entanglement by fishing gear • Ship strikes • Historical whaling era • Changes in food supply from climate change • Noise pollution

Lobster Fishermen Facts
• Daily jobs • Appearance of fishing gear • Appearance of boats • Location relative to the right whale • Modifications to fishing gear • Lobster-Fishing regulations • Impact on time, money, and safety • "ghost" gear

Shipping & Receiving Facts
• Appearance of boats (large and small) • Location of routes relative to right whales • Modifications in routes • Impact on time and money

VI. Different Platform Options for the Video Game

We considered five platform options that video games can be played on that included: consoles, such as Xbox; hand held devices, such as a Gameboy; desktop computers; mobile apps for a phone or tablet; and interactive museum exhibits. We narrowed the platforms down to three platforms based on the hardware and available space at our three locations: the NEAq main visitor building, the NEAq website, and the BHC whale watching tours. The following are general descriptions of the three platforms:

Video Game Museum Exhibit: A game designed to be played at the museum near its corresponding exhibit. This can either be a desktop or mobile application setup, however

its intended playtime is much shorter than a desktop or mobile application due to the nature of visitor behaviors at museum exhibits; visitors tend to spend two minutes or less at each exhibit based on observations performed at the NEAq main visitor building. The average playtime for a museum exhibit game is about one to three minutes.

Mobile App: A game designed to be played on a mobile device such as a phone or tablet. Games of this type are uploaded to an app store, where it is available to anyone with a device that can access the app store. Google, Microsoft, and Apple devices all have separate app stores. Distinctions from desktop applications and museum exhibits include: user input is generally from touch screen, users have the ability to use a phone's other sensors to sense tilt or geographical location, and users can play anywhere they take their mobile device. The playtime for a mobile app normally ranges from five to twenty minutes.

Desktop application: A game designed to be a played on a computer. This can be either a stand-alone application that can be downloaded and installed on a computer, or a web browser based application that can be loaded on a webpage. Distinctions from mobile app and museum exhibits include: can support more processing demanding applications, is most likely to have the player's full attention for the longest duration, and uptakes user input generally from mouse and keyboard. The playtime for a desktop application has the largest average playtime from fifteen minutes to an hour.

VII. A Comparison of Platforms

Table 1 compares each platform based on the playtime, audiences best suited for the type of platform, location of where to place the platform, pros and cons of using this platform, and pros and cons of how feasible the platform is to design and maintain a video game on. The NEAq can use this chart to compare options and determine which platform they believe would suit their needs. At the end of the chart we provided our recommended platform and location combination.

Table 10: Platform Comparison Chart

Platform	Museum Exhibit Supplement	Mobile App	Desktop Application
Playtime	• 1 min – 3 min	• 5 min – 20 min	• 15 min – 1 hour
Audience	• All ages	• All ages	• All ages
Location	• NEAq main visitor building	• NEAq website • NEAq main visitor building • BHC tours	• NEAq website
Pros of Using this Platform for the Audience	• Exhibit highlighting right whales to go along with the skeleton to give visitors live experience • More presence about whales and integration of NEAq research with visitor engagement • Immediate game climax, allows the point to come across directly • Fills the gap that live right whales cannot be held in captivity	• Quickly engaging • Lots of exposure to the public • Can have multiple levels/goals • Can have difficulty levels for all audiences • Can be played anywhere	• Longest playtime can create lasting engagement • Can send multiple messages
Cons of Using this Platform for the Audience	• Limited exposure to audiences, i.e. only a few guests could play at a time. • May not be able to engage passerby visitors	• If advertised only at NEAq site or website it may be missed • People like family time while at the NEAq or BHC and would rather not be on their phones or tablets.	• Can be a hit or miss with the amount of exposure (depending on where/how the game is advertised)
Feasibility: Pros	• Shortest to program • Can have complex program because of the length of the game	• Manageable by WPI students to create 1 or 2 good levels • Minimum cost for advertisement posters or webpage link • Readily available for the public • Potential to be sold to users	• Not costly to advertise with posters or on the NEAq website • Potential to be sold to users
Feasibility: Cons	• Demands more time and money from the NEAq to implement a touch screen display • Will not be readily available for public use • Requires staffed technical support	• Dark in NEAq making hard to advertise • Low number of user downloads based on the 92 Penguinology QR code downloads • Requires staffed technical support	• Will take the most time to program • Will not be readily available to public • Requires staffed technical support

VIII. Our Recommended Platform

We recommended a museum exhibit to supplement the existing right whale skeleton suspended between the first and second floor of the aquarium. Figure 10 shows the existing North Atlantic right whale skeleton and display board. We recommended placing a touch screen exhibit, similar to the Blue Planet Action Center panels in Figure 11, to allow visitors to play the video game while observing the skeleton. According to the NEAq visitor profile, the exhibits visitors come to see at the NEAq are all live animal exhibits such as *Penguins, Sharks,* and the *Giant Ocean Tank.* A right whale cannot be contained in a live exhibit at the aquarium and using this exhibit will give the visitors an approximation of a live experience that they are looking. This exhibit can also provide a chance for the NEAq to demonstrate the research they do on right whales. Additionally, by using a touch screen based platform then future projects will have the ability to use the original game designed for the NEAq main visitor building to expand the game into a mobile app or other platforms.

(Left) Figure 11: North Atlantic Right Whale Skeleton at the NEAq
(Right) Figure 12: Blue Planet Action Center Touch Screen Panels

IX. Criteria for Designing a Video Game on Right Whales

We recommended using a set of criteria to meet the needs of a fun and educational right whale video game. Based on research on what makes a good video game, we developed the criteria in Table 2 for designing a video game. Our research reflected that the main goal in developing a video game is to have the player experience the "Flow Zone" where an equal balance of challenge and ability are presented in the game (Chen, 2007). Ccommon techniques to get a player into the "Flow Zone" include (Chen 2007):

- A challenging activity requiring skill
- A merging of action and awareness
- Clear goals
- Direct, immediate feedback

- Concentration on the task at hand
- A sense of control
- A loss of self-consciousness
- An altered sense of time

To make the video game effective and engaging at conveying the suggested main messages to the audience in a way that will inspire and empower them to conserve right whales, we developed a set of seven criteria for the video game design based on the research and suggestions from NEAq experts and the School and Community Programs Manager. These criteria were chosen because they will promote the design of a full right whale experience that is not only captivating, but educational as well. The criteria are posed as questions that the NEAq and WPI student developers can answer when designing and evaluating the right whale video game:

1. Is the game factually accurate?
2. Visually appealing?
3. Does it create empathy?
4. Is it fun to play?
5. Does it feel like a live experience?
6. Does it convey the main messages?
7. Does it excite the player?

Table 11 provides guidelines to help answer those questions that the WPI student developers of the video game can use to design and evaluate the video game prototype.

Table 11: Rubric to Evaluate the Video Game Design

	Meets the Criteria *All the elements are fully expressed/ developed.*	**Somewhat Meets the Criteria** *Most of the elements are fully expressed/ developed.*	**Does Not Meet the Criteria** *Only some of the elements are fully expressed/ developed.*
Factual Accurate descriptions of: • Right whales • Environment • Behavior • Key Players	Accurate portrayal of right whales interacting with the environment and the key players.	Accurate right whales and their behavior, but the environment is not fully developed to contain all the elements of the key players.	Accurate right whales, but does not portray their behavior, environment, or key players.
Visually Appealing • Colorful • Detailed images • Variety of subject matter • Majestic portrayal of right whales • Beautiful (e.g. Mona Lisa)	The video game is detailed in every aspect with a variety of color and objects to look or interact with.	There is not a variety of subject matter, but the subjects that are present are detailed and colorful.	The subject matter is plain without variety.
Empathetic • Allows a person to feel as if they are in the position of the whale or other characters	The design makes the person feel as if they are in the game, facing the struggles of the right whale or other characters completely.	The game is in the perspective of the right whale or other characters, but does not feel real to the player.	The game is not a role playing game in the perspective of a right whale or other characters.
Fun • Contains challenges, rewards, and goals • Includes the whole family • Creates laughter	The game has many challenges, rewards and goals to keep the player(s) playing the game and focused. The game is fun for everyone and creates a bonding experience for friends and family.	The game has one challenge/goal for the player to achieve. The game is fun for everyone, but does not create a bonding experience.	The game does not have any challenges, goals, or rewards. Does not make the player laugh or create a bonding experience.
Immersive • Simulate live experience	The game makes the player feel as if they are having a live experience as a right whale.	The game shows a live experience, but the player does not feel connected to the whale.	The game does not provide a live experience.

(Table 2 Continued)

Main Messages • Right whale endangerment • Connection to the ecosystem • Conservation efforts • What we can do	The game conveys all the main messages through either telling them, or allowing the player to make their own connections.	The game conveys the messages of right whale endangerment and the conservation efforts, but not how we are connected to the ocean or what we can do to help.	The game conveys the right whale endangerment message, but does not have conservation, connection or action plan.
Player Experience • Positive • Hopeful • Empowering • Inspiring • Knowledgeable • Connecting with Others (family, researchers, etc.)	The game leaves the player excited about right whales, hopeful that they can help them, and empowers them to share their knowledge with others.	The game leaves the player knowledgeable about right whales, but not excited about saving them.	The game traumatizes the player by only showing the causes of endangerment and not how to save them.

X. Summary of Recommendations

The NEAq visitor profile suggests visitors are mainly attracted to the live animal exhibits at the main visitor building. Right whales cannot be kept in captivity, but a role-playing right whale video game exhibit can simulate a live experience. The game design criteria can quickly engage and entertain visitors to encourage them stay at the exhibit. Levels, goals, challenges, and quick results can make them continue playing as they enter can into the "Flow Zone" where they would be completely immersed in the game and where the most learning is occurring (Chen, 2007). The immersion in a roleplaying game will make the player aware of the struggles right whales or other characters face and feel compassion for right whale conservation (Bowen, 2011). The concrete actions can appear to the player to act on their compassion for right whale and create the most behavioral change (Costanzo et al. 1986). These concrete actions can show the player how to help make the ocean a safer and healthier place for right whales.

XI. Video Game Storyline

We recommended using our storyline as a general idea for the video game, but encouraged the WPI game developers to create a prototype of the video game that builds on our idea. A storyline consists of the timeline, narratives, and related content of the setting. We have also provided a set of character decisions the WPI student developers can use to make their own storyline.

We have proposed an example of a timeline, shown in Figure 18, and six separate narratives that make up the storyline. The narratives include perspectives of two consumers, a lobster fisherman and a ship captain. There are other perspectives to consider such as a researcher, a disentanglement team member, a lobbyist, an environmentalist, an educator, and other consumers. It is important to consider human characters from different genders and ethnicities to provide a wide range of characters that the players can relate to.

Our proposed storyline takes place in the North Atlantic Ocean off the east coast of the United States and Canada. Two right whales are traveling from Florida to the Bay of Fundy. During the adventure, the right whales interact with several characters along the way. Each character they encounter has their own side of the story where we as readers understand what brought them to the right whales. The characters the right whales encounter are a lobster fisherman, a cargo ship captain, and a consumer.

The right whale Snowball is a real right whale. We learned that Snowball has a scar on his lip and postulated a story for how he got that scar; however, we do not know the exact circumstances of how he received his scar. We based his story off of how researchers believe right whales spend their time in the North Atlantic Ocean, but there is still some speculation about their daily lives because of the obvious difficulty in tracking each whale every day of the year and the fact that most of their lives are spent underwater and out of our sight when we are in near proximity. Wharf is a fictional whale we created for the purposes to demonstrate all the threats right whales face.

XII. Character Decisions

Through discussions with our NEAq sponsors we complied a series of decisions potential characters can make and how they might affect right whales. In our storyline narratives, we used one or two of the main character decisions to highlight, but we wanted to express there are more options to consider.

The character decisions for a right whale in Figure 13 are arranged differently than the rest to show how right whales do not make these decisions, but live their natural life and encounter the repercussions of other character's decisions.

Figure 14 depicts a ship captain deciding whether or not to follow speed restrictions, and what can happen when the decision is made. Ship captains can also decide whether or not they decide to follow the designated shipping lanes, or report right whale entanglement and ship strikes. The latter is important to highlight because many ship captains do not report right whale entanglements or ship strikes for fear of the repercussions.

In Figure 15 the lobster fisherman decisions are limited because under each modification changes there are varying levels of how much modification they do. The more modifications they do, the less risk there should be to right whales. For example: if they only mark their gear but do nothing else, then the risk to whale remains high. If they also using sinking groundlines, the risk is slightly reduced. If they do all three, risk is even more reduced. And if they don't set gear or use ropeless fishing, then risk to whale is none. Also, similar to the ship captain, there should be something about reporting the entanglement. Many fishermen do not report for fear of repercussions but I think this is something we need to encourage.

Figure 16 describes how a disentanglement team goes about disentangling a right whale. What the chart cannot outline is the stress and risk a disentanglement team undergoes when trying to locate and disentangle a whale without harming themselves or the whale any further. The chart also does not include when teams are sadly unable to save a whale.

Figure 17 includes additional characters and decisions they can make that will affect right whales. These characters were not fully developed as a project limitation.

Figure 13: Right Whale Decisions

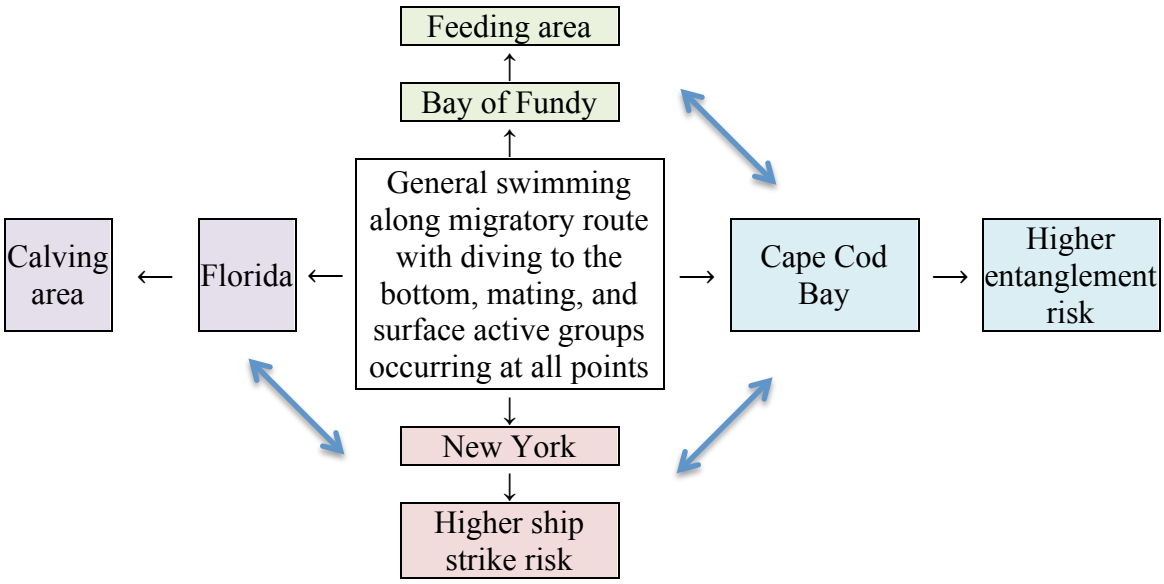


Figure 14: Ship Captain Decisions

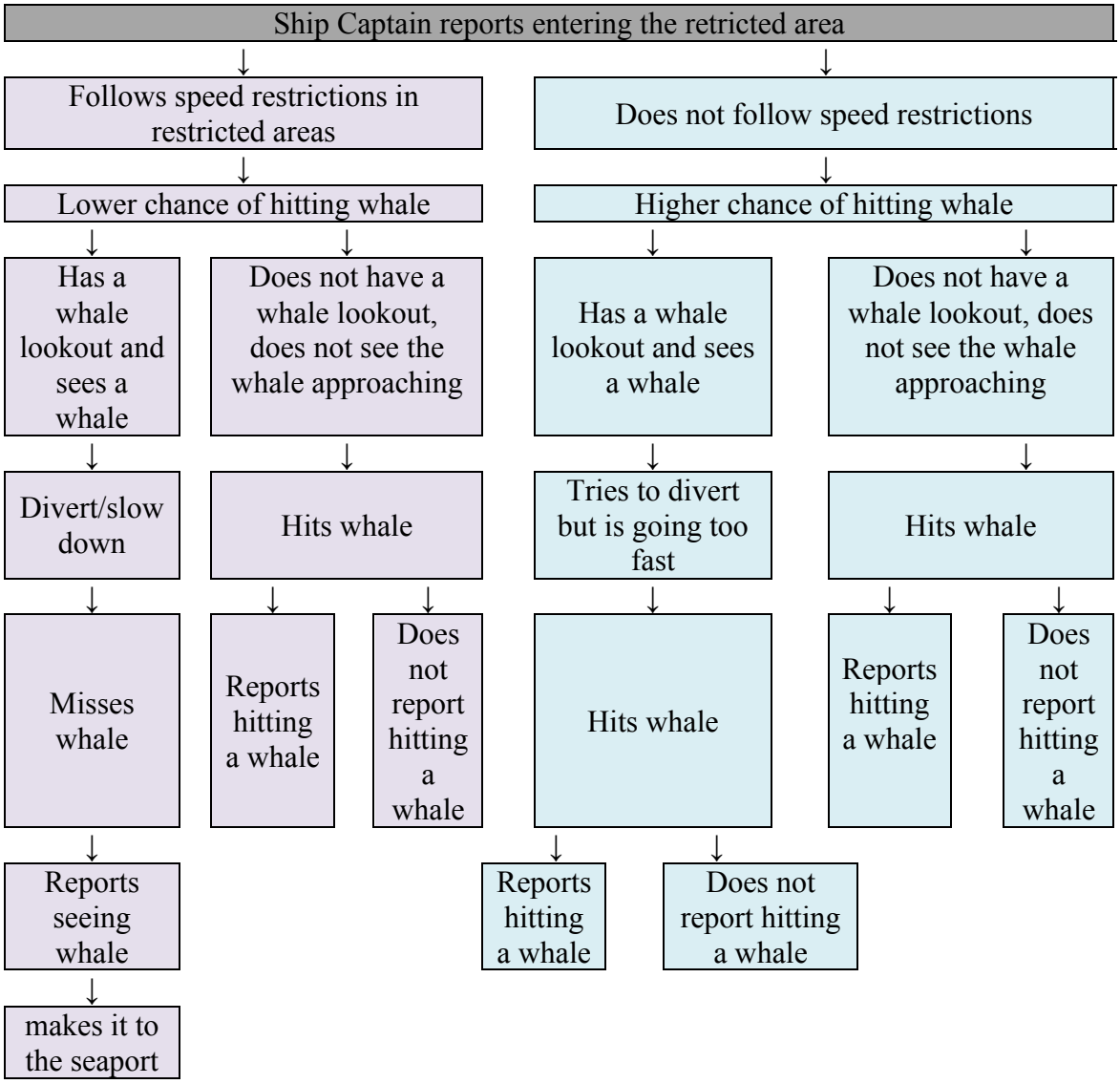


Figure 15: Lobster Fisherman Decisions

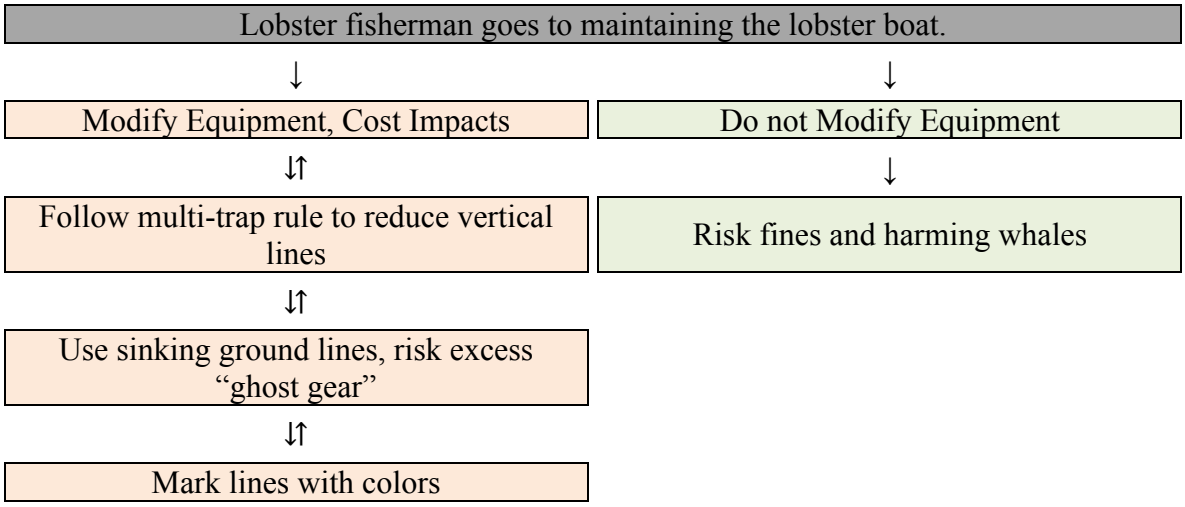


Figure 16: Disentanglement Team Member Decisions

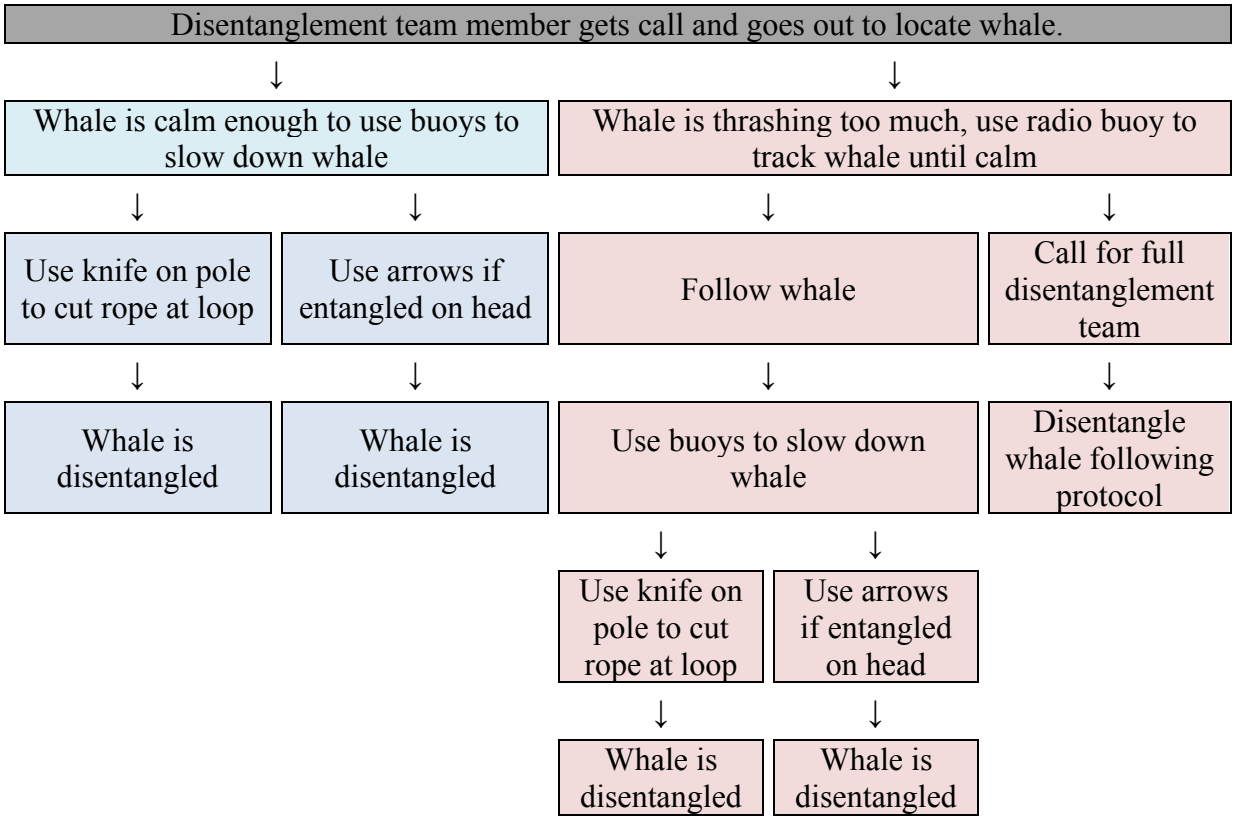
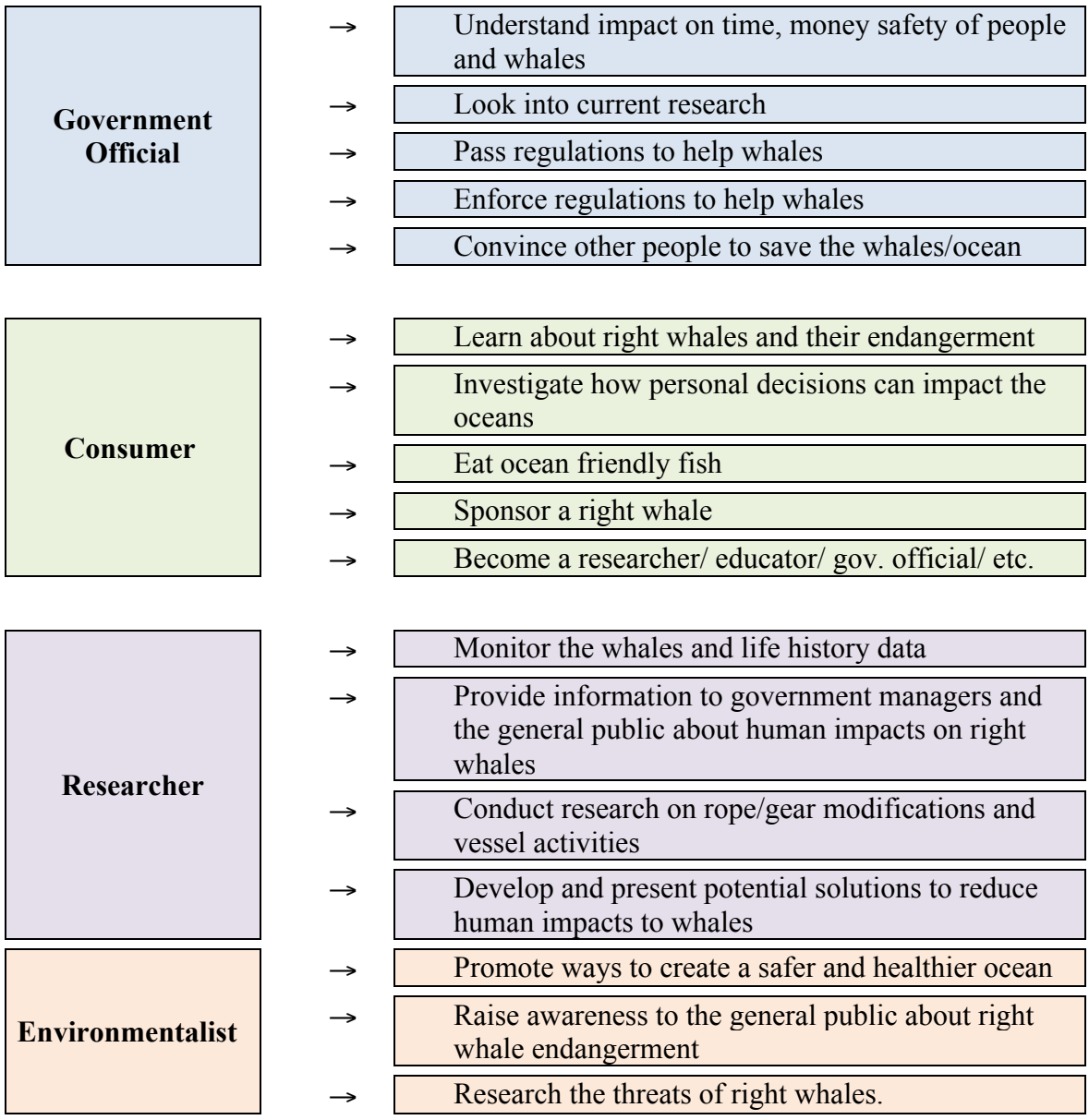
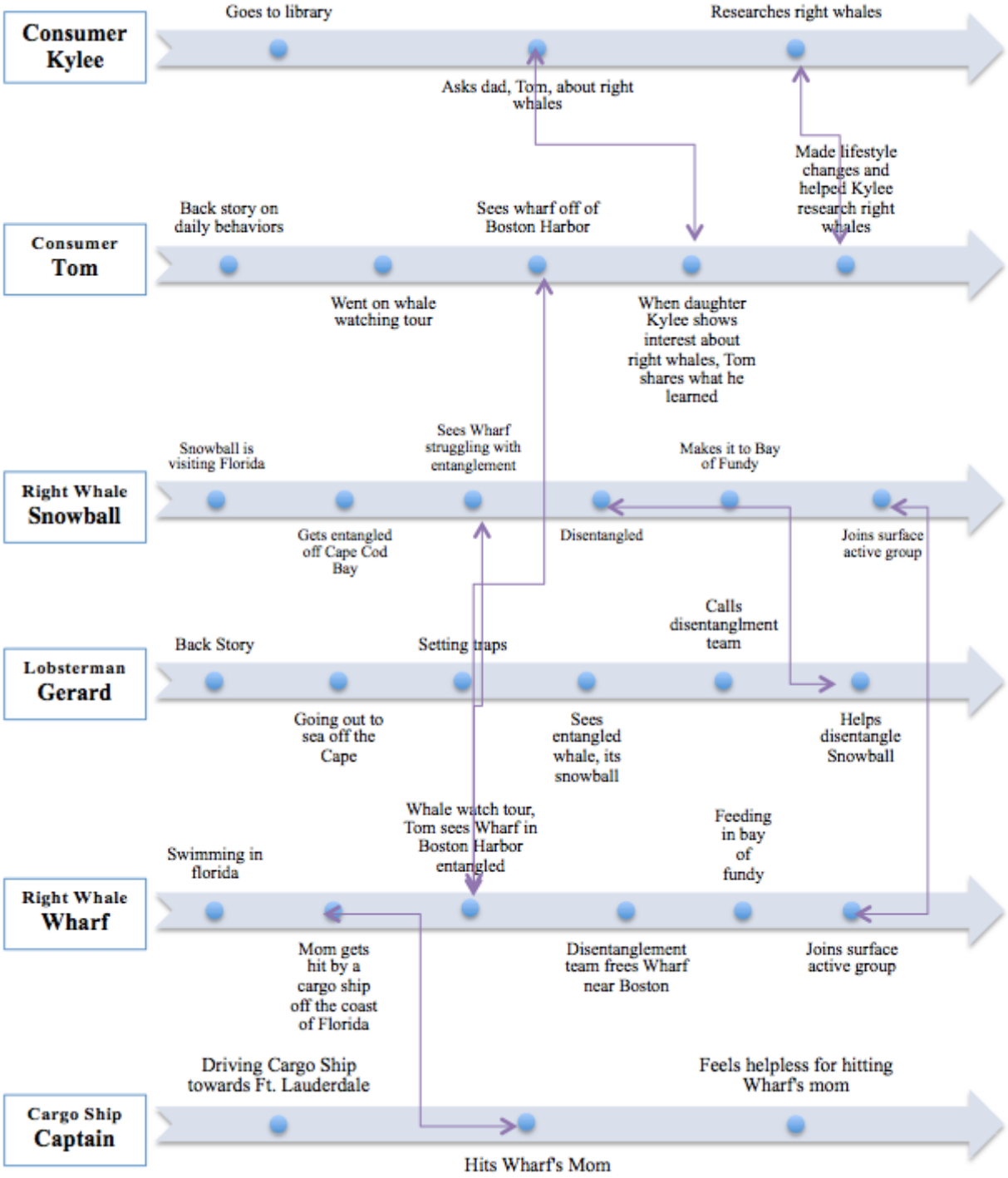


Figure 17: Additional characters and their decisions that help right whale conservation.



XIII. Timeline for the Storyline

Figure 18: Timeline for the Storyline



XIV. Narratives We Recommend for the Storyline

The following six perspectives are our sample narratives for the video game storyline that the WPI student game developers can use as a guide in their video game design. They include the right whale Snowball, the right whale Wharf, the cargo ship captain, the consumer Tom, the consumer Kylee, and the lobster fisherman Gerard.

Right Whale Perspective: Snowball, improvised from NARW catalog on 9/20

It was another sunny winter day for Snowball off the coast of Florida. He was just visiting the area, as males do not usually hang out in the calving grounds for very long. As a fully-grown right whale he swam along, lifting his flukes before going on a deep dive. His senses were keen--he could taste the salt in the water and feel the minute changes in temperature.

A few months later, Snowball continued his swimming up near the ocean's shelf on the East coast of the United States. As an experienced male, he knew very well the migratory route his mother showed him years ago when he was a calf. It was spring now so he was heading towards Cape Cod Bay. As he continued, he nudged small buoys on the surface of the water. Snowball noticed that underneath each was a long, strong, dark rope that tied deep down towards the sea floor. He continued feeding.

One of the lines got caught in his mouth, it was pulling against his upper lip, but he could manage to keep swimming since he is a strong whale. A few times he tried maneuvering the ropes off his snout. The ropes only got tighter around his head, and so he pulled harder. He pushed as hard as he could. After dragging the ropes for miles he gave the ropes one last tug and it snapped off. Snowball felt a sharp pain above his lip, but he was now free from the ropes and tried to continue feeding but was interrupted by a call for help.

Snowball quickly swam towards the sound. It came from a few miles away, and deep underwater. As he got closer to the sound of a tired whale, he noticed more and more of the ropes. He was not sure if they were dangerous, even after grazing past quite a few of them. It was difficult to avoid all of the lines, and he remembered how they would sting when they wrapped and tightened around him.

Following the whale call, he saw a shape. Getting closer still, Snowball recognized the paddle-shaped fins and flukes--it was a familiar whale named Wharf.

But something was wrong. He noticed that the lines were wrapped around her fins and her flukes. There was blood flowing from where the lines gripped her skin. The lines with the heavy gear attached at the bottom were holding her back, and she was forced to drag all the gear across the ocean floor. Her movements became more and more labored. The traps were a burden, but she was slowly moving with the long lengths of rope and gear still attached. Snowball was a strong whale, but he did not know how to help Wharf so he continued up the coast.

Snowball needed to regain his strength from the stressful travels. He had been slowly migrating north to the feeding grounds, and he was very hungry because he had not eaten for months.

His senses told him that he had found his prey. All around him, he was surrounded by dense aggregations of tiny red plankton. They were hard to see, since they were so tiny, but he knew they were there. He opened his mouth and allowed the delicious water to flow into his mouth and through his baleen as it filtered out the millions of plankton that he then swallowed. He had many long days of feeding ahead of him.

A few years later, as he was feeding, he heard another whale calling for him. But it was not a distress signal. Then the call sounded again. It was the call of a female. Despite it being mid-summer the water was cool in the Bay of Fundy, and it was the season for mating. And once again, he heard the female's call. Snowball turned toward the sound and began to swim.

Soon, he saw a female with her belly in the air. Snowball was not the only one she was calling for, however. There was two other males present chasing after her in an intense surface active group. With fully restored health, Snowball could compete with the other right whales.

Right Whale Perspective: The Adventurous Wharf

Moving nonchalantly through the warm waters, Wharf was ready to migrate through the vast Atlantic Ocean. She was quite a young whale and new to this great big ocean, and she relied on her mother to know where to go. She had taken her up the East coast once before, but Wharf was not yet ready to be on her own. It was a rare situation for a young right whale to stay with her mother this long.

Wharf knew the area, and that there was no food here. But they would be going somewhere with more food soon. They were returning to the North, where the food was plentiful. As she got closer to the coast she noticed something peculiar, the water felt oily and unpleasant against her flukes. Her mother called to her to keep moving, but it was barely more than a whisper with all the noise from the boats.

Many of the ships coming near the shore obeyed the speed restrictions and shipping lanes, but there was one cargo ship heading for Wharf and her mom that showed no signs of slowing down. By the time the captain received the signal from his bow watch that there were right whales in the area, it was too late. Wharf and her mom move much slower than the already slow moving adult whales, and did not have time to react to the approaching cargo ship. In an instant, Wharf was separated from her mom who had fatal wounds from the ship strike, and left to travel up the coast without her. Being such a year-old calf, her chances were slim but Wharf was a strong young whale.

As Wharf meandered her way up the coast she found an abundant feeding ground in Cape Cod Bay three miles from the shoreline. Feeling more rambunctious than usual, Wharf began to rise to the surface and stretch out her belly in the air. One more time, Wharf soared out of the water as much as her blubber would allow for.

The whale-watching tour in the Bay was very fortunate to see such an act. There are only 500 right whales, and they got the opportunity to see one although they had to keep the mandatory 500 yard distance away. The lead naturalist aboard noticed the last time Wharf surfaced she had a new addition around her mouth; it was a rope from a lobster trawl. Wharf immediately noticed the ropes too. She began thrashing violently around and rolling her body in circles. As she did this, the ropes grew tighter and tighter around her flippers and tail. Soon, the whale watchers could not see Wharf for the lobster pots at the end of the line were stuck on the ocean's floor and entangling Wharf the more she rolled. The captain of the whale watching tour immediately called for help.

The ropes wrapped around Wharf as she struggled to break free. She tried to pull away, but to no avail. The ropes where cutting into her body and she did not have much time left. The disentanglement team arrived with moments left to free Wharf, because just like humans, whales need to surface to breathe. Since Wharf was smaller than a full grown right whale, the disentanglement team could get closer to her. They tied buoys to the line, which made it harder for Wharf to swim away. The ropes around Wharf's mouth extended 100 feet passed her body.

They decided to use a new method of the "projectile broadhead cutter". They shot arrows with blades at the ropes and were able to cut one of the ropes. This allowed the ropes to slip from Wharf's head. The team avoided her flukes, which were splashing dangerously close to them. They began to approach the ropes around Wharf's body and flukes with a long pole with a shiny, sharp knife at the end. Wharf was badly entangled. If the team could not cut the rope, she would not stand a chance. Luckily, the disentanglement team was full of experts. Before Wharf could react, they used the knife to cut one of Wharfs ropes. The fishing gear slid from Wharf's body. Her tired body rose to the surface with extreme signs of stress and fatigue. Without the ropes, her struggles were not over yet. The wounds she obtained from the ropes were prone to infection, but only time could help her now.

Wharf finally made her way to the Bay of Fundy around late summer, early fall. She sensed the whales around her and in the distance. In the coming years, she continued to feed each summer and fall in this area. As she felt more mature, she began to call out to other whales. As she was calling, she noticed more and more male whales joining her. Among them was the strong Snowball, a familiar whale. All together, the whales created a surface-active group, which would result in the expansion of the right whale population.

Cargo Ship Captain Perspective

The Captain has been piloting his ship off the coast of Florida for quite some time. He had implemented many shipping changes and speed restrictions over the years that put his business in a hard place. Of course he does not want to hurt the whales that are calving in his shipping route, but he wants to make sure all the other ships coming into the port are following the same orders he strictly abides by.

As the Captain approached the Seasonal Management Area, he sent out his report to the Coast Guard to let them know he was crossing right whale territory and slowing his speed. He received a transmission stating that there were two right whales, a mother and a calf, sighted recently near his location. With such a large cargo ship, about 1,200 feet in length, he relied on the transmissions from survey teams ofwhale sightings to divert around if he could because they were hard to see in front of his huge ship. Yet, it had been a few hours since the pair had been sighted so the lookout kept a sharp eye out for the whales. The lookout radioed him and told him there were whales ahead and that they needed to turn and divert their path from the whales. The Captain did everything he could, pulling hard to turn the ship. They hoped this would work. They felt the ship strike something. With heavy eyes, a crewmember spotted a whale surface behind the ship with a trail of blood. He reported to the captain that they had hit at least one of the whales. In his entire career this has never happened to the Captain. He consulted his informational guide to see if there was anything he could do for the whale, but now that the whale was struck, there was nothing he could do besides report the incident to the authorities. He provided detailed information about his vessel type, speed, and avoidance efforts at the time of the incident so that this incident could be used to help researchers better understand how and where strikes were occurring.

Consumer/Whale-Watching Tour Perspective: The Story of Tom

Tom has lived in New England his entire life near the coast. Seafood was a common part of his diet, as he enjoyed plentiful in lobster, salmon, and good old clam chowder. But never did he think about where his food was coming from, or how it was caught.

One day, Tom decided to spend the weekend whale-watching. In the distance he saw a strange dark whale. He noticed the perfect shape of the whale's flukes as it splashed the waters. The naturalist on board explained that the whale they just spotted was a young right whale, which was very rare. Then they noticed the ropes wrapped around the whale's head and flukes. The boat had to stop to contact a disentanglement team. Watching the young whale twist and struggle made Tom's heart clench in his stomach as he thought of his own daughter Kylee.

Tom felt useless as he witnessed the whale slowly disappear under the water. He asked the very anxious naturalist what he could do to stop this from happening. Recognizing the opportunity to raise awareness about right whales, the naturalist began explaining that as a consumer, Tom has a lot of influence. To prevent entanglement, Tom learned he could ask where his seafood comes from, and how it was caught. Buying ocean-friendly fish means that particular fish is in abundance and caught under regulations. He can also tell people about what he saw on the whale-watcher tour to make people realize they can help too. The more people who know to buy ocean-friendly foods, they can support those fishermen who do follow the regulations. This will lead to less bad practices, and right whales will have a chance at surviving along the urban coast.

Consumer/Whale-Watching Tour Perspective: The Story of Kylee

There was a little girl named Kylee who lived in New England. Kylee enjoyed growing up in New England as the summers were always beautiful and the best part was that she would always see his friends playing in their backyards and would join them. One day Kylee's dad told her she needs to start her summer reading and took little Kylee to the library. At the library Kylee glared at all the books on the shelves, she told her dad, "Where do I even begin Papa?" Kylee's dad came across the librarian in the kid's section who said she would help little Kylee find a good book to read. While searching the bookshelves, the librarian came across a right whale book. She handed the book to little Kylee and told her she would enjoy reading this book as this species of whales is currently endangered. Kylee checked out the book and quickly got home to start reading. Every page of the book had such marvelous pictures of right whales and their specific features. Kylee was fascinated.

After Kylee finished the book she was amazed at what she had learned. She went to the dining room and told her dad reading the daily newspaper that she wanted a pet right whale. Kylee's dad smiled and said, "Kylee these creatures are endangered, they need to be protected from their threats, there are only a few hundred left in the whole wide world." Kylee's dad had recently come from a whale-watching tour in Cape Cod Bay and had witnessed seeing an entangled right whale struggle. Kylee was saddened by the news and told her dad she wanted to help right whales in any way possible. In the next few days, Kylees's dad did research on how as a family they could help right whales. Through his research, Kylee's dad learned that he could help right whales by buying ocean friendly fish, recycling, buying from local industries, installing energy efficient appliances and by sponsoring organizations that help in right whale conservation. Kylee's dad talked to Kylee about the various things that could be done.

As a family they started making small life changes and hoped that their changes would help in conservation efforts for right whales. Little Kylee felt great for what she was doing to help the creatures she cared for but she felt like it was not enough. Kylee told her dad that she wanted to help more. They both sat in the computer room in their house and looked up right whale research. Little Kylee now knew what she wanted. She wanted to follow right whale experts on Facebook to keep updated on how her small efforts would one day make an impact.

Ever since that day, Kylee kept updated on right whale research and hoped and prayed that one day right whales would recover fully. Kylee hoped that one day she could join experts in the field and save right whales too!

Lobster Fisherman Perspective: Gerard the Lobster Fisherman

It had been a long thirty years. Thirty years since Gerard's father first taught him the art of lobster fishing. He glanced to his left to see photographs of his family, faded by the constant abuse from sunshine and water.

"Another day on the job", he thought, "today's the day to test out this new equipment…" Since notice of new fishing regulations set to come in effect soon, Gerard had modified his equipment to meet the requirements. New sinking lines have been tied between his lobster traps, all his vertical floating lines are marked with red thread, and he replaced all his links to be breakaway links. The change was expensive, and all he hoped was that it would do some good for the whales. He had nothing against these whales, and had even participated as a member of a disentanglement team trained to help cut whales free from ropes when entangled. He just wanted the regulations to be in his favor for once. He did not know how long he could afford to keep up with all the new regulations. The clock read 5:00AM. Crickets were still chirping in the midst of the night as Gerard set out.

As Gerard ventured towards his deployed traps he passed familiar fishermen and their boats. He waved cheerfully and they waved back, but this gesture was only a symbol of territorial acknowledgement. Lobster fishing is a competitive business. Each fisherman tends not to wander too far out of the areas they normally fish, as other fishermen do not treat kindly anyone who tries to fish in their areas without notice or consent.

The sun was just peeking over the horizon now. The water glistened and rippled as the twenty-foot boat cruised over the water surface at ten knots, roughly eleven miles per hour. He used to see large ships soaring in the waters at this time, but the speed restrictions slowed them down to reduce right whale ship strikes. In all thirty years of his fishing career, Gerard had never seen a right whale. He had heard stories, seen pictures of them, but he did not have the chance to see one live in person. "Hopefully," he thought aloud, "all this hassle really does give the right whales a chance."

Gerard was five miles from the coast now. With open water on three sides and the coast line barely visible, he looked at the GPS mounted on his dashboard, pulled out a notepad and pencil, and marked his exact coordinates before putting the pad back into his chest pocket. He slowed the boat to a stop and prepared to set the new lobster traps. In one smooth motion, Gerard picked up and tossed the set of lobster traps into the ocean. Ninety feet of sinking-line rope lied between each trap and multiple traps made up each trawl. This trawl had eight traps instead of just one something new that Gerard was trying to reduce his amount of vertical lines and buoys set into the ocean.

A few white buoys bobbed in the distance. Gerard knew right away that these were his lobster traps due to the striped pattern, color, and the coordinates of the buoy. He carefully steered the boat towards to buoy and swung to the side of the boat to pick up the buoy with a hooked rod. He attached rope from the buoy to a pull system with a motorized disk. When he turned a knob next to the steering wheel, the disk rotated and drew the rope in. He cleaned the buoy and rope of algae build-up like grime, before setting it on the floor. He turned the knob once more and saw the first trap haul of the day. The trawls Gerard was picking today were set seven days ago. Seven days to allow lobster to traverse in and out of the cage, nipping at the

bundle of bait within, some getting caught. When the traps were full, Gerard took the lobsters out and put them on a tray on top of a storage tank. He then rearmed the trap with bait and prepared to toss the trap overboard back into the ocean. The lobsters were then examined to meet state regulations. Females with eggs must be marked with a small cut on a tail flap and returned back to the ocean. Of those that are not egging females, only those within the regulated length can be kept. Gerard put an elastic band on each claw of the keep-able lobsters and tossed them into the holding tank. On an average day, this hauling process would continue until he got to about 200 of the 700 traps he owned. But today was not an average day.

As Gerard was sitting down to eat lunch, he noticed a fluke thrash onto the surface of the water. Without looking at his identification chart he knew it was a right whale. He could not believe his eyes as he stared in awe as the majestic creature surfaced again. He did not know until later that he was staring at Snowball, but he knew that Snowball was in trouble as Gerard noticed the line of buoys trailing on the whale's tail. In his mouth, Snowball had a rope trapped by the force of water rushing into his baleen. Anxious for the whale's safety, Gerard called upon a disentanglement team.

Waiting for the team, Gerard followed Snowball while keeping his distance from the whale that was three times the size of his boat. Within an hour, the team arrived as Snowball used his great force to break the ropes. As they asked Gerard about the encounter, the team mentioned that they had just returned from an entanglement in Cape Cod Bay that was one of the worst they have seen. Gerard knew at that moment that these whales needed more help. He wanted to help researchers find ways to create gear that was safe for whales, but gear that also allowed him to continue his lobster business. He vowed that day to actively participate in efforts to conserve right whales and help lobster fishermen continue their livelihood without significant changes by collaborating with researchers in the Maine Lobstermen's Association.