

The Biosocial Ecosystem Dynamics of
Sustainable Wildlife Based Ecotourism in Panama

by

Katie Chun Surrey

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Graduate Supervisory Committee:

Leah Gerber, Chair
Hector Guzman
Ben Minter
Michael Schoon

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ABSTRACT

Understanding the dynamic interactions between humans and wildlife is essential to establishing sustainable wildlife-based ecotourism (WBE). Animal behavior exists within a complex feedback loop that affects overall ecosystem function, tourist satisfaction, and socioeconomics of local communities. However, the specific value that animal behavior plays in provisioning ecosystem services has not been thoroughly evaluated. People enjoy activities that facilitate intimate contact with animals, and there are many perceived benefits associated with these experiences, such as encouraging pro-environmental attitudes that can lead to greater motivation for conservation. There is extensive research on the effects that unregulated tourism activity can have on wildlife behavior, which include implications for population health and survival. Prior to COVID-19, WBE was developing rapidly on a global scale, and the pause in activity caused by the pandemic gave natural systems the chance to recover from environmental damage from over-tourism and provided insights into how tourism could be less impactful in future. Until now it has been undetermined how changes in animal behavior can alter the relationships and socioeconomics of this multidimensional system. This dissertation provides a thorough exploration of the behavioral, ecological, and economic parameters required to model biosocial interactions and feedbacks within the whale watching system in Las Perlas Archipelago, Panama. Through observational data collected in the field, this project assessed how unmanaged whale watching activity is affecting the behavior of Humpback whales in the area as well as the socioeconomic and conservation contributions of the industry. Additionally, it is necessary to consider what a sustainable form of wildlife tourism might be, and whether the incorporation of technology will help

enhance visitor experience while reducing negative impacts on wildlife. To better ascertain whether this concept of this integration would be favorably viewed, a selection of individuals was surveyed about their experiences about using technology to enhance their interactions with nature. This research highlights the need for more deliberate identification and incorporation of the perceptions of all stakeholders (wildlife included) to develop a less-impactful WBE industry that provides people with opportunities to establish meaningful relationships with nature that motivate them to help meet the conservation challenges of today.

DEDICATION

To the people and communities who live side by side with animals and nature, who desire
to hear their stories and share their journey.

*“Some people talk to animals.
Not many listen though.
That’s the problem”
– A.A. Milne*

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PREFACE

Science is a discipline that is always asking why. While the first questions are always “what” and “how,” we always inevitably land on “*why*.” Why do systems function the way they do? Why do different species act a certain way? I believe it is the lack of understanding this *why* that drives conflict, i.e., the inability to see the other side’s perspective and come to mutual understanding and to collaborate on solutions that mutually meet the needs of all. Much of traditional science and conservation has often approached problems as a zero-sum game – the result being one side having to give up its claim (either through persuasion or force, e.g., policy and restriction, walls, and cages). This is not done out of malice, but concern: fear of making the “wrong” choice, feeling like we are running out of time, or that we have too much time. As the frequency of interactions and conflicts between humans and nature - especially wildlife -becomes ever more prevalent, the need for this understanding will become more paramount.

While we are unable to ask wild animals these questions directly using our language, it simply means we must adjust the ways we ask these questions and be willing to listen to the answer. I arrived at this project wanting to ask the whys. Why do humans seek out interactions with wildlife? Why do they act on these desires? And why do wildlife respond in certain ways? I was motivated to become involved with this project because there is a dire need for less impactful mitigation strategies to address human-wildlife conflicts at their core- the reasons why species compete for resources. I believe that we can identify mutually beneficial solutions, if we only take the time to listen to what nature is telling us.

INTRODUCTION

The increasing global popularity of wildlife-based ecotourism (WBE) has led to a corresponding need for increased understanding of the dynamic relationship between humans and wildlife. The success of WBE is built on facilitating the development of meaningful and transformative relationships between humans and animals, however, many studies have revealed the negative effects that unregulated tourism activity can have on wildlife behavior, including implications for population health and survival. This influence on wildlife populations also impacts humans, as animals become more elusive, endangered or disappear altogether. This dissertation assesses the relatively nascent and unmanaged WBE industry in Panama to determine how changes in animal behavior alter human-wildlife interactions and can thus influence the socioeconomic dimensions of this biosocial system. The aim is to help shift future development of this industry towards a more sustainable path in the future.

Through this work I aimed to deliberately seek out both human and non-human perspectives and voices of those most intimately related to this system, the providers, and the consumers of WBE. I listened to both their reasons and motivations for seeking out these interactions and what they genuinely receive and are hoping to receive. The original goal of WBE is built upon humans' foundational desire to be in relationship with nature, allowing local communities to benefit economically from sharing their environment with others, and generating an environmental and conservation ethic in all who are part of the system. At its best, WBE has the ability to motivate protection of vulnerable systems, to support community livelihoods, and to help educate and change minds. But these benefits are not always guaranteed, and continuing research is needed to

determine how those outcomes can be more consistently achieved to meet the ever-changing needs of a dynamic global system. In my first two chapters, I focus on the relationship between humans and whales, identifying both its beneficial aspects and areas where the relationship is currently being strained. Recognizing that human understanding of the motivations of animal species is and may always be limited to an extent, it can nevertheless be beneficial to obtain a better understanding of how the motivations of human groups, e.g., tour operators and tourists, might be unknowingly misaligned. Finding points of mutual understanding in stakeholders' environmental ethics and their respect for wildlife could be the key for establishing mutually approved and appreciated approaches to meet conservation goals.

The WBE industry will be better served through a more nuanced and thorough understanding of how changes in animal behavior might impact the benefits derived from successful tourism experiences, and the repercussions any significant behavior changes may have for local communities. The development of a novel, biosocial model that deliberately incorporates various perspectives and types of knowledge of all relevant stakeholders in decision-making processes will enhance the flexibility and resilience of the system against future perturbations (e.g., future pandemics or global cessation of activity). This will require a more adaptive and inclusive development framework that incorporates primary stakeholder concerns. It will also theoretically be more aligned with conservation goals and flexible enough to be more resilient to future disruptions and disturbances, thereby benefitting all members of this social-biological system. Overall, this work contributes to what has been a dearth of research on the specific role that

animal behavior plays in ecoservice valuation frameworks, and which will contribute to more effective alignment between development and conservation goals.

Chapter 1

Utilizing evidence-data collected from the field, I assessed the behavioral responses of Humpback whales (*Megaptera novaeangliae*) to whale watch activity in the Las Perlas Archipelago in Panama. My goal was to answer the following questions: 1) Are wildlife behaviors being affected due to high levels of tourism vessel presence? 2) Do wildlife exhibit lower frequencies of avoidance behaviors in absence of vessels? 3) How will assessment and dissemination of these findings influence the development of more conservation focused ecotourism practices? I found that both the average dive time and average number of exhibited surface behaviors varied between different types of whale groups, and I used predictive models to estimate what shifts would happen in the presence of additional boats. Most notably, I found that the average number of direction changes exhibited by whales was significantly higher when whale watching boats approached the whales more closely than was permitted by regulations.

Chapter 2

Through surveys and interviews, I collected information on the motivations of the stakeholders involved in the wildlife-based ecotourism system (specifically, tourists and tour operators) to identify whether there may be a lack of shared knowledge regarding the conservation values and ecoservice benefits of the industry. My goal was to explore: 1) Whether the understanding of the motivations and satisfaction indicators for WBT participation are significantly different among tour guides, tourism operators and tourists; 2) Whether varying levels of understanding are contributing to the formation of

misaligned goals regarding the development of conservation policy and responsible ecotourism behavior; and 3) Identifying what mechanisms that would enable better communication and collaboration between stakeholders, enhancing integration of development and conservation goals (e.g., educational programs). I found that tourists generally had a high level of satisfaction with the tour experience, even when they were unable to get physically close to the animals, or to see them at all. This appears to contradict commonly held opinions of tour operators, who believe their guests are most satisfied when they observe whales exhibiting specific behaviors. Likewise, I found a perceived lack of compliance with regulations among operators, with both tourists and operators highlighting a desire for more educational opportunities that could better facilitate education about whales and conservation.

Chapter 3

I utilized all the data I collected from the field to identify what a more sustainable wildlife-based tourism model might resemble be for this industry. Recent innovations in virtual tourism (e.g., VR, drone videography) that have emerged because of the COVID-19 pandemic might serve to reduce the negative impacts of wildlife-based tourism on animal behavior. However, the perception of the public towards this type of nature-technology integration has not been thoroughly explored. Together with a research team, I utilized an open-ended survey to collect responses to questions relating to their images of nature, from individuals 18+ from across the US; how they feel most connected to nature and conversely, how they feel about aspects of technology and the idea of its integration in natural spaces. We found that people initially perceived nature as diametrically opposite to technology, although their definitions greatly varied, were

subject to interpretation. People reported the physical aspects and emotionality of their nature-based experiences to be the most important contribution to their experience, although they also recognized the increased knowledge and accessibility that technological platforms provided.

Positionality

Before presenting my dissertation research, I believe it is essential to acknowledge my positionality in relation to this work. There is always inherent subjectivity in the interpretation that goes with any type of research, and it is never possible to fully remove one's own perspectives, life history and prior experiences from the work. As students we are taught to not merely ask "how" something is the way it is but to also follow up with "why." An investigation into any topic will inevitably result in the questioner eventually having to ask whether he or she is the right one who should be asking the questions. My goal coming into graduate school was to contribute to the growing body of conservation research that identified and addressed conflicts between humans and wildlife, while developing a thorough understanding of the drivers behind them. A project that encompasses both the biological and social aspects of a system requires meaningful engagement with all parts of that system – which means not only presenting the questions but really listening to the answers as well. This is especially true in fields of environmental and marine sciences where research is usually perpetuated by outsiders and not necessarily by those who are most affected by the outcomes.

Even though I was fortunate enough to be able to spend considerable time living on the islands where I conducted my data collection (presented here in Chapters 1 and 2) and made many positive relationships with the local people who live there, I was always

consciously aware of my outsider status. I am keenly aware of the historical “white-saviorism” approach to environmental research, which greatly influenced the way I strove to conduct my data collection. I acknowledge the privilege that has allowed me to conduct this work in the first place (e.g., my socio-economic status, nationality, education) and it would feel dishonorable to not utilize my platform to its fullest extent.

However, it is my fundamental wish that future research that builds on this work is not perpetuated by external forces, but from within the community of people most affected by ecotourism and conservation, and who have a meaningful sense of place. No matter the ultimate outcomes of this specific project, I wanted to ensure that my research provided space for the voices of those who have not been previously heard yet are most affected by the implications of this system: the animals and the local residents. For this reason, I have done my best to replicate the phrases and answers of individuals I surveyed identically to how they were initially expressed. And yet I recognize that my interpretation of their responses, sentiments and experiences will never be truly reflective of their own lived realities. In addition to my intention to publish this work and contribute to the growing scientific literature on the implications of WBE and hopefully help influence change at a policy level, it is also my goal to find a way to give this research back to the communities, for them to use in the development of their own pathways that allow them to achieve successful conservation of their home.

CHAPTER 1

THE IMPACTS OF VESSEL ACTIVITY ON HUMPBACK WHALE BEHAVIOR IN LAS PERLAS ARCHIPELAGO, PANAMA

Abstract:

Within wildlife-based ecotourism (hereafter referred to as WBE), human and animal behaviors are strongly coupled in biosocial systems, but little is known about the role that behavior plays in contributing to conservation goals. Whale watching, a relatively nascent industry in Panama, has become extremely popular among visitors, however, whale watching regulations are not currently being enforced. In this study, I aimed to identify the extent to which whale watch activity has impacted the behaviors of humpback whales in the Las Perlas Archipelago in Panama. I found that both the average dive time and average number of exhibited surface behaviors varied between different types of whale groups, and I used predictive models to project what further shifts would happen in the presence of additional boats. Most notably, I found that the average number of direction changes exhibited by whales was significantly higher when whale watching boats approached the whales more closely than was permitted by regulations. Ultimately this research sought to identify the behavioral, ecological, and social interactions and feedbacks within this biosocial system. The goal was to determine which interventions might be necessary, desirable, and possible to manage whale watching in Panama to simultaneously protect the wellbeing of wildlife and ensure that the ecoservice benefits from this industry are maintained.

Introduction

An understanding of the adaptive changes and interconnections between human wellbeing and animal population viability is critical for establishing effective wildlife conservation strategies. This is especially relevant for industries that are heavily dependent on sustained interactions between humans and nature, such as wildlife-based ecotourism. WBE is a major component of the global tourism economy and has experienced a notable increase in popularity over the past 50 years, particularly in developing countries such as Panama (Hoyt, 2001; O'Connor et al., 2009; Guidino et al., 2020; Weiner et al., 2020). Within WBE, human and animal behaviors are strongly interconnected in what can be termed a social-ecological or “biosocial” system; animal behavior exists within complex feedback loops that affect overall ecosystem function and health, tourist satisfaction, and the economic sustainability of local communities (Orams, 2002; Williams et al., 2002a; Mayes et al., 2004; Wikelski and Cooke, 2006). However, the specific effect that changes in animal behavior have on provisioning the ecosystem services of the tourism industry is still being thoroughly evaluated (Surrey et al., 2021; Mortelliti, 2023), although there are some notable examples (Trave et al., 2017) related to whales (Arnold and Birtles, 1999; Birtles et al., 2002a, 2002b; Wilson, 2003; Birtles et al., 2005; Birtles et al., 2008; Birtles et al., 2014), turtles (Tisdell and Wilson, 2002a, 2002b; Tisdell and Wilson, 2005; Meletis and Harrison, 2010) and sharks (Mau, 2008; Smith et al., 2010; Barker et al., 2011; Smith et al., 2014; Apps et al., 2015). These studies showcase how deliberate management and conservation of species behavior can successfully coincide with tourism interests. However, there is still a strong need for considerations of animal behavior to be directly integrated with conservation

management planning (Berger-Tal et al., 2011) to ensure ongoing sustainability of both the ecological system and the tourism industry.

Previous work has suggested that the failure to consider animal behavior in wildlife management plans has detracted from wide-spread conservation success (Greggor et al., 2019). In some cases, high levels of human activity can strongly influence animal behavior through the induction of stress responses in individual animals. This is notwithstanding the indirect impacts such as pollution and climate change that also pose threats to species' wellbeing. The potential for anthropogenic-induced stress is especially high when tourism is improperly managed or unregulated (Williams et al., 2002a; Akkaya Bas et al. 2017; Di Clemente et al. 2018). Unmitigated stress has the potential to cause long-term population decline that could further reduce the ability of wildlife to provide the desired ecoservices to tourists in the future. However, animal behavior does not occur in a vacuum, and it can be difficult to identify the specific anthropogenic disturbances that trigger behavior changes. Future behavior studies will need to be expanded to incorporate all aspects of a system, including the human socioeconomic variables that simultaneously influence and are influenced by changes in animal behavior.

Defining the Problem: Wildlife Based Ecotourism (WBE)

When WBE is sustainably managed, experiences that allow for direct human-wildlife interaction can simultaneously create tourist satisfaction as well as generate or encourage already existing pro-environmental attitudes and interest in local conservation efforts (Mallick and Driessen, 2003; Mayes et al., 2004; Zeppel and Muloin, 2008; Cárdenas and Lew, 2016). WBE can also contribute to the local economy, through direct

employment opportunities for residents in the service industry and through tourists' patronization of local businesses (Stoeckl, 2008, Cardenas and Lew, 2016). Conversely, if there is an element of WBE that causes displeasure for guests, such as the behavior of a tour operator causing aversive or undesired behaviors in wildlife being observed, then tourists may become dissatisfied with their experience. This may subsequently decrease their financial contributions to the local communities and conservation initiatives.

Humpback whales (*Megaptera novaeangliae*) are charismatic megafauna that serve as major tourist attractions around the world and are one of the main reasons why tourists choose to visit the Las Perlas area (Cardenas, et al., 2020; see Figure 1.1). The warm, shallow waters in the Archipelago, located off the coast, provide ideal habitat for mothers to rear their calves (Morete et al. 2007; Stamation et al. 2010; Felix et al. 2011; Guzman et al., 2014), and what tourists perceive as ideal opportunities to view them. According to the official decree published in 2007 (updated in July 12, 2002), Humpback whales are legally protected in Panama at the federal level, both from hunting and from harassment from vessels, and regulations restrict the number of boats that can be present around a whale at one time (two maximum), the distance a boat must maintain from an animal (250 m) and total time that a boat can spend observing (15 minutes for groups with calves, 30 minutes for adult only groups (ARAP, 2007, Ministerio de Ambiente, 2022). More specific regulations exist to manage the behavior of boats around calves. As Panama's tourism sector has grown over the past decade, it has created a higher demand for wildlife-viewing opportunities (World Tourism Organization, 2018), and a small informal WBE industry has developed on the islands, primarily driven by local fishermen ("lancheros" or boat-drivers) who provide whale-watching services in addition to their

traditional fishing practices. Increased popularity with tourists responding to social media trends to capture “the perfect” social-media worthy picture can cause tourism operators to reconsider their adherence to regulations and bring visitors closer to wildlife than is allowed or even physically interact with wildlife (Pagal et al., 2020). The informal composition of the cetacean-watching industry in Panama and corresponding lack of effective mechanisms to enforce existing policies, (which is routinely denied by the government) has resulted in vessels frequently being observed chasing and harassing wildlife with no repercussions (Sitar et al., 2016; Amrein et al., 2020).

There are several larger companies that offer boat tours on private catamarans and yachts that leave from Panama City. These tours usually offer whale watching in tangent with visits to other islands and beaches around Panama, and still typically employ some of the local *lancheros* to physically provide the tours once they are out on one of the islands in the Archipelago. (I was unable to procure any official data on the visitor numbers and practices of these companies, despite numerous repeated requests. As a result, I was unable to include any specific analysis of their vessels’ behavior directly in my research, aside from opportunistic observations).

The Biological System

Many wild animals have a natural aversion to people. Being forced to remain in the presence of a human can cause stress-responses that range from increased levels of cortisol and heart rate to self-harming behavior resulting from a creature’s attempts to hide or escape (Howland, 1974; Weihs and Webb, 1984; Hoyt, 2001; Hoyt and Hvenegaard, 2002; Ellenberg et al., 2006; Schaffar et al., 2008; Parsons, 2012; Newsome, 2013; Di Clemente et. al. 2018; Newsome and Hughes, 2018). These impacts can cause

wildlife to become more likely to hide or flee, denying people the opportunity to have interactions with wildlife, and affecting the ecosystem service benefits that stem from these interactions. Animals chronically exhibiting higher rates of avoidance and stress-related behaviors can also have long-term implications for the health and longevity of populations (Buckley, 2004; Mullner et al., 2004; Walker et al., 2006; Wilson et al., 2020). These implications include direct physiological effects on individuals' survival (Mullner et al., 2004), lowering of reproductive rates (Bejder, 2005; Kellar et al., 2006) or indirect physiological modifications of behavioral responses to human encounters (e.g., habituation - the suppression of a response to a repeated stimulus) which can affect future viewing opportunities if populations abandon habitat all together (Rose and Rankin, 2001, Rankin et al., 2009). Studies on different cetacean populations in Latin America (e.g., Ecuador, Argentina, Brazil, Colombia) have suggested that groups of whales shift their behavior in the presence of vessels, which can include changes in acoustics, respiration rates, nursing, swimming behavior and group size and dynamics (Morete et al., 2007; Schaffar et. al. 2008; Sousa-Lima and Clark, 2008; Parsons, 2012; Avila et al., 2015; Argüelles et al., 2016; Rossi-Santos, 2016; Chalcobsky et al., 2020) which could pose threats to population and even species survival. On a more acute level, increased levels of anthropogenic disturbance in this system could lead to reductions in the frequencies of certain behaviors (e.g., those of charismatic value to tourists such as whales breaching) or increases in submerged (diving) time as individual animals try to avoid the presence of encroaching vessels (Williams et al., 2002, a,b). All these occurrences could contribute to a change in tourists' perceptions of wildlife, and the conservation value of the industry. If tourists are unable to achieve their desired level of

satisfaction of witnessing “cool” behaviors (or even seeing animals at all), they will be unlikely to view the ecotourism activity or entire industry within the host country favorably and this could impact their desire to return in future. This could cause lost revenue for local communities, as well as ecological shifts as wildlife continue to change their movement patterns, resulting in further concern regarding lack of conservation success in the region and initiating a negative feedback loop.

A report conducted in New Caledonia by Schaffar et al., (2008), found that 93% of the humpback whale groups observed in their study exhibited some level of behavior change upon being approached by a whale watching vessel, including increased dive time and decreased linearity of their movements, which unequivocally mimic predator-avoidance behaviors. This can be problematic for both the tourists who are hoping to see the whales and for the whales themselves, as they must forgo important behaviors such as resting and protecting their young to avoid boats and thereby increasing the energetic costs for survival. It is not only the presence of vessels that causes stress to marine species, but also the noise they generate. Generally, whale watching vessels are bigger than the average personal boat and they have correspondingly large motors to power them. These motors generate a lot of noise pollution, which is magnified underwater and can have serious impacts on the health and behavior of cetaceans. These include, but are not limited to, impacts on communication, navigation, and foraging, (Lussea et. al. 2009; Nabi et al. 2018), and the lack of surplus energy can compromise pregnancy and lactation, (New et al., 2013; New et al. 2014).

As Panama’s WBE industry is still developing, there is the high potential for the integration of behavioral ecology into conservation planning in a way that enhances the

long-term sustainability of the industry, while allowing for the implementation of more effective regulation and compliance with existing policies (Sitar Soller and Parsons, 2019; Surrey et al., 2021). Thus, the goal of this study was to determine the extent that human activity was affecting the behaviors of the humpback whale population in Las Perlas, and to allow researchers to construct a predictive model that portrays human-environment interactions in the growing Panamanian ecotourism industry which could be used to estimate the results of increased and unmitigated disturbance. In this chapter, I evaluate the extent to which humpback whales exhibit notable behavioral responses to high levels of wildlife-watching activities, which are indicative of avoidance and disturbance. Specifically, I seek to understand whether humpback whales that experience high levels of human disturbance exhibit a decrease in surface behaviors and/or increase in traveling behavior and/or increased dive time. I also aim to determine if, conversely, humpback whales that experience low levels of human disturbance exhibit non-avoidant behaviors (e.g., lower dive time and frequency, more surface behaviors).

Methods - Study Site

This study took place in the Las Perlas Archipelago, located approximately 60 km southeast of Panama City in the gulf of Panama (8.41° N, 79.02° W; Figure 1.1). The Archipelago comprises 250 basaltic rock islands and islets, and covers approximately 1,688 km², making it the fourth largest coastal marine protected area of Panama; (officially protected in 2007) (Best, 2008). The Gulf of Panama has been known as a breeding ground for humpback whales since the 19th century when it was initially discovered by whalers (Johnston et al., 2011). Humpback whales are migratory for most of the year; however, they regularly aggregate in waters less than 200m deep for their

annual breeding season. Although the specific reasons for this seasonal spatial distribution have not been conclusively proven, previous studies have suggested that

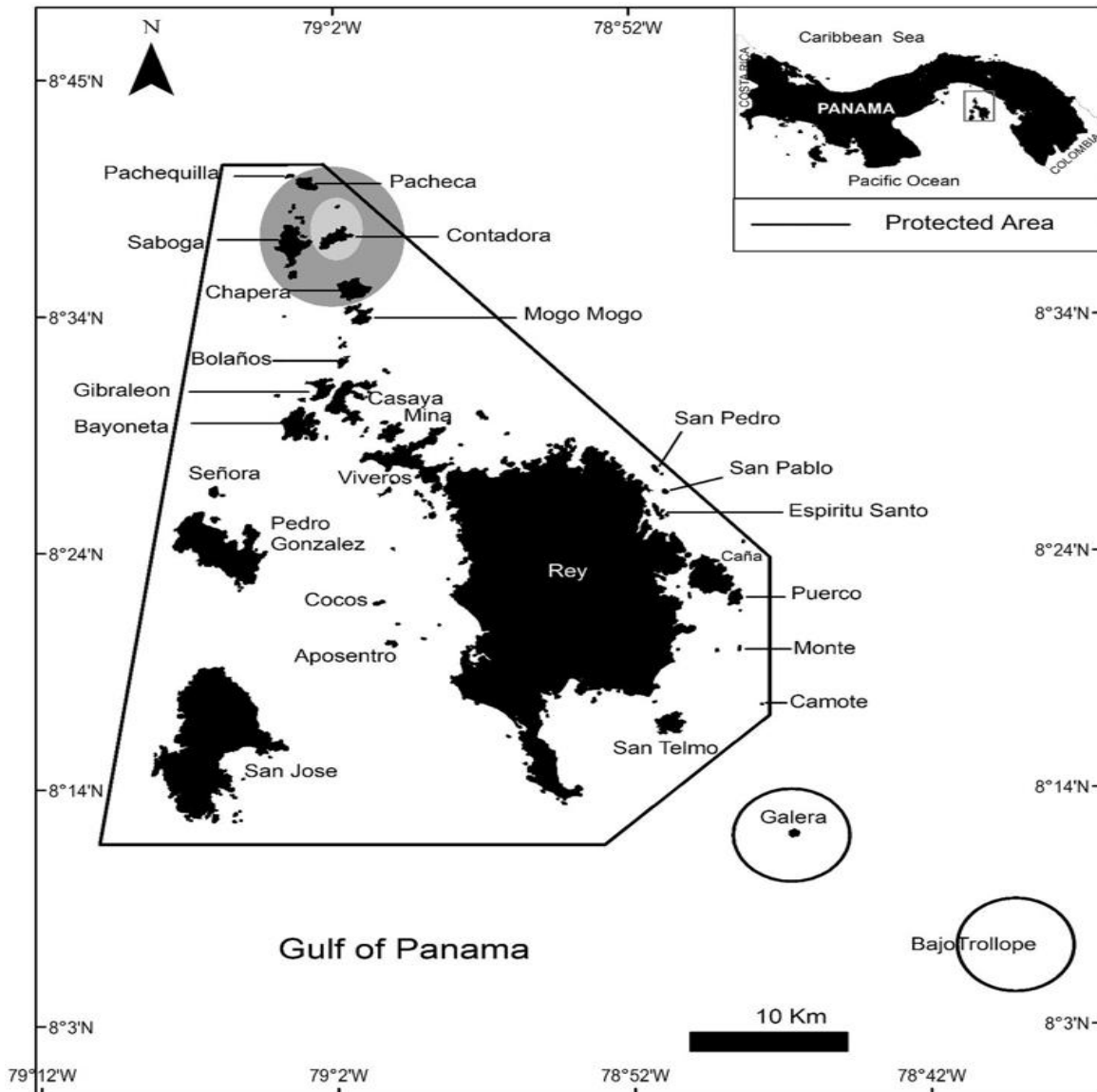


Figure 1.1: Map showing the study area in Las Perlas archipelago in Panama (from Amrein et al., 2020). The solid lines indicate the limits of the protected area. The shaded area is the core of the fieldwork and data collection.

depth is the most reliable predictor of humpback whale distribution with some segregation based on age and sex, with mother and calf pairs tending to remain closer to shore, and lone adults preferring deeper waters (Felix and Haase, 2005; Rasmussen et al.,

2012; Bruce et al., 2014; Felix and Guzman, 2014; Guzman et al., 2015; Guzman and Felix, 2017). It has been theorized that the warm, shallower waters are more hospitable to young calves who have limited swimming capabilities when they are first born (Guidino et al., 2014). This habitat preference puts the vulnerable population of mother and young humpback whales at greater risk for harmful interactions with humans, mainly in the form of ship strikes and fishing net entanglements, which can also present additional conservation management challenges.

The tropical clear waters in the Archipelago serve as an attraction for many tourists (both local and international) who visit the beautiful beaches of Las Perlas islands for abundant snorkeling opportunities, as well as convenient viewing of whales. The optimal humpback whale viewing season lasts from July to November, with peaks in August and September, and can occasionally extend into November, which overlaps exactly with when mothers are raising their calves. Previous studies put this specific humpback population (known as Southern Pacific Breeding Stock G) at approximately 6,500 individuals in 2006, after it suffered a historic depletion in the late 1950s to only a few hundred individuals. However, these population numbers are approximate due to challenges of long-term population monitoring of cetaceans and the variability of environmental conditions (Guzman et al., 2015). While globally this species is listed as “least concern” on the IUCN Red List (Cooke, 2018), they are one of the most at-risk marine mammals for exposure to world-wide threats that include pollution, incidental by-catch and boat-collisions (Avila et al., 2018). The movements of individual whales throughout the breeding season are not as well studied although some researchers believe the breeding grounds span several countries (Guzman et al., 2015; Avila et al., 2020).

Las Perlas islands are equally accessible and relatively not widely dispersed, so the humpback whales who frequent this area are likely experiencing similar environmental conditions throughout the season. Until 2017 there were no existing regulations monitoring the speed and movement of ships as they entered and exited the Panama Canal, which is located just to the north of the Archipelago and which resulted in frequent collisions with migrating whales (Guzman et al., 2012). The government recently enforced a Traffic Separation Scheme adopted by the International Maritime Organization to restrict vessel traffic entering the Gulf of Panama to two lanes (or 65 nautical miles) and requiring them to reduce their speeds to 10 nautical knots during the four months of maximum abundance of whales which would reduce the number of accidental vessel-whale strikes by over 90% (sensu Silber et al., 2012; Guzman et al., 2013). Nevertheless, the constant presence of vessels and their resulting acoustic disturbance remains a notable stress to marine wildlife, including cetaceans, and is an environmental variable that must be considered in any behavioral study and adds to the necessity of more disturbance-studies in this specific system.

Methods - Data collection

All data for this project were collected during the high whale watching season between August and October of 2019, 2021 and 2022. (Interruption in continuity was due to onset of COVID 19 pandemic which prevented international travel and research). This project utilized the same methodology of Amrein et al., (2020): observations were conducted from both boat and from a land-based vantage point (8.624694, -79.033478), as well as three sessions conducted with aide of a drone (Mavic Mini 2). Observation sessions occurred in two-to-three-hour periods, six days a week, when weather permitted.

Data were collected by conducting 15-minute focal follows (i.e., watching behavior of a single individual in a group) from both boat and land to examine patterns of sequential behaviors (Noren et al. 2009; Amrein et al., 2020). Researchers hired one of the boats that are owned and operated by the local lancheros to conduct the boat-based surveys. The vessels typically have one to two on-board motors and are about 10-15 feet (3-4.5 meters) in length. For the land-based survey sessions, visual scans of the visible area were completed every 5 minutes throughout the hour and began once a whale was spotted within approximately 3 miles (4.8 km) of the lookout point (approximately 15 ft above sea level) given the increased visibility and the use of Nikon Aculon A211 7x50 binoculars. Drone-surveys were only able to be conducted when the atmospheric conditions were appropriate and when whales were observed outside of the restricted flight zone surrounding the local airport on Contadora, which restricts the use of unnamed aerial systems (UAEs).

Observation sessions occurred on days with good weather conditions (i.e., Beaufort wind scale < 5) to highlight maximum visibility but were fully cancelled in cases of severe weather conditions (e.g., thunderstorms, Beaufort scale > 5; Cloud cover = 100%), if focal individual was lost, or if the whale group split during the observation session. During boat-based surveys, an observation session began once humpback whales were spotted within 300 m of the research boat, which provided a clear view for researchers to observe the focal individual. For both types of sessions, the approximate GPS coordinates of the whales were subjectively estimated by the researchers at both the beginning and end of the session, judging the whale's distance from landmarks such as the local islands, and recorded using a mobile device's GPS application. Each

observation session lasted 15 minutes, following existing federal regulations which limit observation sessions to 15 minutes maximum around any cetacean group that includes a calf.

Behavioral data were collected by recording the counts of behaviors, specifically those of charismatic value to tourists (e.g., breaching, tail slaps; Cardenas et al., 2021) as well as average dive time and frequency of direction changes which are indicators of avoidance (Stamation et al., 2010; Schaffar et al., 2013). Dive time was measured using a stopwatch and identified as observed exhalation rate (i.e., time between breaths) in seconds. When possible, fluke recognition was used to differentiate between already sampled individuals, yet this was often precluded due to the proximity and angle of the animals to the research boat. I did not record the frequency of behaviors that occurred continuously beyond the 15-minute observation time. I tracked 16 specific variables including group type, group size, Beaufort wind scale, number of boats, cloud cover and 11 behaviors (Table 1.1). Behavioral observations were collected from a single focal individual and in the case of mothers with calves, both the mother's and calf's behaviors were noted. If more than one group was spotted during a study session, the group closest to the observer was tracked. A change in direction was noted by considering the location and forward trajectory of whales when surfacing. If a group surfaced in a different location and facing in a direction other than their original orientation, it indicated a direction change. The number, type (e.g., lancha, sport fishing boat, yacht), behavior and approximate distance of any observing boats was also recorded. A boat was only included as part of a session if it was observed to be clearly following the whale group and if it was within 300 m of the whale. All data was analyzed using Excel (Version 16.68) and

RStudio (2022.02.1, Build 461). Dive time data was log transformed for easier visualization and several extreme outliers were dropped as those individual observation sessions did not contain any contributory information (i.e., no dive times or surface behaviors recorded).

*Table 1.1: Description of behavior categories for humpback whale behaviors (based on Table used in Amrein, et. al, 2020; descriptions by: Glockner-Ferrari and Ferrari (1984) and Gabriele (1992) (adapted from Bauer, 1986; Helweg, 1989; Corkeron, 1995; Darling and Nicklin, 2002). * Indicates behaviors which can be characteristic of stress or avoidance.*

Behavior Name:	Description:
Breach	Whale leaps out of the water, spinning in the air before re-entering.
Head Raise/Spy Hop	Raises head vertically out of the water while stationary, flippers outstretched
*Pectoral Fin Slap	Slaps flipper down onto the surface of the water
*Tail Slap	Raises flukes (tail fins) out of the water and slaps them on the surface
*Side Fluke	Swimming on one side with one fluke (tail fin) extending above the surface
*Head Slap	Jumps out of the water and hits the ventral side of head forcefully on surface
*Chase/Charge	Lunges at another whale, often bubble-streaming from mouth
*Strike/Collide	Whales intentionally collide or one hits another whale with fluke (tail) extending above the surface
Singing	An extended high-pitched sound made by male humpback whales (underwater)
Lobtailing	Whale extends flukes (tail) and occasionally lower part of tail above the water's surface and slaps them down on the surface of the water.
*Direction Change	Rapid change in direction

Description of Group Types

Following the classification system employed in Amrein et al., (2020), whale group type was identified as the following:

- A lone adult (LA) was an individual whale observed without any other identifiable individuals in proximity (approximately 50 m).
- Mother and calf pairs (MC) comprised of a single large whale (assumed to be the mother), traveling together with a smaller individual (the calf) that was approximately one-third the length of the adult (Chittleborough, 1958; Cartwright and Sullivan, 2009).
- If another adult whale (e.g., escort, competing male) was present and was traveling in proximity with mother and calf, that group was identified as a mother, calf, and escort (MCE), although the exact gender of the escort can vary (Félix and Botero-Acosta, 2011).
- Lastly, a group of at least two adults that were observed in proximity and displaying high energy behavior were identified as a competitive group (CG). The composition of these groups is typically males, potentially with a single female (with or without a calf), with at least one adult showing a high frequency of surface behavior and rough physical contact with each other (sensu Herman et al., 2007).

Results

In total I collected 89 days of data over the course of three years (2019, 2021 and 2022) for a total of 224 visual observation sessions. The majority of focal surveys comprised of MC (mothers with calves) groups (53%), the second highest observed

group was MCE (mothers, calves and escort) (23%), followed by LAs (lone adults) (18%) finally CGs (competitive groups), which were only 6% of the total observations (Figure 1.2). I used these data to develop a simple predictive model to estimate potential changes in the average dive time with the presence of an additional boats (Figure 1.3). Based on these values, I found that the increase from one to two boats was associated with an increase in average dive time for LAs, MCs, and CGs, but not for MCEs (indicated by a negative slope line).

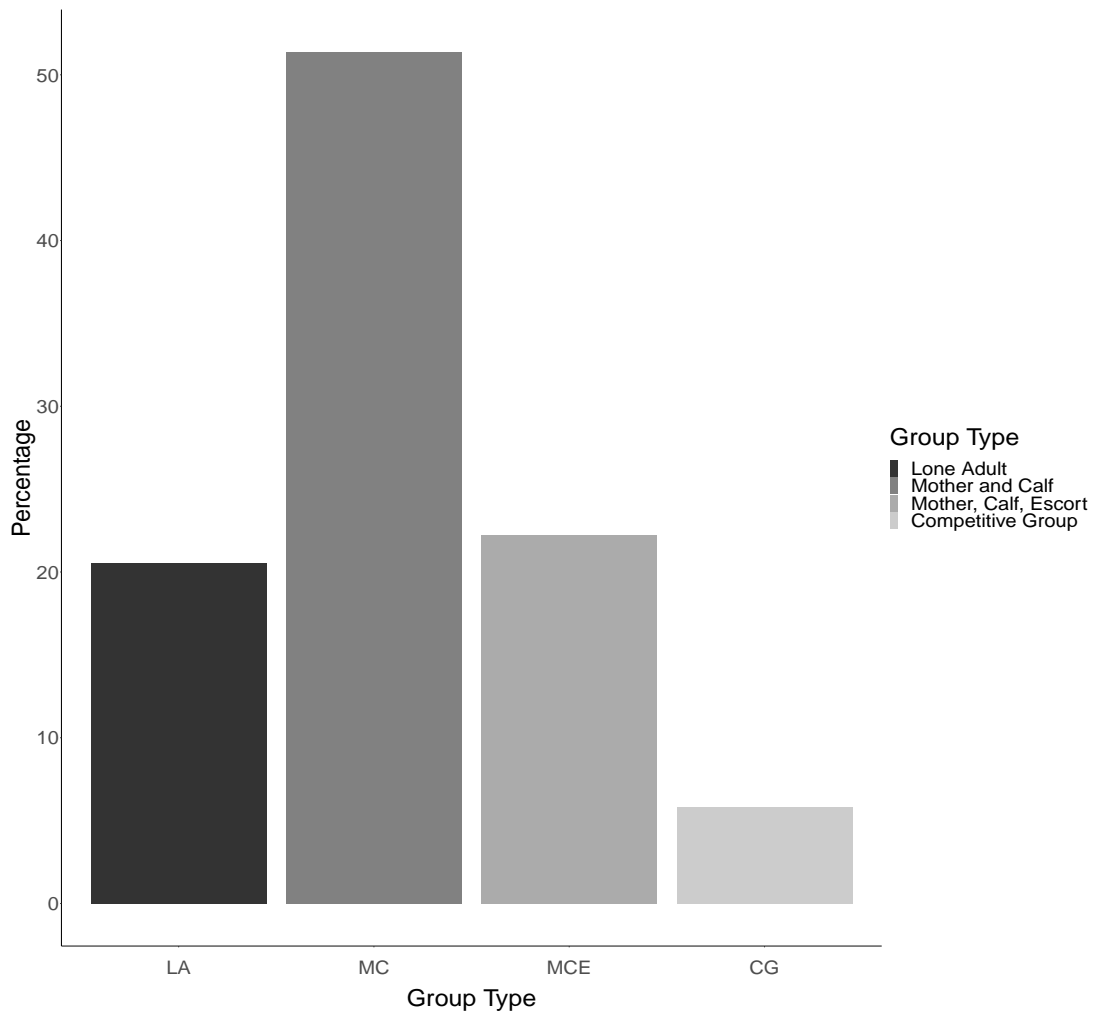


Figure 1.2: Percentage break down of all types of whale groups observed, LA (Lone Adult) – 18%, MC (Mother and Calf) - 53%, MCE (Mother, Calf Escort) – 23%, CG (Competitive Group) – 6%.

This result suggests that higher levels of disturbance potentially result in shifts in average dive time and supports findings by Shaffar et al., (2009) who found groups of mothers and babies immediately shifted their behaviors in the presence of a single boat. Increases in average dive time has been cited as a potential form of stress in cetaceans, as it often means the animals are increasing travel speed or distance covered, to either escape from predators or a more general disturbance (Baker and Herman, 1989; Williams et al., 2002; Stamation et al., 2010).

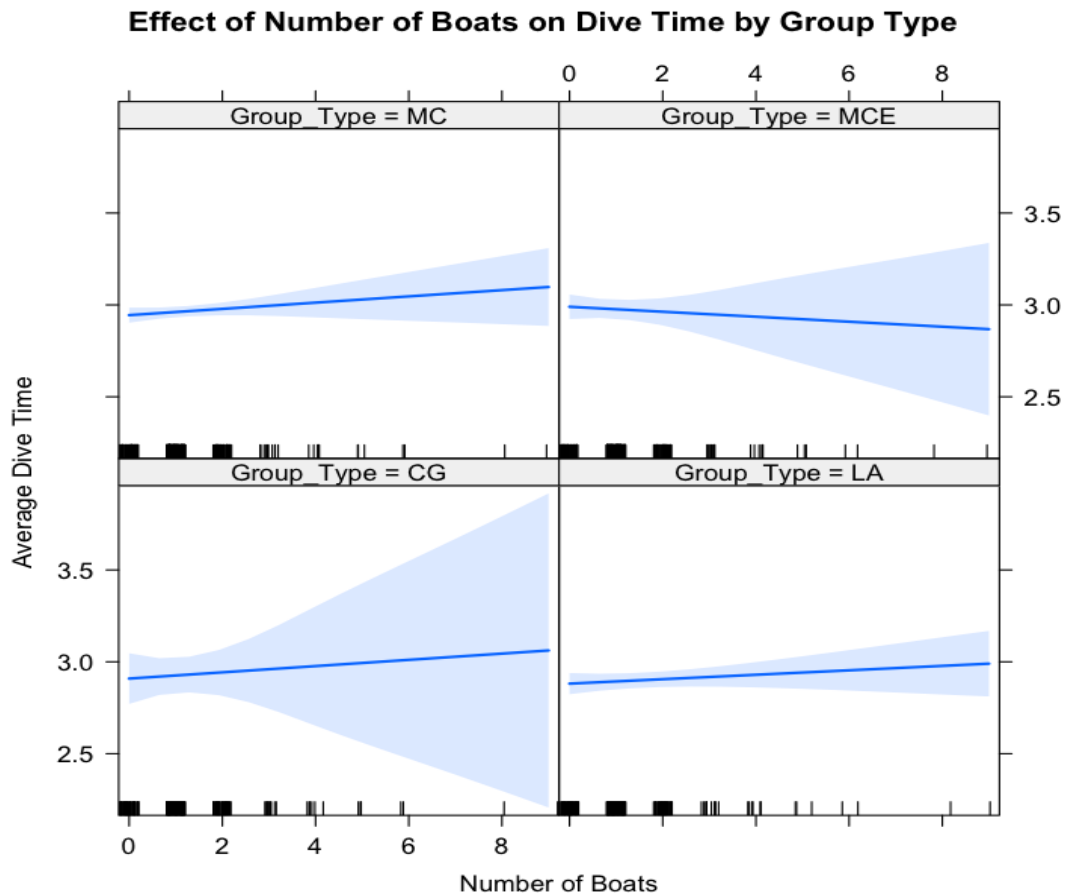


Figure 1.3: Average dive times for all whale groups and predicted slope of effect on dive time from different numbers of boats. For each additional boat, the rate of dive time is predicted to increase for: LA (Lone Adults) (2.8%), MC (Mothers and Calf) (5%), and CG (Competitive Groups) (3.8%). Meanwhile the average dive time for MCE (Mother, Calf, Escort) - is predicted to decrease (-3.2%).

As this study population is primarily comprised of breeding mothers and their calves, who are already extremely vulnerable physically, there is an elevated risk for disturbance induced stress. Young calves can find it challenging to keep up with their mothers as they dive or increase traveling speed, which can threaten their survival rate (Scheidat et al., 2004; Braithwaite et al., 2015). From a human standpoint, this could also be problematic as visitors often prioritize observing mother and baby whales and increased dive times makes the animals harder to track and watch (Shaffar and Garrigue, 2008, Shaffar et al., 2013).

Group Type Effects

Group type was found to have a significant effect on the average dive time ($F=3.3244$, $p = 0.0202$), the average number of surface behaviors ($p=0.003849$) and number of direction changes exhibited ($F=5.4079$, $p = 0.00124$). Specifically, MC (mother and calf pair, $p = 0.00719$) and MCE (mother, calf, and escort; $p = 0.01257$) showed significantly higher average dive times than LA groups (lone adults) (Figure 1.4). Higher average dive time could be indicative of higher stress levels: animals spending more time submerged could be either traveling or avoiding disturbances. In contrast, lone adults are frequently observed spending majority of their time traveling or singing (submerged) so most observations of them already typically include higher dive times. Overall, the fact that the other groups (specifically ones that include calves) were found to exhibit higher dive times, could suggest significantly increased time spent moving and traveling underwater which could be indicative of mothers trying to avoid boats (which could be perceived as predators; Baker et al., 1983; Schaffar et al., 2013; Senigaglia et al., 2016). Studies have proposed that higher rates of travel could consequently result in

mother whales being unable to spend as much time raising their calves (i.e., spending necessary time nursing and teaching, looking out for predators) which could prove detrimental to the survival rate of the calves during their first migration to feeding areas (see Villegas-Amtmann et al., 2015; Capella et al., 2018).

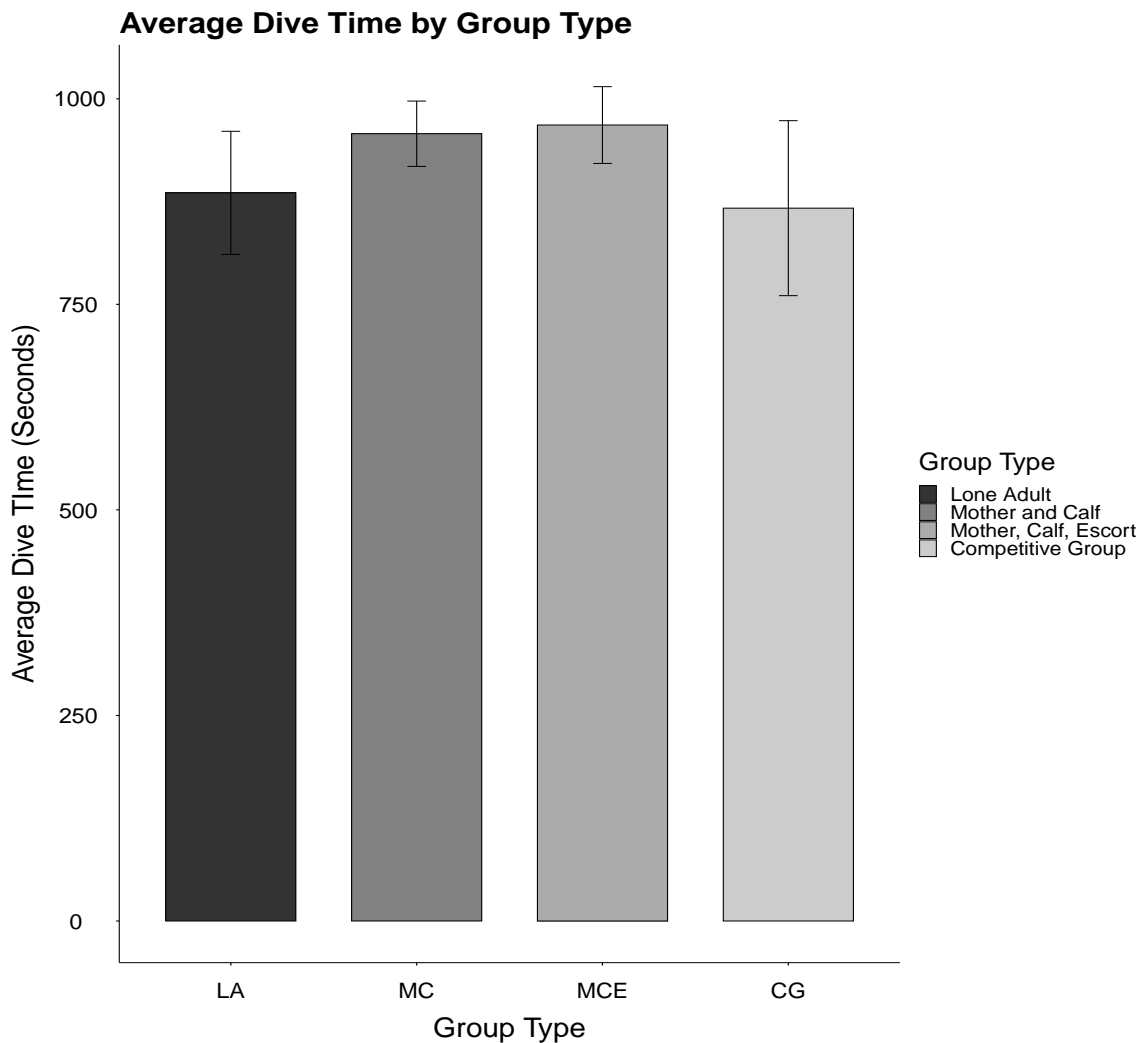


Figure 1.4: The average dive time by Group type was significantly different. MC (Mother and Calf) ($p=0.00719$) and MCE (Mother, Calf, Escort) ($p=0.01257$) exhibited higher average dive times than LA (Lone Adult)

Direction Change Effects

Meanwhile, direction change was also found to be significantly different between group type (Figure, 1.5; $F = 5.4079$, $p=0.00124$). Specifically, CGs exhibited a

significantly higher number of direction changes (ANOVA, $p=0.000436$) than LA ($p=0.0024$), MC ($p=0.007$) and MCE ($p=0.0170$). This could be explained by the typical routine behavior of the groups – competitive groups typically are more active and boisterous as they are usually comprised of juvenile and sexually mature males that are competing for the access to females in estrus. Or possibly because the individuals in these groups are already in heightened arousal states, they may be more susceptible to additional outside stressors.

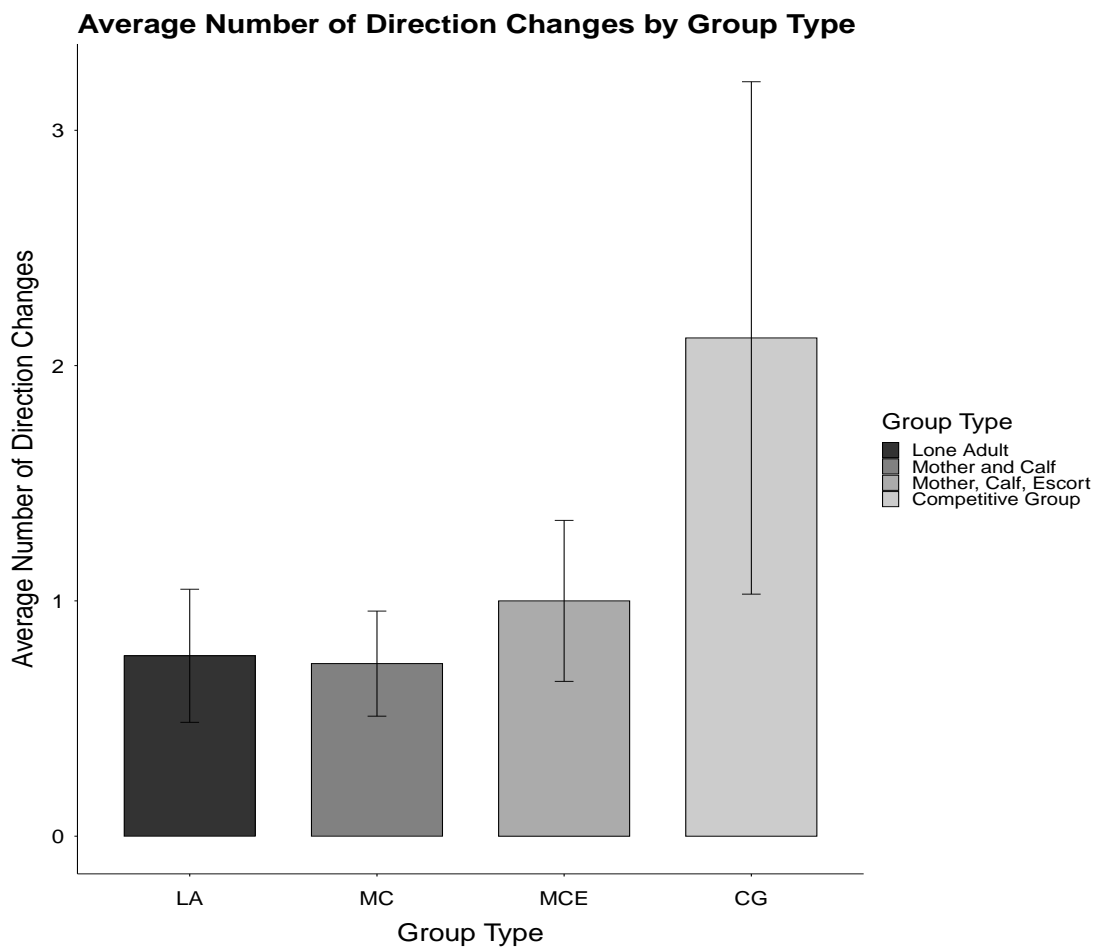


Figure 1.5: The number of direction changes was found to be significantly different between different types of whale groups. CG (Competitive Group) exhibited significantly higher average number of direction changes than MCE (Mother, Calf, Escort) ($p=0.0170$), MC (Mother and Calf) ($p=0.0007$), and LA (Lone Adult) ($p=0.0024$), ($F = 5.4079$, $p = 0.00124$).

I created another predictive model for number of direction changes with regards to number of boats present (Figure 1.6) and found that mothers with calves and lone adults were predicted to increase the number of direction changes exhibited by 2.2%, with each additional boat.

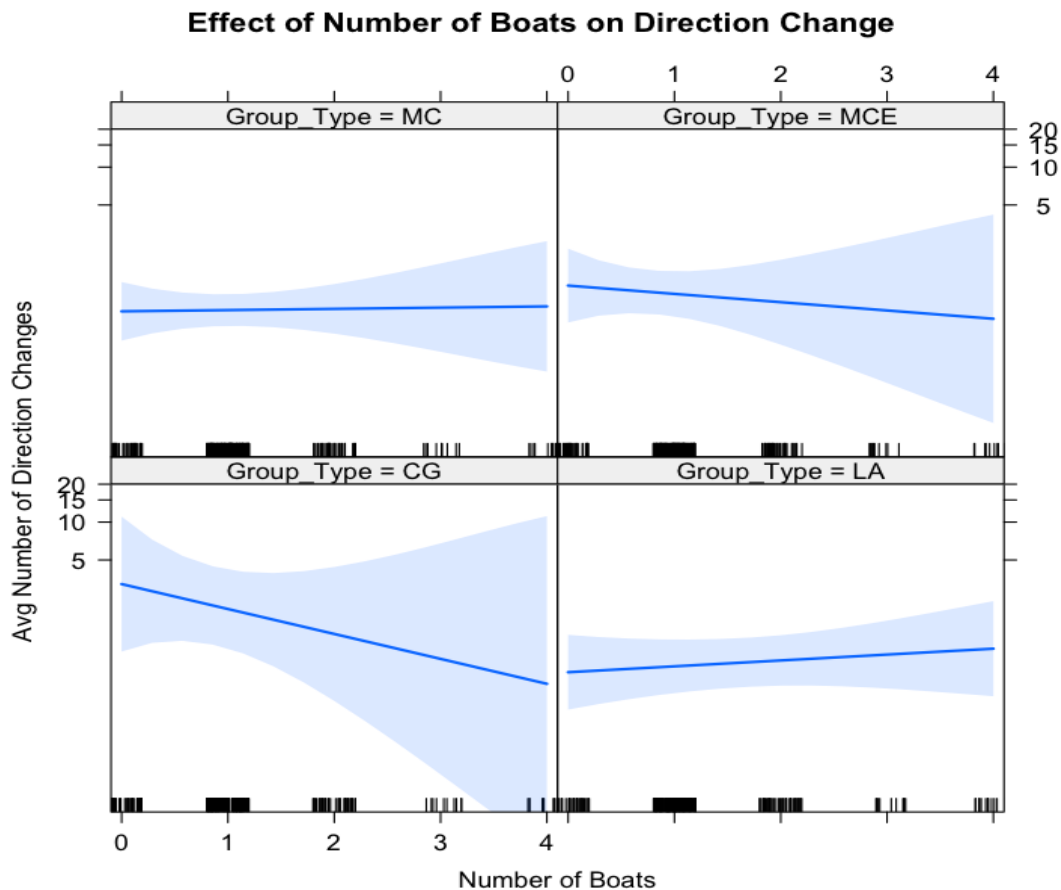


Figure 1.6: Average number of direction changes for all whale groups and predicted slope of effect from different numbers of boats. For each additional boat, the rate of dive time is predicted to increase by 1.2% for LA (Lone Adult), 2.2% for MC (Mother and Calf); and to decrease by -1.15% for MCE (Mother, Calf, Escort) and -1.45% CG (Competitive Group).

Direction change has been previously cited as an indicator of stress by cetaceans (Williams et al., 2002a; Williams et. al., 2002b; Scheidat, et al., 2004; Christiansen et al., 2013; Senigaglia et al., 2016; Sprogis et al., 2020). Lone adults spotted in Las Perlas are

often juvenile males that have recently left their mothers and are practicing courting rituals such as singing. The predictions from the model could point to specific groups (e.g., mother and calf pairs) feeling potentially more “vulnerable” to predators and therefore will be more likely to be stressed by boat presence.

Surface Behavior Effects

Whale group types also appeared to significantly differ in the average number of surface behaviors they exhibited (Figure 7; $p=0.002995$). Due to the low counts of each individual behavior, I combined several different behaviors into one group, “Surface Behaviors” and used this for analysis. This category included all the behaviors listed in Table 1.1, with the exception of singing (as that behavior is conducted underwater), and direction change. My prediction model (Figure 1.7) show that the average number of surface behaviors will potentially increase for all group types, except MC groups, with addition of up to six boats.

It should be noted that many of the behaviors that were included as surface behaviors are those that can be indicative of stress and aggression, such as tail slaps, when whales are being harassed (Tyack and Whitehead, 1983; Cusano et al., 2021). Alternative hypotheses for these behaviors are for enhancing communication when acoustic calls are hampered by surrounding noise pollution (Dunlop, 2016), yet they are often behaviors that are viewed as desirable by tourists. LA groups exhibited higher average number of surface behaviors than the other group types, however, it was only significantly different from the number exhibited by MCE groups (Figure 1.8; $p=0.0058$).

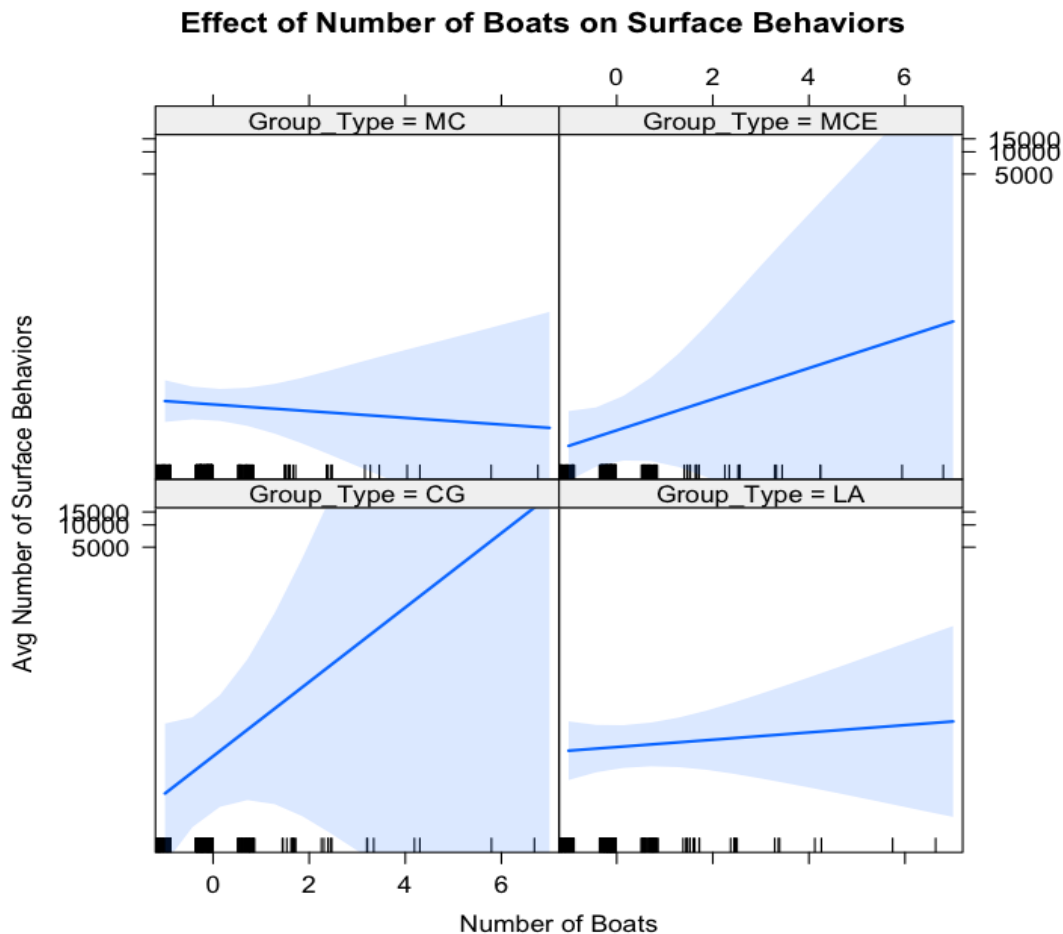


Figure 1.7: Average number of surface behaviors for all whale groups and predicted slope of effect from different numbers of boats. For each additional boat, the average number of surface behaviors is predicted to increase for LA (11%), MCE (47%), and CG (16%). Meanwhile, average number of surface behaviors will decrease for MC (-15%).

Many of the surface behaviors we tracked require significant energy (e.g., lobsailing) and it is theorized that adults use these behaviors for enhanced auditory and visual communication. Thus, mothers with calves may be less likely to engage in them since it would require mothers to shift focus away from their offspring and utilize valuable energy stores. Amrein et al., (2020), proposed that in this specific location, whales could

be using these communication methods when underwater noise levels were exceptionally high, precluding the usage of vocal calls, which supported results by Whitehead (1985).

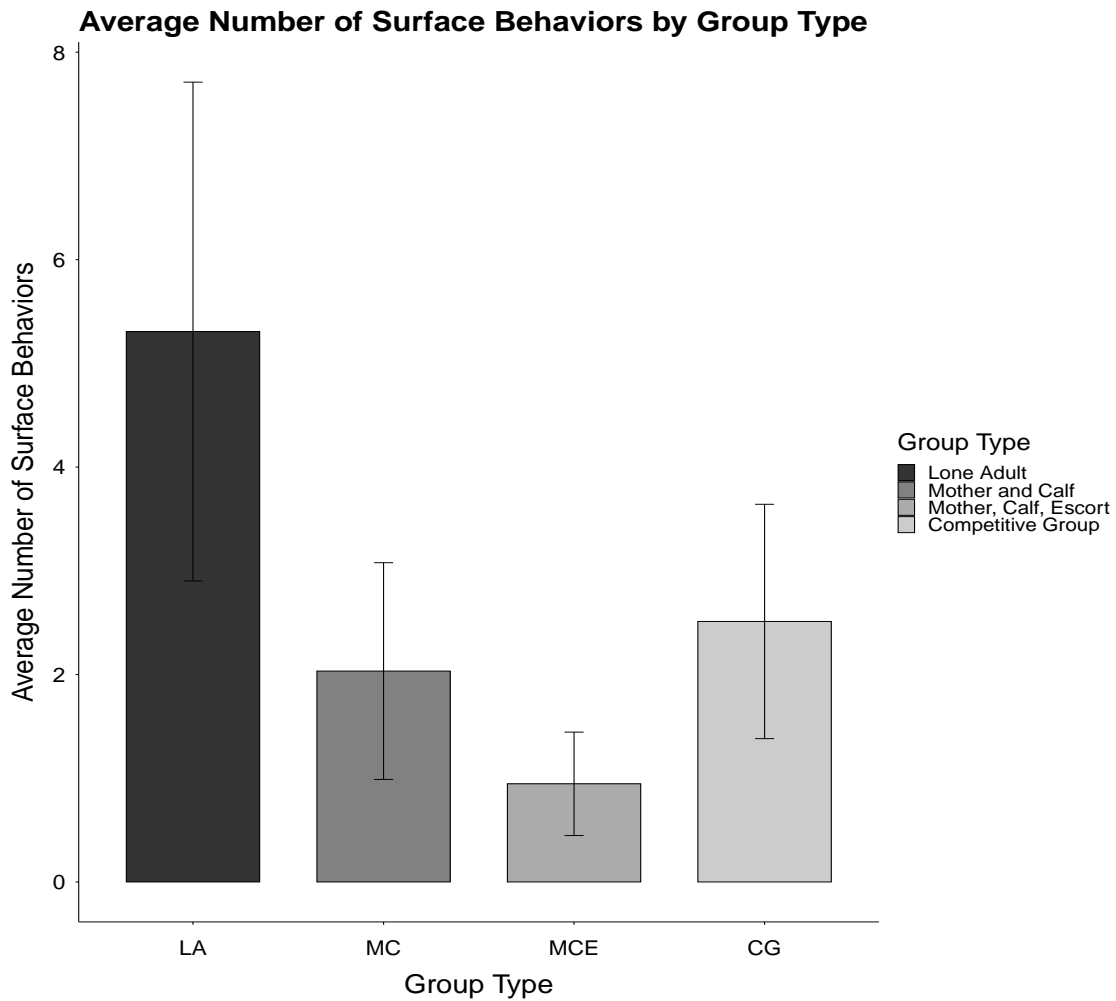


Figure 1.8: Average number of surface behaviors exhibited by different group types. Only LA (Lone Adults) and MCE (Mother, Calf, Escort) were significantly different from each other ($p=0.0016$).

Interannual Comparisons

Overall, the date (the year data was collected) had notable effect on the average dive time for all whales (across all groups), (Figure 1.9; $F = 3.9571$, $p=0.00797$).

Specifically, the average dive time in 2022 was significantly higher than it was in 2019 ($p=0.0217$) and the dive time for MCs (mothers and calves) was higher than it was for

that group in 2019 ($F = 1.95, p=0.0149$). While it is not possible to isolate exactly what factors might have contributed to this change, it is worth noting that the field seasons of 2021 and 2022 were still subjected to the restrictions of the COVID-19 pandemic.

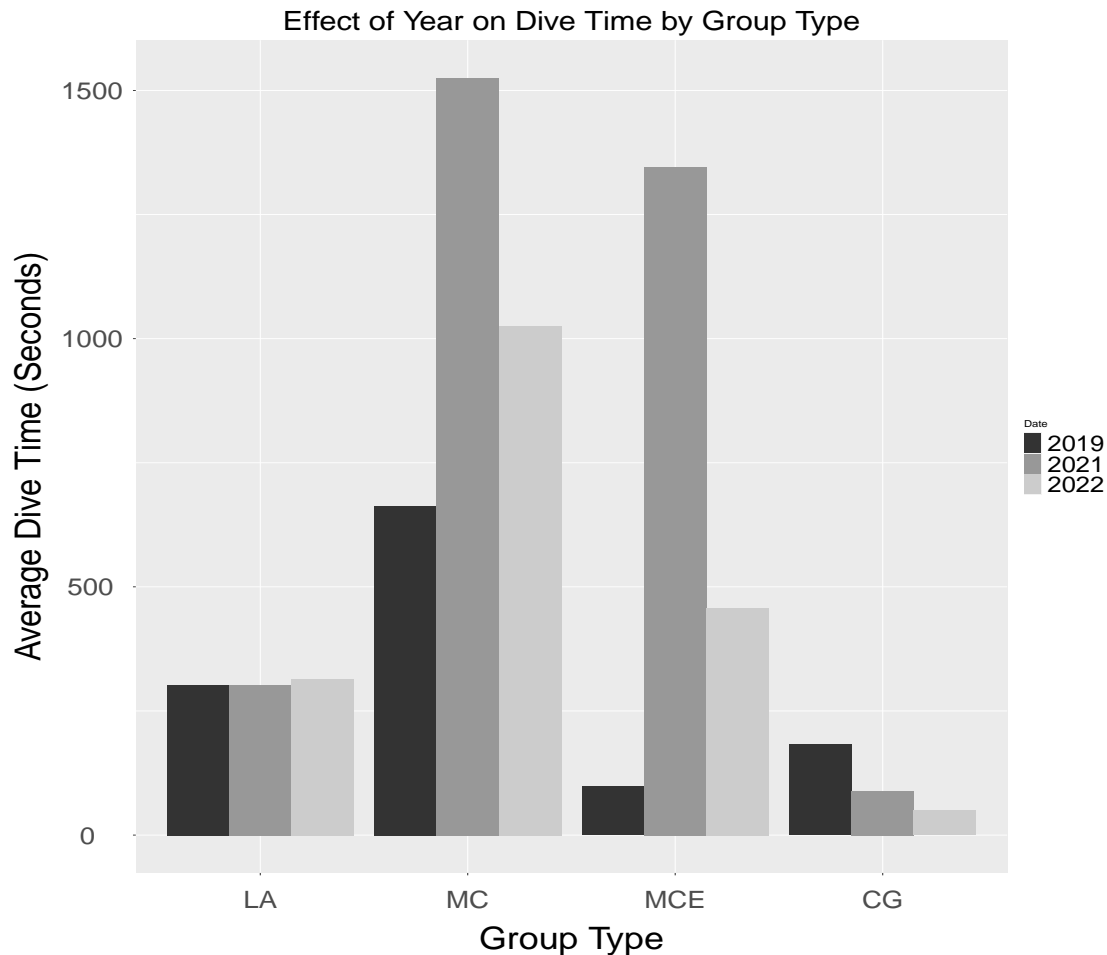


Figure 1.9: Year was found to have a significant effect on the average dive time exhibited across all whale groups ($p=0.00703$). Specifically, the average dive time appeared to be higher in 2022 than in 2019, with Group 2 (mothers and calves) exhibiting higher average dive times compared with 2019 and 2021.

The federal limitations imposed on travel saw drastic reductions in the number of visitors and general tourism activities, including in the Las Perlas, which resulted in many reported examples of wildlife around the world shifting their behaviors and adjusting to the absence of anthropogenic presence. It is possible that this finding is explained by this

whale population becoming habituated to the reduced vessel activity (in 2020 and 2021) and thus was experiencing higher levels of disturbance in 2022 due to lack of time for acclimation.

Adherence

During our observations I recorded whether boats appeared to be adhering to the mandated distance when observing whales. According to the most updated official Panamanian regulations on cetacean watching (2022), boats are required to remain a minimum of 250 meters from any whale (and 100 meters from any dolphin). I found that the number of direction changes significantly decreased when boats did adhere to the required distance (Figure 1.10; $p = 3.23E-06$).

Previous studies have found that tactics such as increased horizontal movement (e.g., increased sinuosity of swimming path, direction changes) are often employed by cetaceans to avoid predators (Williams et al., 2002a). Meanwhile, previous studies, such as one by Sitar et al. (2016), found that boat operators in another part of Panama (Bocas del Toro) frequently appeared to blatantly disregard this regulation (pertaining to dolphin watching). However, the authors acknowledged that it can be challenging for boat operators to estimate distance on water and cited a similar study that found this to be the case (Kessler and Harcourt, 2013). The paper by Sitar warned that aversive vessel behaviors, like heightened the risk of potential injury and fatality for the individual animals involved, due to the increased level of disturbance as well as risk of injury. Meanwhile, a study from Australia reported that proximity to cetaceans had little effect on the satisfaction level experienced by whale watch tourists (Orams, 2000). Although, it should be noted that in some cases, tourists are willing to forgo the ability to get good

photographs by getting close to wildlife in the service of protecting vulnerable species (Valentine and Birtles, 2004; Ballentyne et al., 2009). Dissuading both operators and tourists of the unnecessary need to approach wildlife closer than permitted will be vital producing more universal compliance.

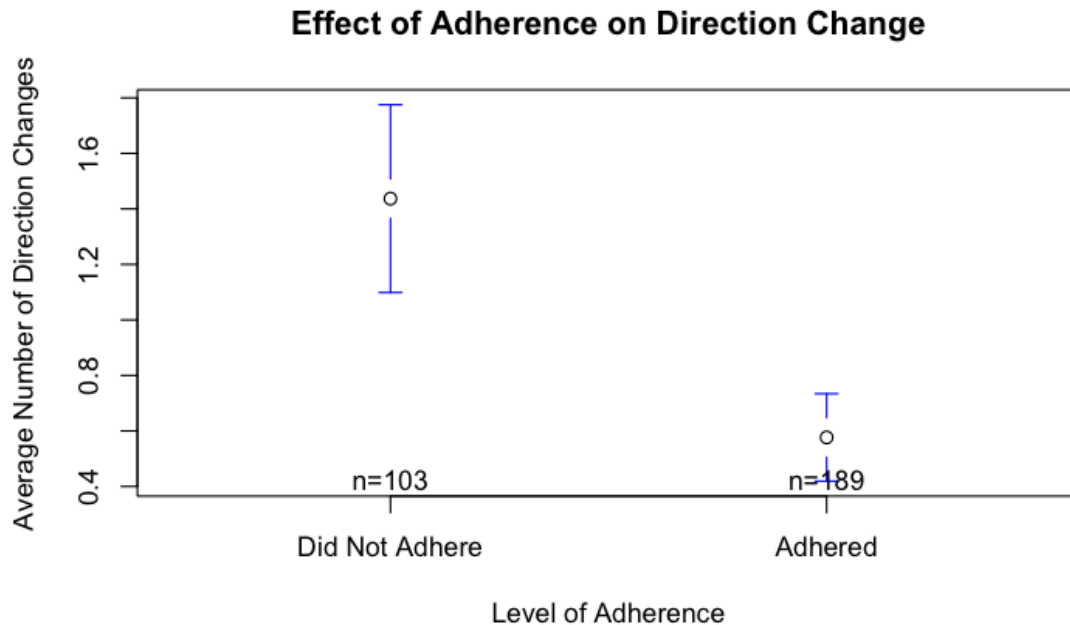


Figure 1.10: Sessions that observed boats that adhered to regulations corresponded to whales exhibiting significantly lower numbers of direction changes ($p = 3.23E-06$). Direction change has been previously reported as an indicator of stress in cetacean species.

Discussion

Based on the results of this research, there were several notable findings. First, it is evident that some level of anthropogenic disturbance is occurring with regards to changes in dive time and direction changes among the whale population in Las Perlas. One of the major challenges of animal behavior studies is the ability to conclusively attribute changes in behaviors to specific stressors, and this case is no exception (Mann and Würsig, 2014; Garcia-Cegarra et al., 2019). While whales did appear to exhibit

higher numbers of direction changes when boats approached closer than 250 meters, this specific whale population is comprised mainly of a breeding population of mothers and calves, which are already a portion of the population under high levels of stress and potentially heightened sensitivity to their environment. The lactating mothers typically do not consume much if any food during their breeding season (although several relatively recent reports have observed Southern Pacific humpback whales feeding on their breeding ground off the coast of Costa Rica (Rasmussen et al., 2012) and Nicaragua (De Weerd and Ramos, 2019), outside of their traditional feeding grounds and season; and are continually having to fend off courting males, which puts them in a heightened state of physiological stress (Lusseau and Bejder, 2007; Currie et al., 2021). Additionally, there are many other vessels aside from whale watching boats, such as cargo ships and private yachts, that routinely travel around Las Perlas, and which were impossible for our study to account for yet could very likely be adding to level of environmental stress that the whales are experiencing throughout the season, even when they are not deliberately watching whales.

Our findings also pointed to a temporal shift in behavior. The average dive time exhibited by mothers with calves was significantly higher in 2022 than in 2019. While the tourism levels were arguably higher in 2019, the 2022 field season occurred after this population had experienced notably lower boat traffic due to the restrictions implemented due to the COVID-19 pandemic. Thus, it is possible that this population is experiencing heightened sensitivity to disturbances due to this sharp re-introduction to higher levels of boat activity without a re-acclimation period.

The predictive models I created provide some potential insight into what behavioral changes might occur if boat activity and presence continue to increase unmitigated. The current federal regulations state that no more than two boats are allowed to be observing the same group of whales simultaneously and that they must always remain at least 250 meters away from the animals, especially when calves are present. According to my results, both the average dive time and number of direction changes exhibited by groups of mothers and calves will potentially increase as the number of boats goes up. Both behavior shifts can be indicative of avoidance and result in higher amounts of energy expenditure, which can be especially problematic for these young calves as they are: 1) potentially more sensitive to the presence of boats (Stamation et al., 2010); and 2) are more at risk to physical harm and stress as they must keep up with their mothers and are typically not adept at swimming (Currie et al., 2021). Studies of other wildlife have found higher levels of stress can lead to physiological changes, such as immunocompromisation, reduced growth rates and ability to recover from injury and reduced reproductive success and investment in raising young (McClung et al., 2004; Amo et al., 2006; Tarlow and Blumstein, 2007; Bateman and Fleming, 2017).

There are some examples where WBE, when managed efficiently, can be indirectly beneficial to wildlife through increasing visitors' environmental awareness and motivations to contribute to conservation issues, all with minimal impact to wildlife. One example are the public sea turtle watch programs (overseen by Florida Fish and Wildlife Commission), that provide guests with a guided tour to observe female turtle nesting behavior. One study (Smith et al., 2019) found that these programs significantly contributed to creating lasting conservation attitudes in participants, with little to no

notable effect on the nesting success of sea turtles. The researchers credit that success to the implementation of updated guidelines, routine systematic review, and adaptive management strategies. Another notable case study is Crystal River in Florida in the United States, which is home to the Floridian manatee (*Trichechus manatus*), a highly endangered subspecies of the West Indian manatee. Crystal River serves as a major tourist attraction, both for manatee viewing and for other water-based recreation (e.g., boating, fishing) and routinely welcomes millions of visitors every year. Aside from direct mortality risk from boat collisions, manatees were also suffering from incidental ingestion and entanglement with fishing lines and harassment from divers. Through a combination of methods, including imposing speed limit zones, establishing a national refuge (Crystal River National Wildlife Refuge) and a public education campaign, the Floridian manatee was successfully downgraded from endangered on the IUCN Red List in 2017 (Deutsch, 2008).

Recommendations

It can be challenging for community-based management systems to successfully regulate common-pool resources, such as wildlife access, without the support of governmental regulations. A more adaptive and inclusive development framework that incorporates the concerns of all affected groups, (wildlife included) and that is focused on sustainable development, will theoretically be more aligned with conservation goals and be flexible enough to allow for future updates and therefore be more resilient to disruptions and disturbances, although care needs to be taken to ensure that the ultimate motivations and intentions for these groups align with conservation.

It is unclear whether immediate implementation of enforcement of regulations for managing this system would be beneficial, plausible, or positively received. Instead, it is more advisable to use approaches such as conducting focus groups within these communities, establishing citizen science efforts, and involving local scientists and leaders in decision-making, to help ensure that there is both local and regional support for both conservation efforts and development regulation (sensu, Burns and Howard. 2003; Rodger et al., 2007; Mau 2008). Sharing of knowledge is crucial for the establishment of trust and understanding between and among involved entities, through deliberate inclusions of various perspectives and types of knowledge. The adoption of this management approach provides several benefits including greater recognition of the different and occasionally contrasting needs of the stakeholders involved in the system; creation of vertical as well as horizontal flows of information and inclusion of a wider variety of knowledge types among stakeholders (Dietz et al., 2003; Vasconcelos et al., 2013). All of these benefits contribute to a higher likelihood of acceptance and adherence to regulations by members of the community, as well as increased capacity of resource managers to be able to respond to uncertainty in proactive ways (Manwa, 2003; Armitage et al., 2008; Cook et al., 2020).

Most of all, it is crucial that the endeavors to conserve wildlife be both transparent and act in tandem with the goals of the community, so that the preferences of visitors are not put ahead of the well-being of locals. One of the most important tools in achieving this goal will be the establishment of education opportunities for both local communities and for visitors. This could take the form of training programs for boat operators that teaches them about wildlife biology, behavior, and conservation issues, as well as proper

boat operations around wildlife. The additional establishment of language programs and guide certifications will also enhance operational success for boat operators, allowing them to increase their own skills and knowledge and the ability for them to share knowledge with their visitors. In addition, rather than putting the responsibilities of adaptive management solely on tourism managers and operators there have been arguments made for the necessity of educating tourists about the animal welfare impacts of their desired activities (Ballentyne et al., 2009; Bach and Burton, 2017). Within this specific system, this could be done through continued research and generation of publications that focus specifically on the emerging conservation-development conflicts. Dissemination of this information to public entities - tourists, government, conservation groups – may help encourage a mindset shift among tourists and operators away from a profit-driven system, towards one that is more oriented towards meeting conservation goals. One solution would be to provision accommodation services (e.g., Trip Advisor) with a grading-system that indicates which activities have been certified as responsible and respectful of wildlife. There are existing wildlife programs that offer certification for ecotourism businesses, but it is not always clear if these certifications are understood or appreciated by the tourists themselves or if these businesses are deliberately sought out. Making efforts to move tourist expectations away from the concept of “guaranteed” wildlife viewing and promoting other aspects of wildlife can be equally beneficial and contributory to visitor satisfaction rate (Orams, 2000; Belicia and Islam, 2018).

To protect wildlife and preserve their natural behaviors successfully, action initiatives need to come from both the individuals providing the ecosystem service and those consuming the ecosystem service (Bennett et al., 2015). If tour operators can secure

increased financial benefits through training programs and thereby can provide more substantial educational experiences for their guests, the net result will be enhanced conservation knowledge for all stakeholders within this system. This will not only increase the likelihood of adherence to existing regulations but also contribute to the future maintenance of this system as individuals are provided with the empowerment and responsibility to hold each other accountable.

Limitations

There were many limitations on this study that could have affected the data collected and thus the lack of other conclusive results. The primary challenge was that I was unable to collect a continuous data set due to the onset of COVID-19, which also affected the consistency of the methodology (e.g., the research vessel that was utilized). There was drastic variation between the sample sizes collected between years, with 2019 only resulting in 38 observations, (due to a shorter field season) and 2021 and 2022 having 100 on average. Future research should expand this work to include the waters surrounding some of the other islands in the Las Perlas, as the entire archipelago is utilized by the whale population throughout the season and tourism activity is not equally distributed. It is possible that whales shift their distribution due to tourism activity to less frequented areas in the southern side of the archipelago throughout the season. As whale populations are habitual in their utilization of breeding grounds, it would be beneficial to collect identifying information on the specific individuals in this population, to allow for long-term tracking as well as preclude unintentional redundant sampling of the same individuals throughout the same season.

Future research should also examine the relationship between behavioral observations and biological markers, such as oxidative stress hormones, to clarify which behaviors are exhibited due to stress (Teerlink et al., 2018; Pallin et al., 2022). These types of studies are more recent but have been conducted both through the collection of fecal, blood and blow samples to establish the connection between behavior and physiology (Hogg, 2009; Rolland et al., 2012; Hunt et al., 2013; Cumeras et al., 2014; Burgess et al., 2018; Cates et al., 2019). This would be a notable contribution to the ongoing discussions about stress-behaviors in wildlife and help isolate the factors that qualify as disturbance and determine if habituation has occurred and to what extent.

Conclusion

While it is not yet entirely possible to draw a direct, unequivocal line between tourism activity and significant disruptions in animal behavior, much of science and conservation is done under the direction of uncertainty and precaution. With a non-zero chance of there being another future global perturbation that threatens travel and tourism, it is imperative that industries that depend on visitor presence be prepared for the worst. The whale watching industry in Panama presents an opportunity for progressive and sustainable development to be implemented, in a way that deliberately takes account of the needs of all stakeholder groups, primarily the wildlife, who serve as the backbone of the industry. Whale watching serves an important purpose, both socially and economically for many communities around the world and provides valuable educational opportunities for thousands of tourists who often see these trips as their only time to get to witness these animals in their natural habitat. The inspiration and awe that is frequently created through these interactions between humans and wildlife, serves as the driving

force behind all conservation efforts, yet systemic adaptation and development is needed to ensure that those emotions are translated into education and motivation, and then into tangible action that is aimed at furthering and contributing to conservation goals that protect the interests of both wildlife and humans.

CHAPTER 2

TOURIST AND TOUR OPERATOR PERCEPTIONS OF WHALE WATCHING IN LAS PERLAS ARCHIPELAGO, PANAMA

Abstract

Understanding the complexity of human interaction with wildlife has become increasingly important in ongoing efforts to save biodiversity. Ecotourism has an important role in conserving at-risk species and systems; however, there is a lack of consensus on what that the specifics of that role might be. One major reason for this uncertainty is the need for greater awareness regarding the motivations and goals of different stakeholder groups. This lack of knowledge often results in a greater need for collaboration in establishing management plans and enforcing regulation compliance. Lack of such collaboration can lead to stressed wildlife and missed opportunities for education and potential socioeconomic benefits. Through surveys and interviews with tourists and whale watch tour operators in the Las Perlas Archipelago in Panama, I found that tourists generally had a high level of satisfaction with the tour experience, even when they were not able to get physically close to the animals, and even if they were unable to see them at all. This appears to contradict commonly held opinions of tour operators. Likewise, I found a perceived lack of compliance with regulations among both tourists and tour operators, with both groups highlighting a desire for more educational opportunities that could better facilitate education about whales and conservation. A management system that explicitly identifies and incorporates the needs of the different groups will ultimately lead to improved relationship between humans and wildlife, both in this system and more globally.

Introduction

Prior to the disruption caused by COVID-19, the popularity and frequency of wildlife-based ecotourism (WBE) was on track to continue growing at an ever-increasing rate, and in 2018 it was estimated that WBE contributed approximately \$120 billion to the global economy (World Bank Group, 2018, World Tourism Organization, 2019). Within WBE, the global whale-watching industry specifically has experienced significant growth - between 1998-2008, it grew at a rate of 3.7% compared with 4.2% for the rest of tourism (Mallard, 2019). The average annual growth increase has been especially prominent in Asia (17%), and South and Central America (10% and 13% respectively) (Cisneros-Montemayor et al., 2010). Approximately thirteen-million tourists participate in trips to view cetaceans each year, generating over two-billion US dollars in revenue across 119 countries (Hoyt, 2001; Hoyt and Hvengaard, 2002; O'Connor et al., 2009, Department of Environment and Science, 2018). Humans seem predisposed to seek engagement with elements of nature (e.g., Wilson and Kellert's (1984) "biophilia" concept), and there are many emotional and physical benefits that people can derive from interactions nature and the outdoors (De Vries et al., 2003; Maas et al., 2006; Van den Berg et al., 2007; Groenewegen et al., 2012). Additionally, there is a distinctive allure for people to experience wildlife in its natural habitat as it enables a more immersive, psychologically stimulating experience. As one researcher describes, "there is nothing like the indelible thrill of meeting a wild animal on its own terms in its own element" (Ackerman, 2003). By building on people's desire to experience nature firsthand,

ecotourism provides a useful vessel to convey both entertainment and educational services to tourists and to further environmental protection efforts.

Defining Ecotourism

The concept of ecotourism has existed since the 1980s and was originally established to simultaneously meet the goals of both the recreation industry and conservation (Brandon and Wells, 1992). It was intended for this new form of tourism to be designed and managed in a way that funneled commercial revenues towards conservation and community development, serving as a “win-win” situation for both communities and ecosystems (Ziffer, 1989; Boo, 1991). The International Ecotourism Society currently defines ecotourism as: “responsible travel to natural areas that conserves the environment, sustains the well-being of the local people and involves local interpretation and education” (Stronza et al., 2019). It is worth noting that there is a fair amount of diversity regarding the definition of “ecotourism” and while there is some overlap, a range of different activities and programs that fall under that term.

Additionally, the distinction should be drawn between “ecotourism,” which again defines the types of typically more environmentally friendly activities conducted by tourists, versus “sustainable tourism,” of which ecotourism is a subset. According to the Global Sustainable Tourism Council, sustainable tourism should be the aspiration for all forms of tourism to achieve, as it also focuses on the more holistic and longer-term social and economic impacts of the industry, in addition to its environmental effects (which is what ecotourism predominantly focuses on). Fennell (2001) found that there were as many as 85 different definitions of ecotourism, and of the 25 governmental agencies involved with ecotourism, 21 had created their own definitions. The IUCN (International

Union for the Conservation of Nature), officially adopted the following definition at their first conference in Montreal in 1996, which was coined by Hector Ceballos-Lascurain):

“[Ecotourism]...is environmentally responsible travel and visitation to relatively undisturbed natural areas, in order to enjoy and appreciate nature (and any accompanying cultural features - both past and present) that promotes conservation, has low negative visitor impact, and provides for beneficially active socio-economic involvement of local populations.”

In both definitions presented, there is clear emphasis on conservation and community development, which is what typically separates ecotourism from other nature and adventure-based tourism and traditional outdoor recreational activities. For this and other reasons, ecotourism is frequently upheld as an alternative to more controversial and consumptive forms of wildlife-human interaction. As an example, whale watching is commonly presented as the non-consumptive alternative to whaling (by organizations such as World Wildlife Fund, Conservation International, 2004; News 2004; Tröeng and Drews 2004). However, the actual mixed impacts of ecotourism may belie its more “preservationist” origins. In this chapter, I seek to identify how WBE can be developed sustainably, in a way that simultaneously satisfies the goals and motivations of all stakeholders, both humans and wildlife. I start by outlining the mixed benefits of WBE, including the increased educational opportunities for tourists and the cultural and economic contributions to host communities, but also present the negative impacts that chronic anthropogenic disturbance poses for animal behavior and well-being. Then I describe the methodology and results of the empirical study that I conducted in Las Perlas, Panama, to assess the potential impacts that unmanaged tourism activity is having on the behavior of Humpback whales. Finally, I conclude with an interpretation of these

results and potential suggestions for how this specific industry could be developed to be less impactful in the future.

The Mixed Contributions of Wildlife Based Ecotourism

Many studies propose that ecotourism can promote participants' environmental ethics and cause them to shift their actions towards more sustainable and conservation motivated behaviors (Anderson and Miller, 2006; Wheaton et al., 2016). The benefits of WBE can even extend beyond those directly received by individuals (e.g., satisfaction, education) and can ripple out into host communities, providing employment opportunities, sustainable income streams, and promoting cultural identity and pride (Orams, 1995, 1999; Zeppel and Muloin, 2009). At its best, ecotourism can lead to the establishment of community-based natural resource programs which can strengthen the management systems for wildlife and other commonly shared resources. Local host communities can reap sizable economic gains directly from visiting tourists, who all need places to eat, sleep and shop, and many ecotourism companies will hire staff from the area, often recruiting nature guides specifically for their traditional knowledge and experience with the local wildlife. This can contribute to the survival of indigenous cultures, as well as increase the cultural awareness of visitors (Prasetyo et al., 2020). Many tourism companies contribute a portion of their income towards local conservation efforts and will advertise their services as such to draw in eco-minded tourists. Some studies have shown that tourists are often motivated to visit a specific location due to the endemic wildlife found there (e.g., Wilson and Tisdell, 2003). Various forms of WBE, such as whale-watching, do not require a large amount of equipment to function, and

therefore almost any (coastally located) country or community can theoretically develop its own industry based on the infrastructure that already exists.

Additionally, WBE can contribute to elevated feelings of local stewardship and pride in natural spaces, which often comprise a large portion of cultural heritage (Zeppel, 2006; Stronza and Gordillo, 2008; Stronza and Pegas, 2008; Coria and Calfucura, 2012; Romero-Brito et al., 2016). WBE offers cultural educational opportunities as visitors interact with community members during their visits (Stonza et al., 2019). Furthermore, WBE can lead to a decrease in illegal poaching activities. Ecotourism provides people with a more stable and sustainable form of employment, in contrast with their traditional dependence on local resources, which can be seasonal in availability, and can result in reduced pressure on the local ecosystems. This is commonly known as the “alternative income hypothesis” (Langholz, 1999; Wunder, 2000; Troëng and Drews, 2004; Brown and Decker, 2005). Many species that have traditionally been harvested for food or commercial trade can see their populations slowly start to increase as the markets shift and communities find that there is economic gain in preserving these species for ecotourism purposes instead. In his paper, Ralf Buckley (2012) points out:

“at least five percent of wild individuals [of the red-listed mammal species with available data] rely on tourism revenue to survive...take it away and animals are killed by hunters. It happens every single day, every time patrols stop or hungry locals lose conservation incentives. Simply put, if tourism money is cut abruptly, poaching will increase” (p. 29).

A supporting study in Costa Rica (Troëng and Drews, 2004) determined that the economic benefits from ecotourism in the Tortugero National Park provided enough incentives for the residents of the area to start protecting sea turtles instead of harvesting them for food. Other examples of conservation success include the protected areas in

Botswana, (Mbaiwa, 2015), India (Banerjee, 2012), Malawi (Bello, 2017). On the other hand, several studies have contradicted this “alternative income” hypothesis, citing situations where the development of the ecotourism industry failed to generate a conservation-mindset among local communities and even created hostility towards governmental organizations when the traditional streams of revenue were threatened (Lindberg et al., 1996; Bookbinder et al., 1998; Young, 1999; Barkin 2003; Stronza, 2007).

There are many factors that influence people’s motivation to participate in WBE and their proclivity to engage in pro-conservation behavior, the latter contributing to the preservation of the benefits that endangered species provide. Evidence has shown that WBE experiences can provide valuable educational opportunities that can translate to attitude or behavioral shifts, as participants are more inclined to share conservation-related messages on social media and increase the support for local nature once they return home (Mayes et al., 2004; Andersen and Miller, 2006; Filby et al., 2015; Wheaton, et al. 2016; Cheng et al., 2019; Clark et al., 2019). It is important to note that conservation inclination and intent does not always directly result in behavior change, but it can provide opportunities and guidance for possible change to occur (Ajzen, 1991, 2005; Jacobs and Harms, 2014; Hoberg et al., 2020). Conversely, other studies have debated the merit of ecotourism as an educational platform and have questioned whether these activities lead to significant increases in environmental knowledge (e.g., Markwell, 1998; Ryan et al., 2000; Powell and Ham, 2008). When wildlife-based tourism is improperly managed, it can cause detrimental effects to both animals and habitats, which can in turn create negative socioeconomic feedback loops that can become divisive

(Steidl and Anthony, 2000; Frid and Dill, 2002; Thomas et al., 2003; Beale and Monaghan, 2004; Fernandez et al. 2005; Goss-Custard et al. 2006). For example, visitors might become dissatisfied with the lack of wildlife to observe, or the mismanaged ecosystems they witness, impacting their likelihood of future return and additional investment, and eventually leading to a decrease in overall visitation rates.

On a purely ecological level, critical studies have investigated the supposed contributions of WBE towards conservation goals and have suggested these activities may be doing more harm to the wildlife involved, and therefore deserve a higher level of ethical scrutiny with regards to the respect being shown towards nature (Beale and Monaghan, 2004; Meletis and Campbell, 2007; Kerbiriou et al., 2009; Buckley et al., 2016; Blumstein et al., 2017). While many forms of WBE have the benefit of not physically containing animals behind walls or tanks, (e.g., zoos or aquariums), there are still various activities that allow humans to get extremely close to wild animals, potentially infringing on their autonomy and ability to express natural behaviors. Some examples of these are swim with dolphin excursions where tourists are allowed to physically interact and touch wild dolphins in either the open ocean or in locations where the animals are kept contained within “pseudo” free ranging environments. Meanwhile, whale watches often initiate close interactions by bringing human visitors directly into the paths of reclusive wildlife. Shark dives typically involve the presentation of food to entice sharks to travel to a designated site, altering long-term feeding and migration behaviors (Knight, 2009). These behaviors can also heighten the risk of direct harm to wildlife, via vessel strikes (Nielson et al., 2012; Guzman et al., 2012), overcrowding (Scarpaci and Parsons, 2015; García-Cegarra et al., 2019), and disruption to activity

budgets by forcing direction changes or causing cessation of necessary behaviors such as rest or feeding, (Senigaglia et al., 2016; Amrein et al., 2020). Some observers propose that whale watching will only become more sustainable when there is wider recognition of the intrinsic value of cetaceans, and animals are offered protection for their own sake and allowed to live parts of their lives completely free from human interference (Higham et al., 2015; Horau-Heemstra and Hjalager, 2021). While current research is still assessing the full impacts of tourism activities on wildlife, such as proving the biological and physiological consequences of these interactions, the rapid development of the tourism industry often outpaces the establishment of new regulations (or strengthening of existing ones) protecting wildlife (Garrod and Fennell, 2004), putting wildlife populations potentially at risk.

According to Christ et al., (2003), “biodiversity is essential for the continued development of the tourism industry, although there is an apparent lack of awareness of the links – positive and negative – between tourism development and biodiversity conservation.” Logically, one would assume that being fortunate enough to observe rare and endangered species would directly translate to an increased appreciation of and desire to protect and conserve them, but that is not always the case. In their 2008 study, Powell and Ham concluded that the industry-wide belief in the benefits of ecotourism (with regards to conservation) were largely unfounded and untested. In their paper, they cite other studies (e.g., Markwell, 1998 and Ryan et al., 2000) that shared the conclusion there was little to no increase in knowledge among participants of ecotourism; in situations where environmental knowledge did increase, the overall attitudes and behaviors regarding environmental preservation did not (Beaumont, 2001; Tubb, 2003; Wiles and

Hall, 2005). Overall, it can be extremely challenging to extrapolate the results of studies on perception and attitude shifts that are direct results of WBE experiences and link them directly with assessments of behavior change or utilize them for broader management goals, as they are usually based on participants' subjective (i.e., emotional) experiences, and influenced by interactions with other social (and environmental) elements. Instead, it may be more beneficial to evaluate the benefits of ecotourism in terms of outcomes (Ardoin et al., 2015) and to consider knowledge gain as a process, rather than merely a result, as it would allow WBE to encourage longer-term and more permanent behavior and attitude shifts as well as draw more applicable conclusions for the system as a whole (Ballentyne and Packer, 2011).

Conceptual framework and case study

I propose a conceptual framework to identify where the goals and motivations of stakeholder groups in this system (tourists and tour operators) align and what meaningful and actionable conservation outcomes can emerge from that consensus (Figure 2.1). Identification of this collaborative point will require better understanding of the motivations behind the different stakeholder groups. Research is still needed to accurately conclude when and in what ways ecotourism can contribute effectively to the conservation of wildlife and its habitats per its original goal, and learning why people engage in WBE will help decision makers determine how to best address the impacts of ecotourism so that future development of this industry will meet the needs of biodiversity conservation at relevant scales (Stronza et al., 2019).

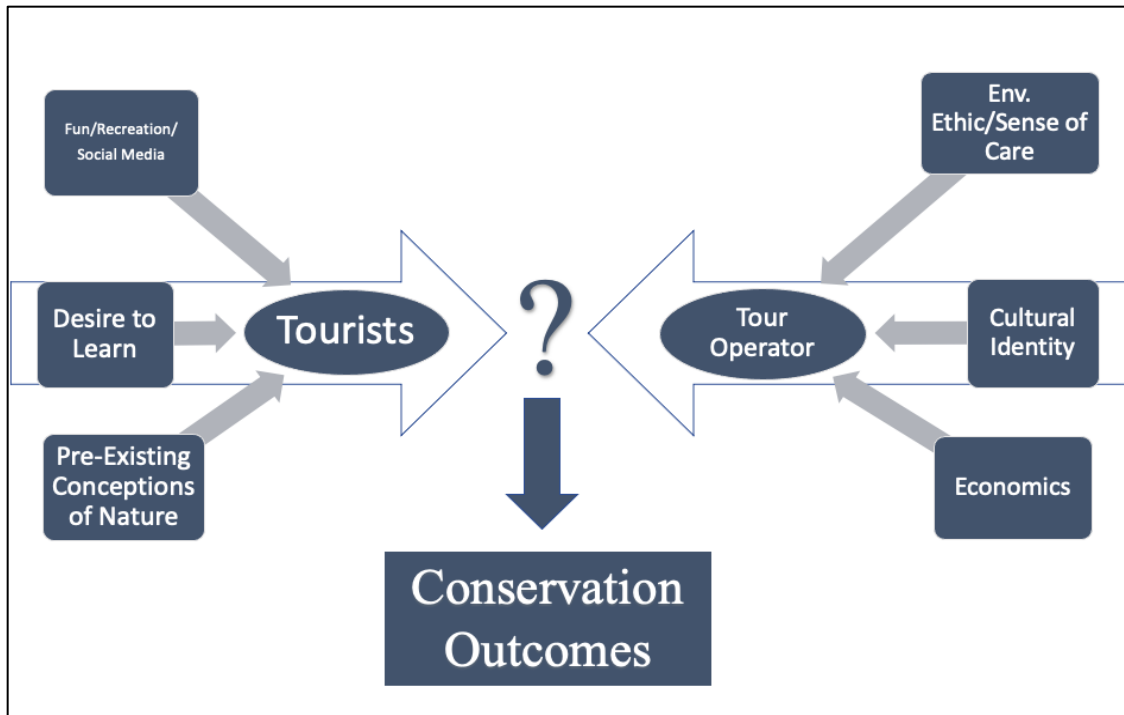


Figure 2.1: To create effective and actionable conservation outcomes, it is necessary to identify where the interests and motivations of the main stakeholder groups align. This also includes the factors that contribute to shaping the goals of each group as well.

Within Panama, a whale watching industry has been established in Las Perlas Archipelago just off the coast of Panama City, that is predominantly run by local fishermen who reside in the island communities, in addition to a couple of companies based on the mainland. The popular time to view whales occurs from July through November, which is when humpback whales (South Pacific Breeding Stock G) visit the archipelago for their breeding season. There are federal restrictions established in 2007 that are designed to protect the whales from harassment by boats and humans. These regulations include: boaters' maintaining a minimum distance of 250 meters from whales, a maximum speed of 4 knots (7 km/hour) when in proximity to whales, a maximum of 30 minutes observation time (15 when a calf is present), and a requirement that no more than

two boats may be in close proximity of the same group of whales at one time (keeping parallel distance between them) (ARAP, 2017; Ministerio de Ambiente, 2022).

The results of a previous study conducted in this location found that whale watching provided significant educational value for tourists, and that visitors derived higher levels of satisfaction when they were able to observe particular behaviors (e.g., breaching and tail-slaps; Cardenas et al., 2021). The research found that tourists were concerned with the lack of regulation compliance they observed from the boat operators, and many individuals stated that they personally did not want to contribute to any activities that caused harm or stress to wildlife. Meanwhile, conversations with some of the boat operators revealed a general lack of concern for whale conservation and led to the theory that the majority of the local community members that live on the islands in the Las Perlas tend to view whales as commodities and as benefits to income, rather than as sentient creatures able to experience stress (Cardenas et al., 2021).

There are likely misconceptions among tour operators that the ultimate tourist experience is achieved by getting as close as physically possible to an animal (Sitar et al., 2016). The common practice of advertising “guaranteed” wildlife sightings by tourism companies only increases the tension between tour operators and visitors, as the staff are aware that tourists have paid money for an experience and thus assume they are expecting a certain level of compensation (Margaryan and Wall-Reinius, 2017). Meanwhile, a study in Australia found that proximity to animals was not actually a major factor in satisfaction among whale-watch participants (Orams, 2000). This same paper revealed that despite the sizable amount of literature that has been published on the impacts of ecotourism on wildlife, there have been few studies on the impacts of the activities on the

watchers themselves, their motivations for participating in ecotourism ventures and what benefits they derive. Other research (e.g., Mallard, 2019) has found that stricter regulations and monitoring of tour operators does not always yield successful adherence to regulations and that a more effective route to enforce compliance is through the influence of tourist behavior, which then encourages responsible practices from tour guides and operators. If attitudes and preferences for wildlife conservation are significantly different between tourism operators and tourists, this could lead to potential misunderstandings about conservation goals and responsible ecotourism behavior.

In this chapter, I examine four main questions to better understand the social dynamics of the stakeholder groups. First, do tour operators believe that tourists hold conservation at high value, and thus are less likely to ignore existing regulations for sake of improving level of satisfaction of their guests? Second, are wildlife-watching experiences that include a wide range of wildlife-behavior sightings more contributory to visitor satisfaction? Third, are tour operators concerned about wildlife well-being, but believe it to be secondary to the satisfaction value of tourists? And finally, do tour operators find the idea of educational programs and training beneficial to both their valuation of wildlife as well as for an increased willingness to pay on the part of tourists?

Methods

This research took place in the Las Perlas Archipelago of Panama (8.41° N, 79.02° W), a collection of 200 rocky islands and islets located 60 km south of Panama City that is part of the Special Management Zone established in May 2007 (Guzman et al., 2008). The Archipelago is a major tourist attraction, both for international visitors and local citizens, who often frequent the islands during weekends or national holidays. The

waters around the islands are shallow and provide ideal breeding grounds for Humpback whales and other coastal species, with the former species serving as one of the main tourist attractions to the islands. Annually between June and November, approximately 1,000 Humpbacks travel up from their feeding grounds to the Las Perlas for the females to breed and give birth to their calves, which are raised in the waters of the Archipelago (Guzman et al., 2014). Most tourism activity is focused on two islands, Contadora and Saboga, although development has recently begun on the other southern islands as well. The local fishermen (lancheros) who reside on the island of Saboga have capitalized on the popularity of the whales and regularly provide whale watching trips using their private fishing boats, or “lanchas.” There are approximately six men who provide the bulk of the whale watching tours, and who are frequently recommended by other locals for their expertise and knowledge. For this chapter, I will refer to this group of individuals as “tour operators” or “lancheros” to differentiate from the tours that operate from the mainland and the single registered tour company on the island of Contadora, “Coral Dreams,” which has both a website and a page on Trip Advisor, and which is also run by a single individual. Tours typically last between two to three hours on average and leave throughout the day. Each tour operator establishes his own rate per hour and prices can vary between \$30-\$50 per hour.

The data collection for this project was based on the methodology previously employed by Cardenas et al., (2021) and consisted of surveying tourists on Contadora who had completed a whale watch with one of the local operators. Based on this previous study, a low approximate estimate for the tourist population visiting Contadora island is about 1000 people annually. The questionnaire was administered from July to October

2022 and tourists were approached as they were in the queuing area of the island's main dock, prior to boarding the ferry for departure. The questionnaire was provided in both Spanish and English, to ensure that I was able to capture both local and international tourists. Participants were provided with a printed consent form and verbal agreement was acknowledged. (The estimation of the tourist population does not include the population of Panamanians who have vacation homes on Contadora, and who frequently travel out to the islands throughout the year and often utilize their own private boats rather than the main ferry. Because of this they were excluded from my survey yet are still an acknowledged part of the system.)

I collected demographic information about participants, such as their country of origin, which was categorized into "national" and "international" for analysis. I used 5-point Likert scales to assess participants' pre-existing knowledge regarding whales and environmental awareness (ranging from Strongly Disagree to Strongly Agree), their satisfaction with the tour (1 = Very Dissatisfied, to 5 = Very Satisfied) and multiple-choice questions to inquire about the factors that contributed to their satisfaction with the tour (and likewise, improvements that would have contributed to their experience). The level of environmental awareness was compiled to ascertain the pre-existing knowledge that tourists to Las Perlas generally arrive with, regarding environmental issues and whale conservation and how it might reflect their environmental identities. Research has shown that environmental identity can be predictive of pro-environmental behaviors and individuals who feel more connected with nature will often be more likely to perform behaviors that align with these environmental beliefs (Clayton and Opatow, 2003; Van der Werff et al., 2013; Clark et al., 2019). Average environmental scores were calculated

for each visitor – answers were coded on scale from -2 to 2) - and correlated with other survey responses.

I also conducted semi-structured interviews with the seven lancheros who provide the majority of the local whale watch tours, with the assistance of student research assistant who helped with translation when needed. Interviewees were identified based on existing relationships and recommendations, and saturation was reached when we started to receive the same names. Interviews were conducted in Spanish, lasted approximately 15-20 minutes in length, and recorded only with the consent of the participant. Questions included how long the operator had been offering tours, the main perceived benefits they receive from offering this service and what they believe their guests enjoy most about the tours. I also asked participants to share any interesting stories they had about their interactions with whales, and their knowledge about the existing regulations. Both the survey and interview questions were created and deployed with approval from the Institutional Review Boards of both the Arizona State University and Smithsonian Tropical Research Institute (see Appendix A for full survey).

Results

Tourist Satisfaction and Motivation

Overall, I collected 127 responses, 8 of which were partially completed, leaving 119 full responses. Of these, 28 were from residents of Panama, 20 came from other countries in Latin America and the rest (71) were international visitors (e.g., from Europe, United States). Most tourists in 2023 (61%; Figure 2.2) reported that their reason for going out on the tour was to see whales. Additionally, the majority of tourists (111 out of 117) surveyed said they were satisfied with their tour – rating it a 4 (somewhat

satisfied) and 5 (very satisfied) on the 5-point Likert scale (30% and 57% respectively; Figure 2.3). The average satisfaction rating was 4.49 (n=127) out of 5, which according to scale developed by Pearce (2006) would constitute a “high” satisfaction rating. Of those who gave the tour a rating of 3 or less (n=15), over half (n=8) said they would still

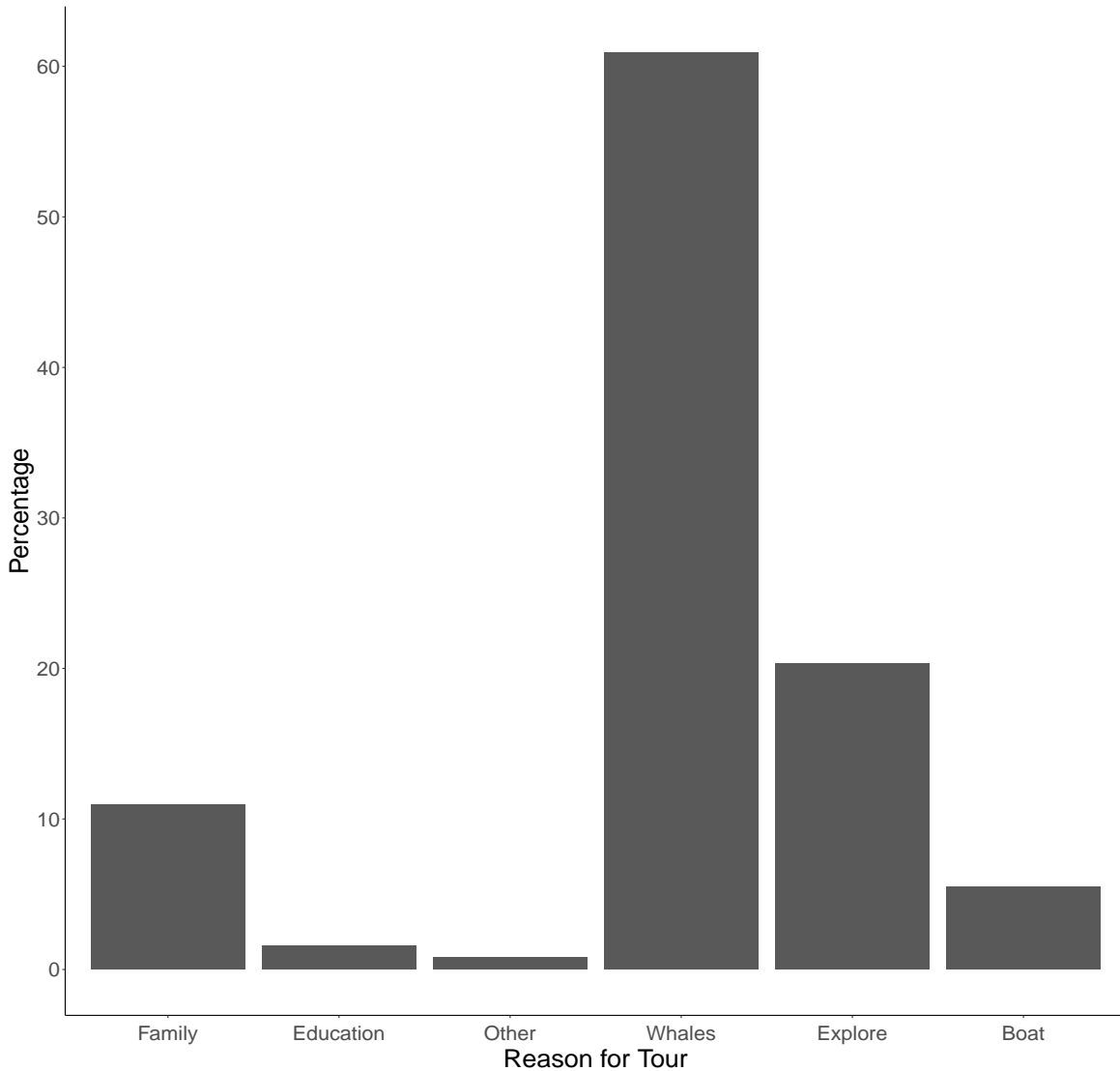


Figure 2.2: Breakdown (in percentages) of reasons why tourists wanted to go on a whale watch tour. Self-reported definitions of “Other” included seeing other wildlife, exploring and tourism (n= 128). “Family” = spending more time with family; “Education” = Learn/Do Something New; “Whales” = see whales; “Explore” = Sightseeing/Exploring; “Boat” = Spend a Day on the Water. 61% said seeing whales was main reason to go on tour, while 20% wanted to spend explore the area.

have enjoyed the tour even if they had not seen whales, which points to other factors contributing to their enjoyment of the experience. These results are consistent with previous work suggesting that whale watching was one of the main motivations that tourists want to visit Las Perlas (Cardenas et al., 2021).

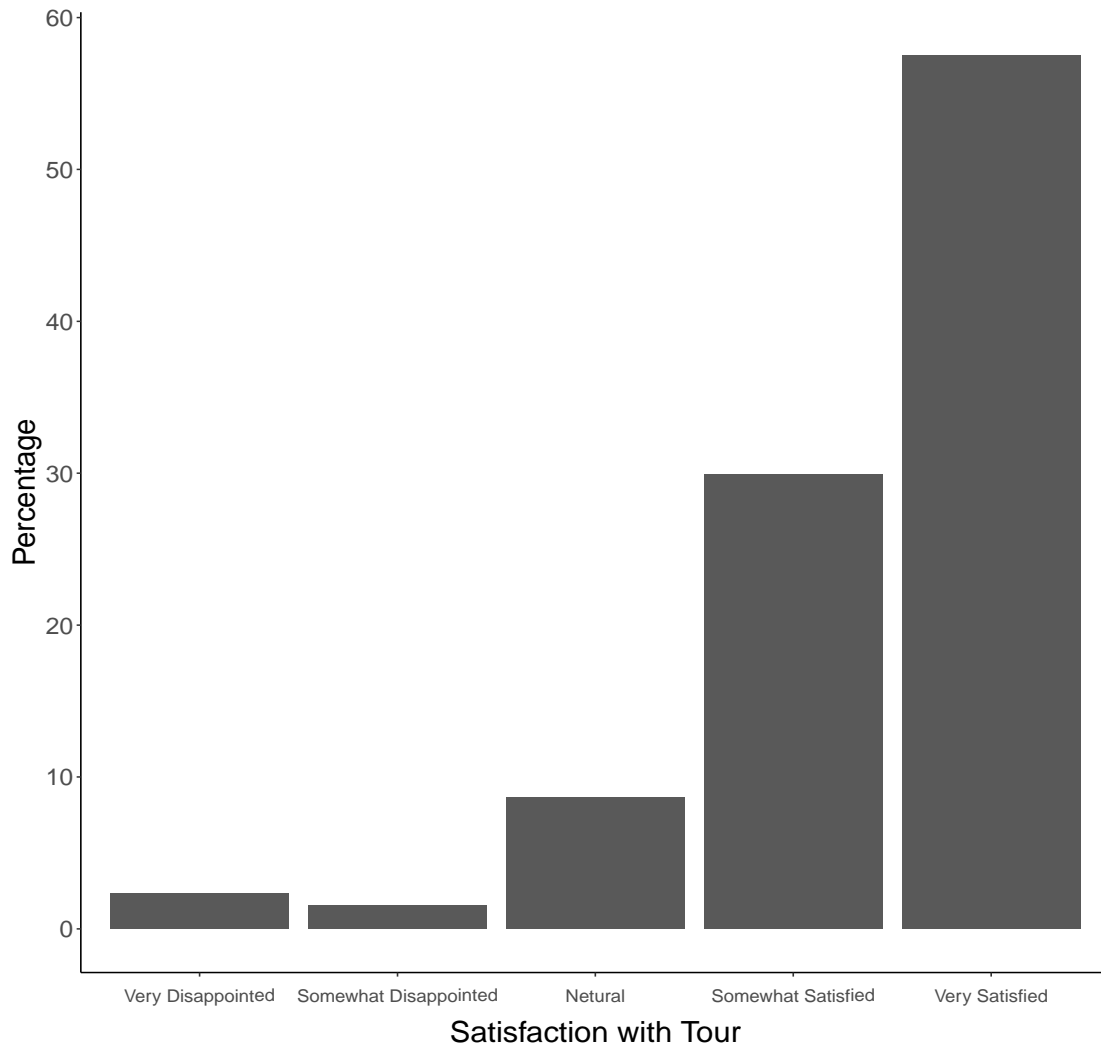


Figure 2.3: Levels of satisfaction with whale watch tour. A score of 1 = Very Dissatisfied, 2 = Somewhat Dissatisfied, 3 = Neutral, 4 = Somewhat Satisfied, and 5 = Very Satisfied. Counts are represented in percentages. (n=127). Majority (94%) gave the tour experience a rating of 4 or 5.

Notably, over half of the overall respondents (63%) said they would be satisfied with the tour experience even if they had not seen a whale. When asked to explain their

reasoning, the answers mainly centered around the understanding that seeing certain wildlife is not ever a guarantee, with one individual saying: “...[*nature*] is always unpredictable, which is the beauty of it”), and others expressing that they were still able to enjoy the natural beauty of the island, beaches, and viewing other species of wildlife. Tourists are usually offered the opportunity to go snorkeling in nearby reefs or bird watching on some of the nearby islands, in addition to looking for whales, so many times tourists will still have a chance to observe some wildlife regardless of their success in locating whales.

The survey also asked tourists what factors contributed to the tour experience and 88% specified that the primary contributor to their satisfaction with the trip was their ability to see whales in general (Figure 2.4). Results suggest that the primary contributor to tourist satisfaction with the trip was the ability to see whales in general. It is important to note that this was differentiated from “getting close to whales” which was only reported 3% of the time as a factor for satisfaction. I also asked visitors if they had been hoping to see whales exhibit a particular behavior, and while 69% said yes (n = 70), their average satisfaction score (4.41 out of 5) was identical to that reported by the 52% (n = 51) who had not had a pre-existing desire to see a certain behavior. Meanwhile, “being on the water” was listed as the second most popular contributor to satisfaction (6%), and tourists expressed sentiments that echoed this, saying, “I love being on the water,” “it is relaxing to be at sea and with family,” and “I’m always up for adventure and sometimes going out and experiencing the ride is just as worth it.” Most of the total respondents (88%) said they were comfortable with the number of boats that were out watching whales at the same time, although about half said that they did witness crowding of boats

around whales. Tourists were also asked if they felt like their boat operator exhibited a concern for whales (e.g., not crowding whales or seeming to keep distance to respect their space); out of a potential score of 5, the average rating was 3.42 with 5 being “very concerned about whales” and 1 being “showed no concern.”

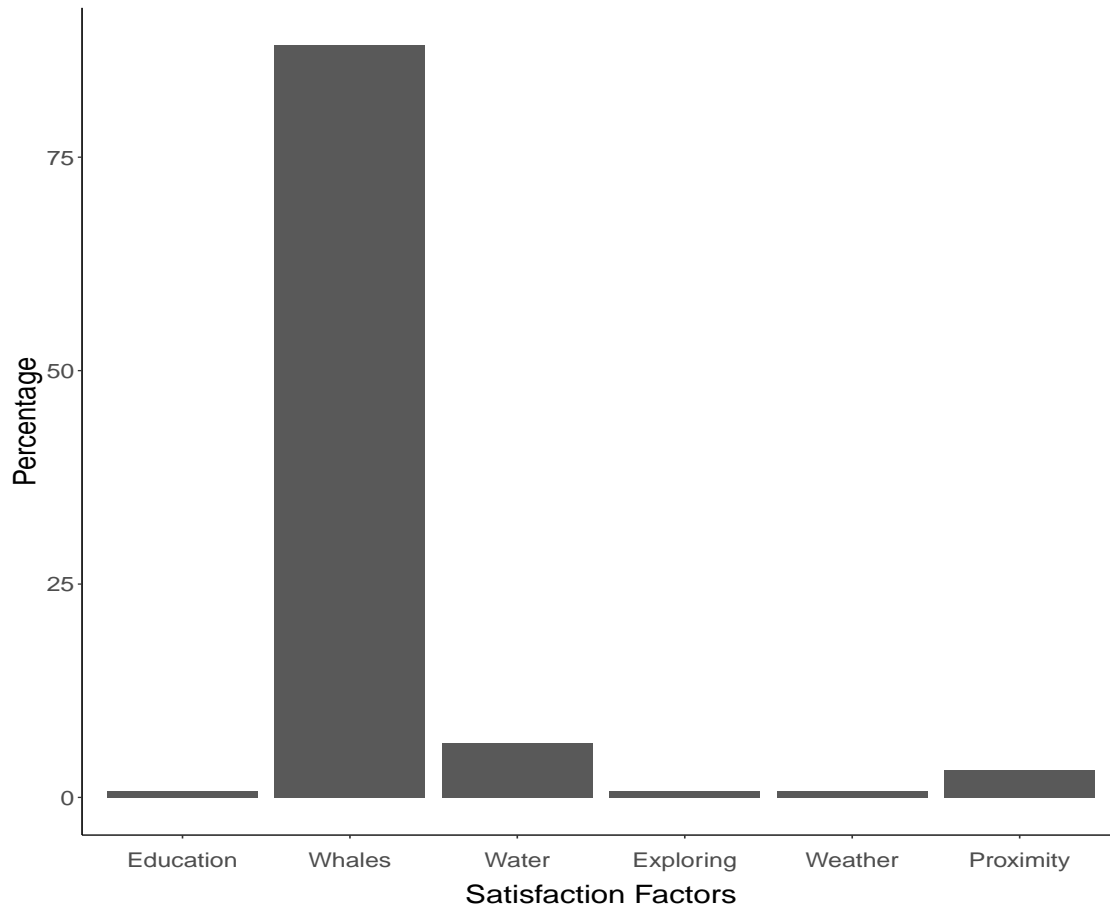


Figure 2.4: Satisfaction factors that contributed to a satisfactory whale watching experience. (n = 125). 88% said that seeing whales (at all) was the main contributor, while getting physically close to the whales was only selected by 3% of the respondents. “Education” = Learning Something New About Whales/Ocean and Tour Operator Knowledge; “Whales” = Seeing Whales; “Water” = Being on the Water; “Exploring” = Exploring Local Area; “Weather” = Enjoyable Weather; “Proximity” = Getting Close to Whales.

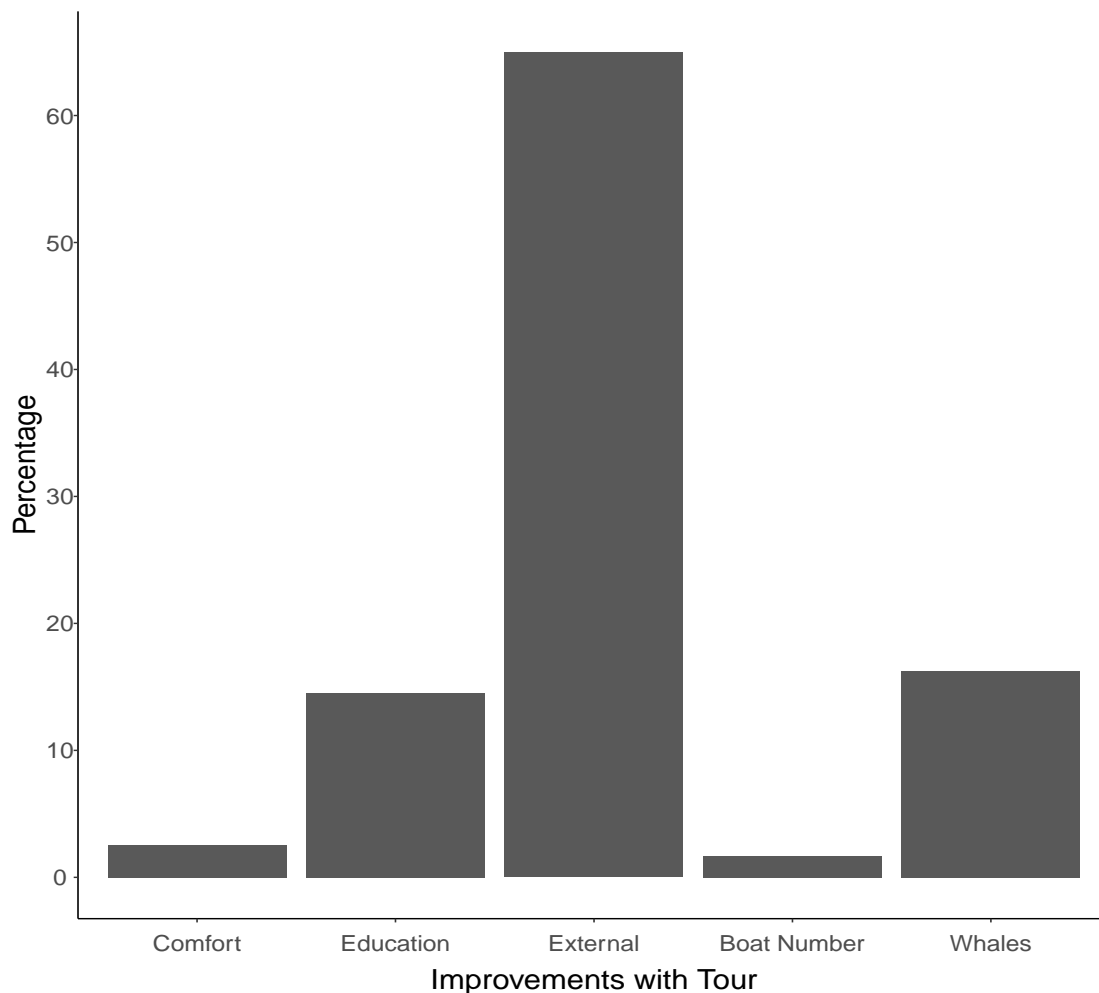


Figure 2.5: Improvements that would contribute to a more satisfactory whale watching experience (n = 114). “External” category combines the follow answers: better weather, better wave conditions, seeing more whales. “Comfort” = Comfort/Cleanliness of Boat; “Education” = Knowledge of Operator, Learning Something New About Whales/Ocean; “Whales” = Getting Close to Whales. 65% said one of the external factors contributed to their satisfaction with the tour, while 16% wished they had been able to get closer to the whales, and 14% said they enjoyed getting to learn something new.

Tourists were also asked what factors would have contributed to a more satisfactory tour experience (Figure 2.5). Some of the multiple-choice options included: seeing more whales, getting closer to whales, operator knowledge, better weather,

comfort/cleanliness of the boat (see Appendix for full survey) and respondents were asked to pick up to three answers. For analysis, I combined the following options: seeing whales, better weather, and better wave conditions into one category - “external” - since those are factors the operators have no physical control over. Meanwhile, “knowledge of operator” and “learning something new” were combined into “education,” since they both represent the same concept. A large portion of respondents chose “seeing more whales” (65%, external), “getting closer to whales” (16%), and “education” (14%).

Pre-existing Conservation Motivation

In general, tourists had positive pre-existing opinions regarding environmental awareness, with approximately 86% agreeing (both somewhat and strongly) that they are environmentally conscious, and that protected areas should be maintained even if it means reduced access to those spaces (Figure 2.6). What is interesting is that while the majority of respondents (90%) believe that others should be environmentally conscious, only about 59% consider themselves to be environmentally active.

When it comes to whale conservation, 92% agree either somewhat or strongly that the public should be educated about the status of whales and 72% said they feel they have a personal responsibility to help conserve whales. Meanwhile, 57% disagree (either somewhat or strongly) that whales are protected, 62% disagree that captivity has benefits to conservation and only 64% believe that whale watching has conservation contributions. These results are somewhat comparable to the results found by Cardenas et al., (2021) where 80% said they felt they had a responsibility to help protect whales, and only 53% disagreeing that whale watching was beneficial for conservation.

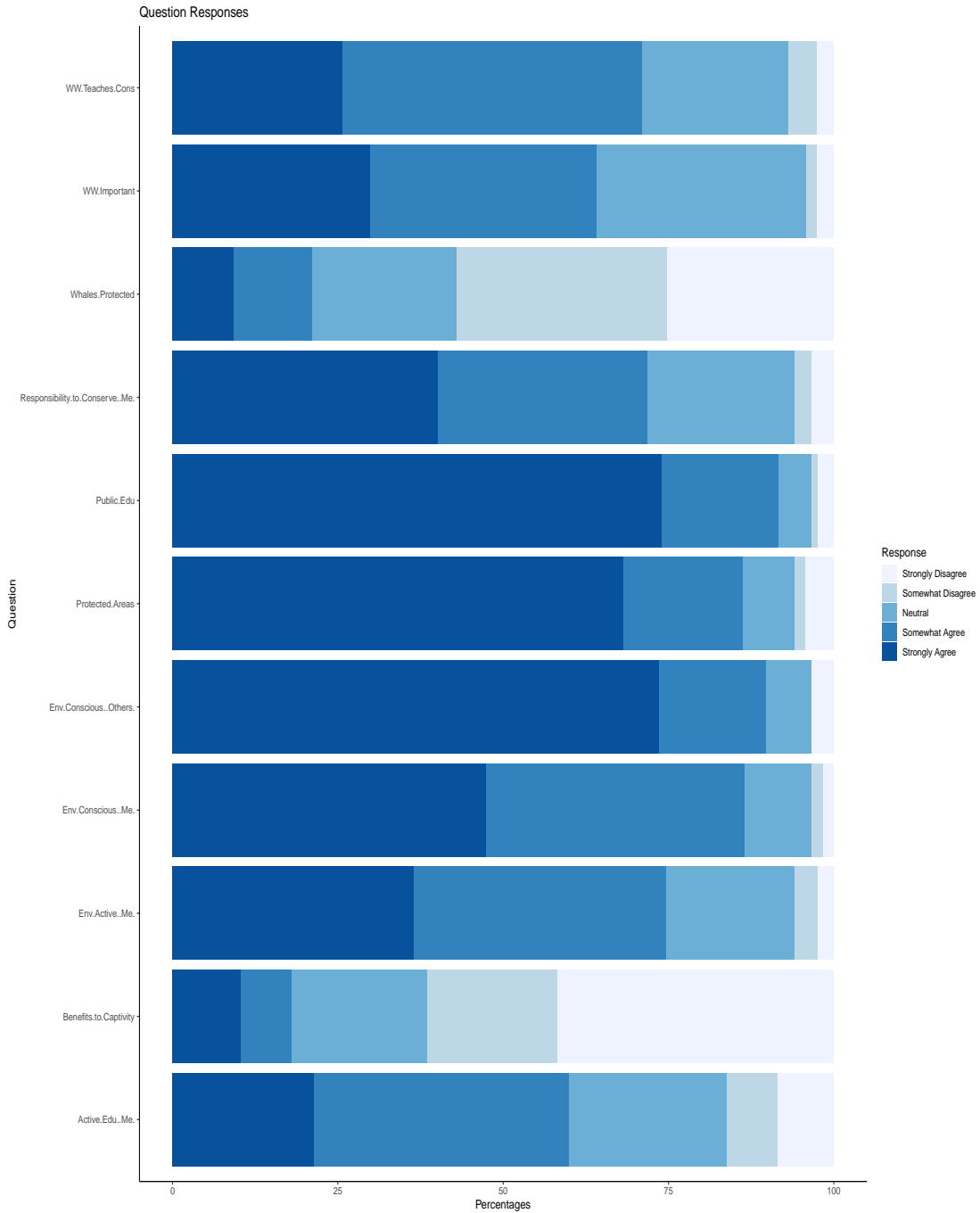


Figure 2.6: Level of agreement with statements about whale conservation and environmental consciousness. Bars represent percentages and are scaled for sample size of each response. (i.e., not all questions were answered by every respondent).

Interview Responses:

In addition to tourists, I also interviewed the seven boat operators who offer whale watching tours on Las Perlas. All operators reside on the nearby island of Saboga and originally started in other professions (e.g., fishing, construction, working on shrimp boats). For these operators, the average length of time spent offering whale watching services was 13.5 years. To answer one of my main research questions regarding their motivations for being part of this industry, I asked what benefits they received from the service, what they enjoy about the job and what they thought their guests enjoyed the most about the experiences. A few operators (4) reported that the main benefit was economic (e.g., having a job and a means of providing for their families); the others mentioned different benefits, such as being out on the water and how the job does not feel like work as a result. All the tour operators believed that tourists seem to care about whales and agreed that everyone should care about them. They also thought that their guests really enjoyed being able to see whales, especially young kids. In turn, the operators enjoyed being able to meet individuals from other countries and share things about whales and the local environment.

I asked the operators whether they felt that their level of knowledge about whales was higher than their guests, and all but one believed that to be true. However, they did acknowledge that the language gap often prevented them from being able to educate and generally communicate with tourists, who often were international and do not speak Spanish, a situation made more challenging by the fact that many of the operators have not received any previous language instruction. Every one of the individuals I spoke with

said that they would be happy to attend a training program if it was provided. There was an educational program offered several years ago that taught the operators about the regulations, basic whale biology and the appropriate methods for approaching and observing whales. However, only a handful of the men were able to attend the training, since it took place on a different part of the archipelago, and there has not been a follow up training offered since. These were cited as the main reasons why there is not universal adherence today.

Surprisingly, all the operators confirmed that they knew about the official regulations that protect the whales, however, none of them accurately knew the specifics. For example, they inaccurately stated that boats were required to keep 20, 50, 200 meters away from whales (rather than the mandated 250 meters) and admitted that many of their colleagues do not follow the rules. Every one of the operators agreed that the regulations were good to have and that they needed to be improved. One individual specifically mentioned his desire that any updates to regulations should also include direct assistance and support for the operators and their businesses as well. The operators observed that the whales did appear to be stressed by the presence of boats, particularly larger ones with bigger motors. One operator specified that this was typically the fault of locals, who visit from the city and often have their own private boats. He said, *“The bigger boats belong to rich people and it is hard to make them understand what they should or should not do. They do not listen. They do not care at all. They don’t come here for the whale watching.”* It would be useful for a future study to deliberately seek out the perspectives of this sector of the population, regarding their thoughts on protecting whales and the future sustainability of the tourism industry on Contadora. While these individuals were

not included in my research, they are still stakeholders in the system as they also have an investment in conserving their local ecosystem and thus their investment.

Discussion

This research sought to identify whether there were notable attitudinal differences toward whales between tourists and tour operators, differences that might result in disregard for responsible ecotourism behavior (Figure 2.1). Specifically, I wanted to learn if tour operators were under the impression that tourists do not have high conservation concerns and would want to get as close as possible to the whales. Correspondingly, this could lead the operators to be more likely to ignore existing regulations for the sake of increasing their guests' satisfaction. I also wanted to learn why tourists were interested in going on these types of tours and what actually constituted a satisfactory tour experience. Below I summarize the results and implications.

Tour operators are unclear about what tourists want from a whale-watch

Tour operators reported that they believe what makes the guests happiest is when they get to observe whales jumping (breaching) or slapping the water. According to Orams (2000) a common misconception among tour companies is that tourists need to be able to get physically close to wildlife to feel satisfied by the experience, as evident by their marketing campaigns that frequently reference "getting close to whales" (pg. 562). While 69% of visitors surveyed said that they had hoped to witness a specific behavior (45% of those specified breaching as that behavior), the average satisfaction score for this group was identical to the group that did not indicate a desired behavior. Overall, the average satisfaction score across all surveyed visitors was 4.49 out of 5, and 63% said they would have still had an enjoyable tour even if they had not been able to see whales.

That is not to say that seeing whales was not a priority: 61% said that their main goal for taking the tour was to see a whale, and seeing whales was the main source of satisfaction for 88% of guests. However, seeing whales was a separate factor than “getting close to whales,” and only 3% of respondents said that would have improved their experience. Based on my personal observations, tourists appeared to get very excited when they even knew a whale had been sighted nearby even if they never were able to get close enough to see the whale physically surface (e.g., they only saw the spray from the blow hole from afar). There are some tourists who consider themselves “wildlife specialists” (e.g., exotic bird watchers), who value the challenge of traveling to the more remote, inaccessible places for opportunities to view exclusive wildlife. These individuals embrace the idea that wildlife may be elusive and hard to spot, but they appreciate the challenge of the experience and still find the trip enjoyable even when they are not able to spot their targets (Knight, 2009). Overall, this speaks to the benefit of using a more holistic perspective to qualify a wildlife tourism experience, and that there are potentially many other sources of satisfaction that go beyond just a few single moments or interactions with wildlife, that can help people feel more immersed in the full experience.

When I examined potential improvements that visitors would have appreciated having on their tours, I found that the ability to see more whales was ranked highest (52%). However, boat operators are not physically able to control the number of whales that might be available to view on a given day, along with other external variables such as the weather and wave conditions. These findings further support the conclusion of Orams (2000) that whale watch tourists in Australia were satisfied with their tour experience even when whales were not observed, and again that the physical distance from the

animals was not a major contributing factor. There are many external factors that the operators may not be able to control – e.g., the actual number of whales seen or the weather conditions – but there are also those that are achievable. These include the cleanliness and comfort of the boat and the operator’s ability and willingness to share his or her knowledge about whales with guests. Additionally, if seeing more whales is an important contributor to satisfaction, then it would lend support to the idea of educating tourists on how their own actions (e.g., patronizing or encouraging unsustainable WBE practices that stress wildlife) might be affecting the behavior of the whales they want to see by scaring them away.

It is worth noting that 16% of visitors said that they would have enjoyed getting closer to whales, which points to the idea that some guests may not be aware of how this action might affect the animals and alludes to the necessity of more educational efforts that aim at raising consciousness among tourists (e.g., consumers). Zeppel and Muloin (2008) that looked at the role educational activities (e.g., interpretation) play in managing tourism behavior, and concluded that it is vital for marine tourism programs to provide educational outlets for their clients such as through interactive lectures and also to manage the tourists’ desires to be near wildlife by explaining why getting closer is detrimental. Additionally, studies have found that tourists who might be classified as “generalists,” or non-expert level tourists compared with the previously mentioned wildlife “specialists” (Duffus and Dearden, 1990) tend to be more tolerant of crowding behavior (*see “Role of Pre-Existing Environmental Beliefs”* section; Caitlin and Jones, 2011), which appears to be the primary composition of this tourist population.

Factors that contribute to the satisfaction of whale watch tourists

Approximately 16% of tourists reported that they would have enjoyed the tour more if they had been able to learn more about whales. Several tourists added specific comments at the end of the survey that further emphasized their strong desire to learn more on their tours (although interestingly, “education” was not listed as one of the top reasons why tourists went on the tour; Figure 2.2). Examples of this sentiment included: *“I would appreciate an effort to educate about and regulate whale watching. I do not have a real clue about the risks/disturbances for the whales at this moment.”* And: *“They must professionalize the guides; everyone should give basic explanations. ours did not speak the entire tour (not a word) ...They should also be concerned for the guides and especially the tourists understand that they should not approach or touch, try to disturb as little as possible and be respectful during the sighting.”* This finding supports the findings by Lück (2003) and Ballentyne et al., (2007) that found tourists appreciate the educational aspect of these tourism activities and find it integral to the whole experience.

Interpretation is traditionally defined as an in-situ educational program or activity that presents information to visitors in a voluntary format (Orams, 1995; Lück, 2003; Stamation et al., 2007; Lopez and Pearson, 2017). This is often identified as the main solution to creating sustainable human-wildlife interactions (Russell and Hobson, 2002; Woods and Moscardo, 2003; Moscardo et al., 2004; Peake, 2007). Some of these activities include talks or presentations given by tour guides or naturalists accompanying the tour, visitor centers or signs and displays. The information usually describes the species or habitat being viewed, along with biological information (behavior, reproduction etc.), and ideally guidelines for safe-practices and local conservation issues.

Previous research has drawn connections between interpretation offered on marine wildlife experiences and increased conservation education outcomes (Forestell and Kauffman, 1990; Tisdell and Wilson, 2005; Andersen and Miller, 2006; Cater and Cater, 2007; Townsend, 2008). Enhanced emotional responses may in turn lead to greater environmental concern and increased support for conservation issues and protection of endangered species (Forestell and Kauffman, 2007; Wilson and Tisdell, 2003). The specific study by Zeppel and Muloin (2008) looked at the conservation and education benefits that emerged from marine wildlife tours in Australia and utilized a framework devised by Orams (1995, 1999) that provided indicators of enjoyment and learning that contribute to pro-environmental attitudes and thus future behavior changes. The foundational theory of Orams's framework is that wildlife tours that have a strong educational focus can lead to long-term lifestyle changes for participants, including increased efforts to minimize impacts and to donate to conservation-based causes. Zeppel and Muloin (2009) concurred that it is vital for marine tourism programs to provide educational outlets for their clients (via interpretation, or on-sight education activities led by a guide) as well as manage the tourists' desires to be in close proximity to wildlife. Cardenas et al., 2021 highlighted that much of the existing research on the contribution of interpretation on tourist satisfaction and pro-conservation motivation has not included Latin America, except for one study by García-Cegarra and Pacheco (2017) in Peru.

Tour operators concern about well-being of whales

Based on the conversations with the lancheros, all of them seemed to speak fondly about the whales (e.g., one of the operators said he frequently sings to the whales), and they all believe that everyone should care about protecting whales. However, almost

every operator admitted that the other drivers are not good at following the regulations and boats frequently follow and crowd the whales. While most of the total respondents (88%) reported that they felt comfortable with the number of boats that they observed watching whales at the same time, about half said that they did witness crowding of boats around whales. Tourists were also asked if they felt like their boat operator exhibited a concern for whales (e.g., not crowding whales or seeming to keep distance to respect their space) and out of a potential score of 5 (showed high level of concern), the average rating was 3.42. Avila-Foucat et al., (2013) found that crowding can negatively impact satisfaction as well as the rate of return among tourists. It should be noted that there is an identified difference between “reported crowding” which is the actual number of boats that an individual observed, and “perceived crowding” which is the subjective assessment of whether that individual thought that number was appropriate. Almost all the respondents who indicated they were comfortable with the number of boats around the whales qualified that theirs was one of only two, if not the only boat, present at the time. Thus, it is hard to ascertain whether these responses were accurately conveying the level of comfort felt by individuals or was just a reflection of the current level of boat activity in this system. However, this finding supports previous research which shows that tourists tend to experience satisfaction when their tour operators obey regulations and reduce their impact on whales (Lück, 2003; Draheim et al., 2010; Kessler et al., 2014; Cardenas et al. 2021).

While a few of the operators mentioned that they enjoy their work because it allows them to interact with guests and be out on the water, the majority referenced the economic benefits that the job provides. Currently there is no universal hourly fee for

whale watches in Las Perlas, and each operator must negotiate his own individual prices. The average per hour price for 2023 (across all operators) was approximately \$55 per hour. (These were based on self-reported amounts paid by tourists, which were not always consistent in their form. For example, some people said they paid per hour while others per person. Therefore, the average cost per hour was assumed based on amounts reported as “per day,” as tours typically lasted 3-hour hours. However, 77% of all survey participants said they would have been willing to pay more, provided they knew the money was going towards conservation efforts and about half (51%) said they would be willing to pay higher amounts if their tour incorporated the improvements they noted. Given that existing research has pointed to the increased willingness of tourists to pay higher fees (especially in protected zones or national parks) future research would be well served to explore the economic benefits that could emerge if pricing and services were able to become more standardized (Peters and Hawkins, 2009; Murphy et al., 2018; Schuhmann et al., 2019).

The Role of Pre-Existing Environmental Beliefs

My study revealed little to no effect of pre-existing environmental beliefs or preconceptions on a visitor’s proclivity to engage with whale watching or satisfaction with the tour. However, it is worth noting that while the majority (90%) of visitors believe that others should be environmentally conscious, only about 59% consider themselves environmentally *active*. This could touch on a finding from a study by Moscardo et al., (2004) that found that conservation messaging must go beyond just ecology and climate change issues, and present tangible, approachable steps that individual visitors can take to make impactful change in their own local environment.

Ballentyne et al., (2007 and 2009) found that tourists often desire this practical information, and that it is important for visitors to be encouraged to think about the broader impact their individual actions can have on sustainability and climate issues. A study by the Monterey Bay Aquarium showed that exhibits which explained the risks of climate change but failed to present feasible solutions, eroded visitors' confidence in their abilities to combat conservation issues and diminished their motivation to act (Yalowitz, 2004). It is quite likely that tourists in my study shared this sentiment and do not feel confident in their ability to manifest their environmental goals into tangible, relatable actions. This suggests a valuable point of potential intervention that would provide a means for tourists in Las Perlas to not only learn about the local system and wildlife but also wider global concerns as well. For example, more than a few tourists noted (verbally and written) how much trash and pollution they observed on the beaches and around the archipelago, a result of rainstorms carrying trash from terrestrial landfills. It could be valuable for tourists to learn about the connections between these systems and how their everyday sustainability actions (e.g., recycling, petitioning for better waste management) could affect the landscape they are witnessing.

It is important for future management plans to also include recognition of the types of tourists who are visiting Las Perlas (and partaking in whale watch tours). Traditionally, wildlife tourists are classified as either "generalists" or "specialists" (Duffus and Dearden, 1990; Scott and Shafer, 2001; Needham et al., 2007), with the first being defined as infrequent partakers who typically do not view the activity as central to their identity and thus do not tend to invest as much time and money into increasing their skills or obtaining equipment. Meanwhile, specialists are well-experienced in the specific

activity, are more accepting (if not preferential) towards less developed sites, require less interpretation and guidance to enjoy the activity and tends to be more conservation minded. According to Duffus and Dearden's wildlife tourism framework (1990), it is possible to track the development and needs of a tourism site, and most notably, the level of risk for environmental degradation and over-use, based on the composition of its audience. Their framework explains how, as a specific location becomes more popular and attractive to visitors, the tourism population will become more dominated with generalists, as the specialists will move on to other, more remote, and less crowded locales that better suit their needs. As the population shifts, the host location will adapt to meet the needs of most visitors, which is typically marked by higher rates of development, infrastructure installation and often higher levels of anthropogenic disturbance.

While the specific population in our study appeared to be conservation-minded, with most respondents responding affirmatively to being ecological minded (Figure 2.6), only about half of the participants indicated that the main reason they had come to Panama was for ecotourism pursuits (although the specific type of ecotourism was not defined). This was echoed in the number of visitors who had previously been out on a whale watch (52 out of 117). Our findings correspond with the findings of Bentz et al., (2016), who found both specialist and generalist whale watchers in the Azores had limited prior experience (e.g., 1-2 previous whale watching experience) and comparable levels of environmental awareness. For this reason, Bentz et al. (2016), suggested that a new category of tourist be considered, "passionate [wildlife watchers]" who are highly motivated to pursue a WBE activity with no combined previous experience. This

contrasts the more typically observed development trend: when generalist population starts to become more dominant, tourism operations tend to prioritize tourism volume over quality. However, when the tourism population appears to defy the trend (such as in this case), it might be in the best interest of management to prioritize high quality experiences to encourage return visitation and future investment.

Policy Implications

The results of this project help identify some practical recommendations for the Panamanian government to ensure the development of a sustainable whale watching industry. The majority of tourists I surveyed (76%) identified as international (not from Panama). Of those, 41% said they came primarily for the ecotourism, and of that portion, 68% said they went whale watching with the intention to see whales. Additionally, 77% of participants said that they would be willing to pay more for their tour (provided they knew the money was going towards the conservation of whales). A study in 2007 of tourists in the Dominican Republic found that over 80% said they would be more likely to visit a specific country, if they knew the country had a strong commitment to whale and dolphin conservation (Draheim et al., 2010). Given that whale watching is growing in popularity and has outpaced development of rest of tourism industry (and as of 2006, whale watching was estimated to contribute around \$3,140,375 to the national GDP of Panama (Hoyt and Iñiguez, 2008) it seems crucial that decision makers ought to weigh the opinions of visitors heavily when considering what more sustainable (and therefore holistic) wildlife-based tourism development in the area will look like (Figure 2.1).

One potential way to achieve a more sustainable model of whale watching would be through the creation of educational training programs for both the guides and for

tourists. In the conversations with the lancheros, I determined that there was a training program that had been piloted by one of the national conservation groups (MarViva), but it had only occurred one time and not all the operators had been able to attend. According to a report by Hoyt and Iñíguez, (2008) there was also a conference on whale watching in 2007 (hosted by Universidad Marítima Internacional de Panamá (UMIP), WDCS, Fundación Cethus) and a “Responsible Whale Watching” workshop in 2006 (hosted by UMIP, Autoridad Marítima Panamá (AMP), Instituto Panameño de Turismo (IPAT), ANAM, FOAR (Argentina). It is unclear if either of these are the programs mentioned by the lancheros. As the population of drivers has shifted slightly over the years, this has resulted in fewer of the operators accurately following the training opportunities.

Through the interviews, I deduced that none of the operators accurately could recall the details of the existing regulations, most notably how close they are allowed to bring their boat in proximity of a whale. However, all the operators clearly expressed a desire and willingness to participate in any future trainings that were provided, especially if they included programs for the drivers specifically (e.g., language, business). A few of the boat operators expressed a desire to converse more easily with their guests and learn about them as well. Informal conversations with tourists and some of the locals who are peripherally involved with the whale watching industry, revealed a desire for some sort of whale “museum” or educational center, where visitors could learn more about the history of the islands, as well as basic whale and other animal biology. (A couple of tourists explicitly added to their survey: “*A whale museum or conservation station would be nice on the island to help protect the whales and also the local community*” and “*I would appreciate an effort to educate about and regulate whale watching. I do not have a real*

clue about the risks/disturbances for the whales at this moment”). There is growing interest from institutions to help foster research interest in Panama (e.g., Arizona State University, Smithsonian Tropical Research Institute), and the Las Perlas Archipelago presents a myriad of opportunities for on-going and innovative research (especially by students). It might be achievable to grow this into the development and installation of educational programs on one or more of the islands.

The adoption of a multilevel management approach provides several benefits, including greater recognition of the different and occasionally controversial needs of the stakeholders involved in the system; creation of vertical as well as horizontal flows of knowledge; inclusion of a wider variety of knowledge types and shared development of new information among stakeholders (Dietz et al., 2003). Adaptive co-management of systems is focused on drawing connections between the acquisition of knowledge that is acquired through both experiential and experimental learning, and the development of collaborative policies and solutions (Armitage et al., 2009). Space must also be made for biocultural knowledge, which acknowledges the role and contribution that local and cultural knowledge can make to further conservation goals (Gavin et al., 2015). This sharing of knowledge is crucial for the establishment of trust and understanding between and among involved entities, through deliberate inclusions of various perspectives and types of knowledge. Many of the operators were initially suspicious of my desire to talk with them, and thus I had to be very careful in my approach to ensure they did not mistakenly believe I was reporting on them to the government. This points to an already existing lack of trust between the *lancheros* and the government, which will need to be improved to facilitate any functional collaboration. All of these changes would greatly

contribute to a higher likelihood of acceptance and adherence to regulations by members of the community, as well as increased capacity of resource managers to be able to respond to uncertainty in proactive ways (Manwa, 2003; Armitage et al., 2009; Cook et al., 2022).

One positive example of successful co-management of WBE is El Vizcaíno Biosphere Reserve (EVBR), in Baja California. This protected area bears a striking resemblance to the tourism system found in Las Perlas. There the focal species in this industry is Grey whales, and whale watching tours are offered by a combination of a few larger companies as well as local fishermen, who view the tours as a significant part of their livelihood. The current management system was implemented through a combination of input from the government and the local communities and followed a specific evolution. First, the government had to implement a system that regulated the access to the whales (e.g., permitting/licensing, seasonal restrictions to certain areas). They established a system to monitor and enforce regulations (that were generally accepted and approved by the local community). Finally, they worked on ensuring that they established and built-up trust between management and the local operators. This was done through the creation of a decentralized agency (National Commission of Natural Protected Areas (CONANP) that reports to the Ministry of Environment and Natural Resources and oversees research and management within all protected areas in Mexico. They also intentionally enlisted local whale watching stakeholders on the Advisory Board of the EVBR, promoting local stewardship to protect local natural resources and by extension acceptance of the government role and regulations. Acceptance of this system was not universal and was only achieved after economic benefits were realized. In this

case, the involvement of the government helps ensure equal access and distribution of whale watching benefits and prevents any single entity from becoming more influential (e.g., larger, professional whale watching outfits; sensu Gustavsson et al., (2014)). It also actively excludes external and foreign actors from accessing whale watch benefits, further increasing income for local players. Finally, the intervention of the CONANP helps reduce the level of conflict and instability between stakeholders. This model showcases a “people-oriented” approach that seemingly marries the interests of conservation and socioeconomic well-being of local people (Mayer et al., 2018) and could represent a plausible future management system for Las Perlas, provided the Panamanian government and policy makers are open to holding discussions with the local people and exploring the idea of how to best share governance and management.

It is crucial that the endeavors to conserve wildlife be both transparent and act in tandem with the goals of the community, so that the needs of visitors are not put ahead of the well-being of locals. This will mean the establishment of a more adaptive and inclusive development framework that incorporates the concerns of all stakeholders that will theoretically be more aligned with conservation goals and be flexible enough to allow for future updates and therefore be more resilient to future disruptions and disturbances.

Conclusion

Ultimately, this project sought to establish a novel approach to explicitly valuing changes in both human and wildlife behavior in wildlife-based tourism, and identifying the various social factors that affect the development of whale watching in Las Perlas as a sustainable and non-impactful form of ecotourism. While there will never be a single, one

size fits all solution, based on existing literature there is a clear need for the implementation of a more defined and sustainability-oriented form of management in the Las Perlas system. This will likely require some level of intervention on a federal level to provide a clear management structure for this common-access resource (i.e., Humpback whales) and to set up a system to ensure that regulations are not only being enforced but routinely updated and adapted as needed. However, the Panamanian government may not have the resources nor be sufficiently motivated to maintain enforcement mechanisms that are effective and accepted by the stakeholders. Therefore, deliberate incorporation of the tour operators, residents of the communities on Saboga (that are part of and benefit from the tourism industry) and the tourists themselves, should all be part of the discussion and development of management solutions. To protect whales and preserve their behaviors successfully, action initiatives need to come from both the individuals providing the ecosystem service and those consuming the ecosystem service. This will not only increase the likelihood of adherence to existing regulations but also contribute to the maintenance of this system into the future, as individuals are provided with the empowerment and responsibility to hold each other accountable.

One of the most important tools in achieving this goal will be the establishment of training programs and educational opportunities, for both local communities and for visitors. Tourists need to be able to derive educational value from their experiences, in a way that encourages conservation and environmental ethics and leads to future contributions to conservation on a wider scale. And yet it appears that there might be more than a single way to achieve this goal, as visitors might be more open to a wider range of different types of viewing experiences than expected (see, Chapter 3). Already

there has been a notable shift towards consumer eco-consciousness on a wider scale, with many studies reporting on the tourists' growing preference for experiences and businesses that embrace ecological responsibility and sustainability (Barber, 2012; Chan, 2013; Chia-Jung and Pei-Chun, 2014). Meanwhile, if tour operators can secure reliable financial benefits from their services, they will be motivated to provide more satisfactory experiences for their guests, with the net result being enhanced conservation knowledge and motivation for all stakeholders within this system.

CHAPTER 3

EXAMINING THE POTENTIAL OF TECHNOLOGY FOR SUSTAINABLE WILDLIFE BASED TOURISM

Abstract

One of the more subtle shifts emerging from the COVID-19 pandemic is in the ways that humans interact with nature, as the outdoors became valued as an opportunity to escape the confines of lockdown and isolation. The ban on travel forced tourism companies to implement new forms of “virtual tourism” and use platforms such as web cameras and social media videos to allow tourists to experience and the natural world from home. Use of technology allowed some sectors of the population to have experiences from which they might otherwise be excluded due to financial and geographical constraints. Little is known about how the use of technology during COVID might serve as longer term approaches for some of the negative impacts of nature-based tourism. We used an open-ended survey administered to 193 adults in the U.S. to understand how people perceived nature and what factors contributed to a meaningful experience for them. We also examined how people viewed the use of digital media in natural spaces, and whether some forms of technology could help enhance or augment their in-person experiences. We found that people perceived nature as diametrically opposite to technology, although their definitions greatly varied and were subject to interpretation. It is evident, however, that technologically mediated experiences of nature will become an increasing part of the way we interact with it. Study respondents reported the physical aspects and emotionality of their nature-based experiences to be the most important contribution to their experience, although they also recognized the increased

knowledge and accessibility that technological platforms provided. Identifying these important factors that contribute to peoples' ability to feel connected with nature will be key to designing a sustainable and less negatively impactful nature-based tourism industry that incorporates technology in an appealing and responsible way.

Introduction

Prior to the onset of the pause in tourism caused by COVID-19 (or “anthropause,” as coined by Rutz et al., 2020), there was growing concern about environmental damage caused by tourism. Visitor numbers have continued to grow exponentially over the past few decades (Hoyt, 2001; Newsome et al., 2013; Newsome and Hughes, 2018; Schulze et al., 2018; Capocchi et al., 2019). The pandemic lockdown provided some ecosystems with reprieve from anthropogenic impacts and in many cases wildlife behavior drastically shifted in the absence of human visitors (BBC, 2020; Stokstad, 2020). Animal populations returned to previously abandoned habitats, expanded ranges, or were observed exhibiting hitherto unobserved behaviors (Kretchmer, 2020; Manenti et al., 2020; Montgomery et al., 2021). This “natural experiment” has led to a series of ongoing questions about whether distanced forms of accessing nature established during the lockdown might serve as long term solutions to concerns about how wildlife-based ecotourism (WBE) and other forms of anthropogenic disturbance were negatively impacting wildlife (Rutz, et al., 2020).

The pervasiveness with which humans utilize technology daily for both convenience and learning is expanding and evolving, and the increasing cost effectiveness and accessibility of visual technology (e.g., VR systems, drones, improved camera and videography equipment, the anticipated “metaverse”) allow people to view

wildlife from an intimate distance while diminishing the need to encroach on their physical space. However, it is unclear what factors significantly contribute to fostering meaningful interactions between humans and nature in a way that results in desired conservation outcomes (Nisbit and Zelenski, 2013; Mackay and Schmitt, 2019). In this chapter, I seek to identify some of the ways people prefer to interact with nature and what types of meaningful connection are derived from the experiences they have. There is the possibility that it is impossible to adequately replicate the immersive, sensory aspects of an in-person experience, or that we risk contributing to the more negative consequences of technology dependence (e.g., increased isolation and disconnection; Lawson, 2017). However, this understanding be necessary to better inform the development of a more sustainable WBE industry in the future that can more effectively contribute to the conservation of nature.

Defining Connection with Nature

Scholars and environmental professionals have for decades explored the complexities of motivating the public to care about conserving nature. The differences in the way individuals relate to their physical environment may influence the depth and quality of the relationship they create (Wells and Lekies, 2006; Collado et al., 2015). Human beings have always sought out a relationship with the natural world, even when tending the land and harvesting natural resources was necessary for daily survival (Williams, 2010). As our civilization has shifted away from hunter-gatherer origins, this connection with nature has started to weaken, as we opt instead for the convenience of technology, and that which is manufactured (Schultz, 2002; Louv, 2005; Pergams and Zaradic, 2006; Ballouard et al., 2011). Possibly in realization of this technological

occurrence, society has responded with surges of interest in outdoor activities such as hiking, camping, and ecotourism (Statista.com), and witnessed the rise of the prominent “back to the land” movement in the late 1960s and more recently, the “No Child Left Inside” coalition in 2007 (Reed, 1975; H.R. 3036, 20098). In her 2009 paper, Susanna Curtin referenced the “biophilia” hypothesis (originally conceived by Stephen Kellert and Edward Wilson in 1993), which proposed that humans are genetically pre-programmed to be attracted to natural environments for survival, and it is in nature “*where we feel more content and function more effectively*” (p. 452). There are many studies showing how nature is physically and psychologically beneficial to humans, with cited improvements to life satisfaction, vitality, and physical health (De Vries et al., 2003; Maas et al., 2006; Van den Berg et al., 2007; Groenewegen et al., 2012) and increased positive emotions and reduction in stress (Schroeder, 1996; Pretty, 2004; Bratman et al., 2015; Chawla, 2015), all of which worsened during to the COVID-19 lockdown.

The shutdown of the entire travel industry during the pandemic brought about many changes in our daily lives. Most notably there was a drastic shift in how people approached their interactions with the outside world (Vimal, 2022), and they were forced to embrace technology as a means of maintaining some connection with nature (Beddington, 2020). National parks, zoos, museums, botanical gardens, and other collections-based facilities that suffered from the absence of physical attendance numbers were forced to pivot and develop innovative virtual ways for guests to visit their facilities. These digital platforms enabled people to maintain and deepen their relationship with nature, and simultaneously made enjoying nature more universal and

equitable by removing major barriers—such as money, time, and physical distance—that limit sectors of the global population from experiencing these activities in-person.

It is important to note that an affinity for nature does not necessarily translate to a commitment to actions that are beneficial for conservation. As mentioned previously, there is ongoing discussion in the literature about whether people derive any conservation education or meaning from nature experiences in general, and how this can be more effectively achieved. (The use of the word “experience” in this chapter is used to indicate that a person is impacted enough by an interaction with nature that they deliberately change their behavior or thinking, which echoes the distinction highlighted by Clayton et al., 2016.) As the level of “digitization” and overall dependency on technology increases, and since research has suggested that digital experiences of nature can generate this type of meaning for participants, it is worth exploring whether the integration of technology and nature can serve as an effective means of conveying important conservation messaging and lessons on a broader, and more accessible scale.

Technological Solutions

As technology (specifically videography and cinematography) has continued to improve, it may be that the line between virtual and real becomes more blurred. The visual accomplishments of contemporary documentaries have already enabled audiences to get “physically” closer to wildlife than ever before, providing magnified visual perspectives that most people will never get to experience even if they were to travel to see these animals in their natural habitats. Other advanced forms of technology, such as drones or UAS (Unmanned Aerial Systems), may provide innovative tools to both researchers and tourists and allow people to view wildlife from new perspectives by

providing increased observational capacity compared with traditional viewing platforms (Hodgson et al., 2013; Goebel et al., 2015; Christiansen et al., 2016; Dawson et al., 2017).

This type of technology could be easily integrated into wildlife observational tours such as whale watching. Most whale watchers will never be able to view more than the arch of whale's back as it dives or the spout from an occasional blowhole hundreds of meters away. Even in the event of a close encounter, either from a whale or dolphin voluntarily approaching the boat or the boat illegally getting close to the animal, the size of the animal and the angle looking into the water from the boat limits a full appreciation for any exhibited behavior. The bird's-eye perspective offered by drones could provide a more comprehensive viewing experience, which could lead to more educational opportunities, as well as to more appreciative and satisfied visitors. Recent studies have shown that drones do not appear to negatively impact cetaceans in a way that has been conclusively proven to be negative (although this may change as UASs become more prolific). Other species (notably birds) have been shown to be affected (Mulero-Pázmány et al., 2017), particularly in response to larger sized drones with noisier engines. However, when utilized responsibly, UASs can provide scientists and tourists unprecedented access to novel and previously unseen behaviors (Torres et al., 2018). Tourists could still derive an emotional experience from the excitement of going out on a boat to search for whales, but the incorporation of a UAS (operated by a trained operator or guide) would enable guests to get a closer view once the animals have been located, without having to physically bring them closer, thereby respecting the autonomy and well-being of whales.

As technology continues to make its way into the tourism industry in various forms, future studies will be needed to specifically explore the level of satisfaction that is derived from viewing wildlife through this new lens to determine if this novel form of interaction can serve as suitable alternative to traditional wildlife viewing. It is also worth considering what potential ramifications (e.g., financial support) this could have for more “traditional,” in-person WBE activities if this alternative format becomes more ubiquitous and popular. If companies can find a way to embrace more technology that makes their practices more sustainable and that achieve tourist satisfaction while preventing disturbance to wildlife, there is a chance that market pressure will work to make this the norm (Horau-Heemstra and Hjalager, 2021). This could mark the beginning of new relationships with nature, one that utilizes particular kinds of experiential technology to reduce conflict and ensures that the needs of both wildlife and humans are being met.

The overall goal of this chapter was to identify if there is a way for technology to help facilitate more sustainable and less-impactful interactions with nature. The research team (comprised of myself and two other graduate students from ASU) assessed how people desire to interact with nature and what types of meaning and connection are derived from the experiences, based on their own perceptions and the context of the experience (Clayton et al., 2016). More specifically, we wanted to evaluate how technology could be perceived as a method to aid in creating connections with nature, particularly for people who have less access to more in-person experiences. We devised a conceptual figure (Figure 3.1) that outlines the main links between the main concepts we were exploring: the concepts of nature and technology, what experiences enable people to

feel most connected with nature, and how the utilization of nature could augment or enhance those experiences. The hypotheses for our study were: 1) people can derive similar levels of meaning from a technologically enhanced nature-based experience as one that is without technology, and 2) technology can provide innovative and more sustainable ways to connect with nature that can more effectively lead to conservation motivation.

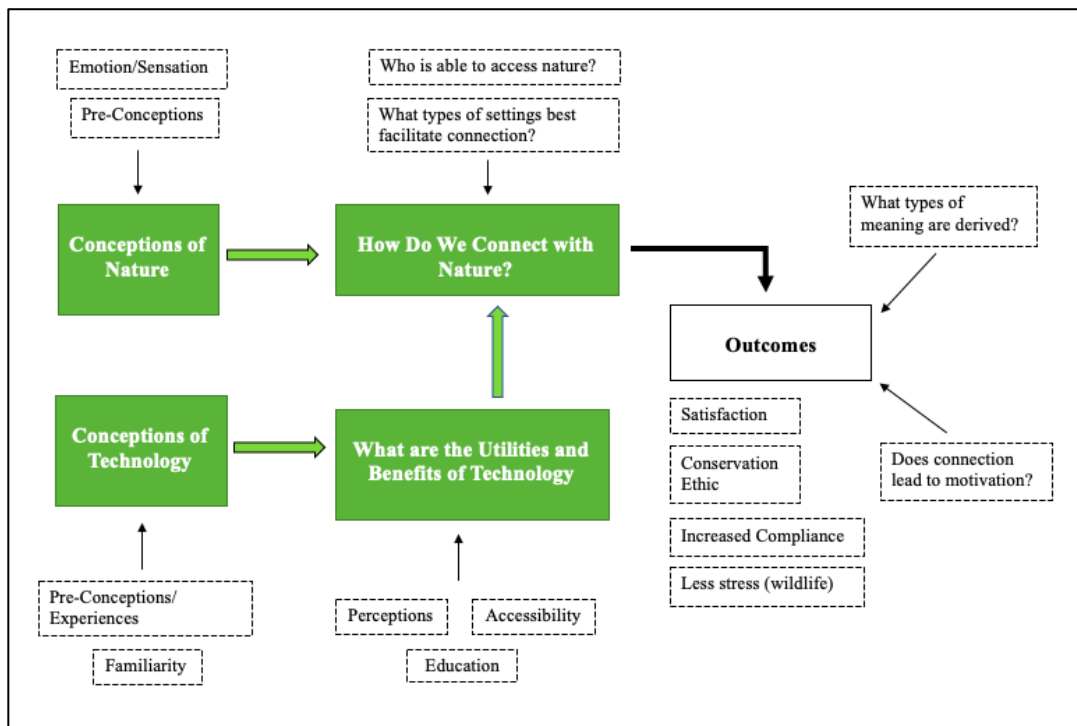


Figure 3.1: Conceptual framework for this study. Green boxes and arrows highlight the direct inquiries explored through this study. The boxes with dashed outlines indicate the relevant factors that need to be considered when we are seeking to answer the questions (solid boxes). Previous research has already explored various aspects of this concept (e.g., the specifics of our relationship and whether interactions can promote learning and care for nature); however, we seek to add an extra component that deliberately explores how our relationship and conception of technology affect our ability to use it to have meaningful connections with nature that can still contribute to significant outcomes (in the form of conservation education and motivation).

To test these hypotheses, we employed an open-ended survey to collect empirical data from members of the public in the United States. First, we sought to determine how people generally defined nature and to identify what factors made experiences with nature memorable and significant to each individual. Our survey also included questions about technology; specifically, we asked participants to describe an experience they had in nature where they utilized a piece of technology, and to consider what elements of that experience were memorable or meaningful. Finally, we asked respondents to share their opinions on how technology might contribute to a nature-based experience (e.g., whale watching with the enhancement of using a drone).

Methods and Study Sample

This research focused on assessing whether and to what extent people can form emotional connections with a virtual or digital version of nature. Examples of these types of experiences could be a web camera, documentary or drone video that shows an animal on a screen. To explore this question, we implemented a survey to identify views of technology and its utility in augmenting nature-based experiences based on findings by Nisbet et al., (2008). Surveys were distributed from January 22 through February 24, 2023, through a combination of convenience and snowball sampling. In total we collected 193 completed responses. Due to limited time and funding, pre-selected individuals (i.e., either already established contacts or professors at high schools and universities) were asked to distribute the survey within their communities (e.g., student populations, work colleagues, friends, and social circles) and the surveys were completed through an online platform (Qualtrics). The questions asked participants to reflect on experiences they had in nature, that both included and did not include utilization of technology. Adults (from

the United States, 18 years and older) completed an online questionnaire with open-ended questions that asked them to use their own words to describe an experience they had in nature that was memorable to them (See Appendix: Table C.1 for full list of survey questions). Participants were also asked to describe a situation where they utilized technology in some way during a nature-based activity, to reflect on their selected memories, and to explain why either the nature-based or technologically augmented experience was more significant than the other. Additional demographic questions identified their pre-existing level of environmental concern and commitment.

Data analysis followed a mixed-methods approach, with the qualitative portion using a combination of grounded theory and thematic analysis (Charmaz, 2006; Cooper et al., 2017). Data were used to construct patterns and theories (rather than using theories to analyze data). All completed surveys were assigned a number for identification and divided up between the main research team. The coding process of the answers included open coding, axial coding and then writing out common theme narratives. Open coding refers to generalization of responses and the generation of key words. The second step of axial coding involved reviewing selections of open codes to draw out broader themes. Finally, the theoretical code, or narrative, was used to connect each of the axial themes to explain some of the broader phenomena and to answer our guiding questions. The co-authors of the study coded their section of the responses individually and then inter-rater reliability was used to measure the level of agreement between the codes. We performed quantitative analysis (using RStudio Version: 2023.03.0+386) to analyze the questions that involved Likert scale data. The survey was designed using Qualtrics and approved by the Institutional Review Board of Arizona State University.

Results and Discussion

Overall, we collected 193 completed surveys, from a total of 208 respondents. We saw the largest number of responses from individuals in the 23-29 age group (31%; Figure 3.2). Participants identifying as female were the largest population of respondents at 73% of our sample. The survey also asked participants to indicate what kind of societal environment they grew up in (e.g., urban, rural, or other). Many reported growing up in a predominantly urban environment, although “other” (self-reported as “suburban”) was the 2nd highest portion of the population (Figure 3.3).

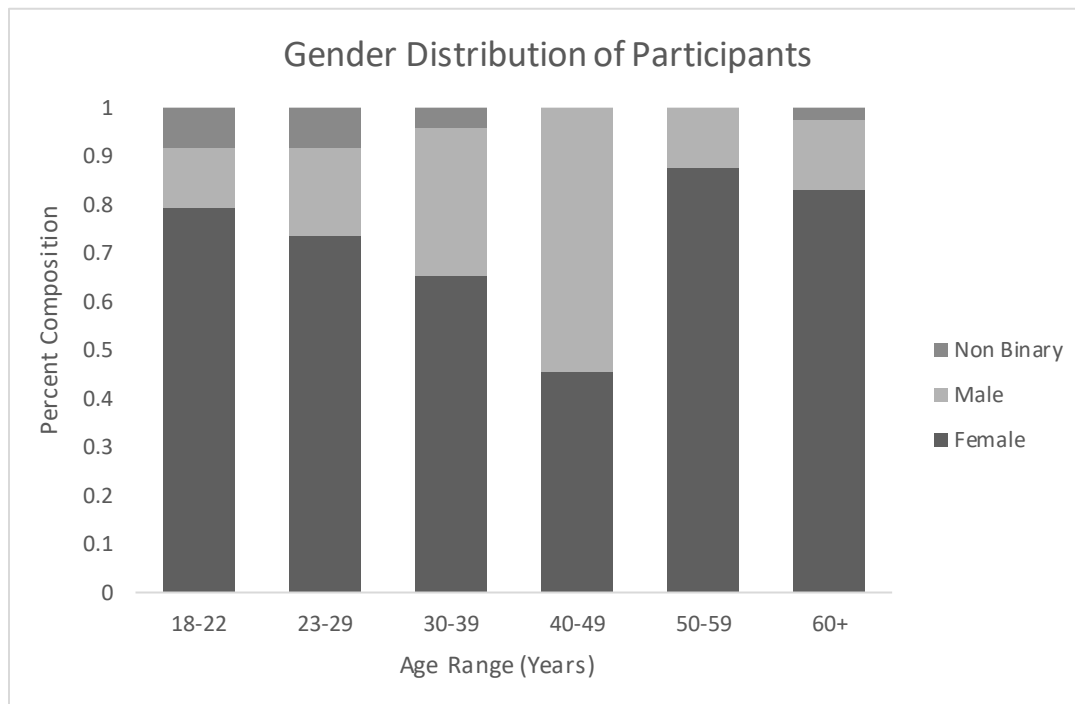


Figure 3.2: Distribution of self-identified gender across age groups. 1 respondent chose “prefer not to answer.” Sample size of each age group was different: the largest population was 23-29 ($n = 60$), followed by 30-39 ($n=49$), 60+ ($n=41$) and 18-22 ($n=24$). Only 8 individuals reported as being between 50-59 and 11 between 40-49.

The overall aim of this research was to explore why people find nature so meaningful, and what they derive from their interactions and connection in order. It is

necessary to identify what qualities might be adoptable by nature-ecotourism services in their efforts to become more less negatively impactful on nature and wildlife, while still providing participants with motivation to adopt an environmental conscience or ethic.

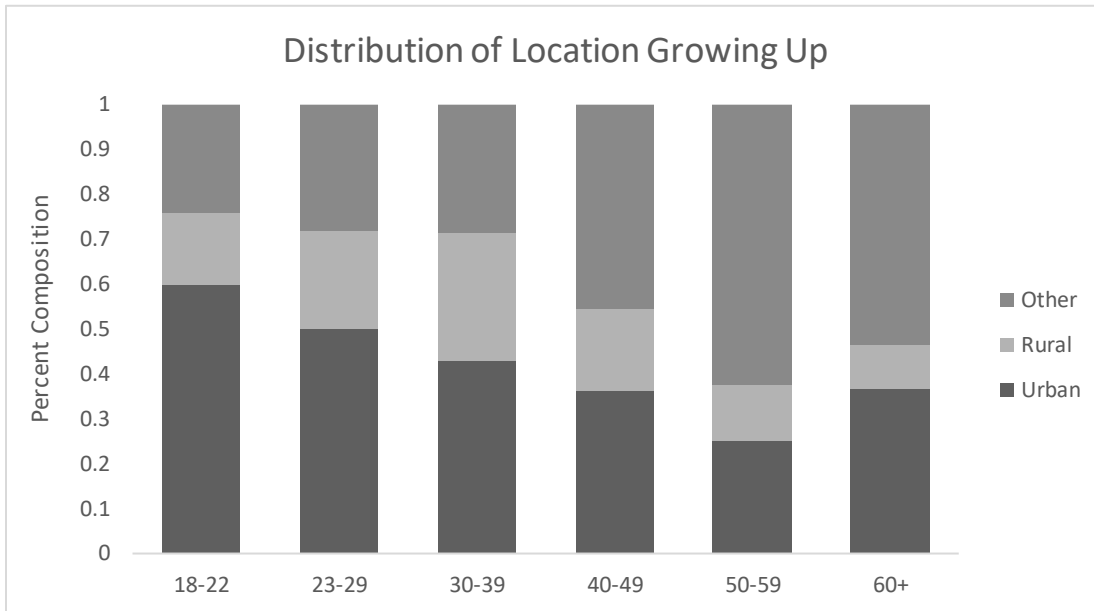


Figure 3.3: Distribution of where respondents self-identified as the environment they grew up. "Other" was primarily described as "suburbs" (46 out of 69 total), although a few (n= 8) described moving a lot during their youth or spent time living in both types of environments.

We found that the perceptions of nature varied between individuals, and descriptions were generally open to interpretation and reflected a diverse range of experiences. Also, despite an initially diametrical opposition towards the idea of technology being associated with nature, people were relatively unaware of how much they already depended on technology for experiencing nature. Finally, people were open to the concept of using technology to visually enhance nature-based experiences, especially if it increased access and learning opportunities, allowed them to gain new perspectives or aligned with conservation goals. The following summary describes the

notable themes that emerged from our results, with implications for how they could affect the development of more sustainable relationships with nature going forward.

What is Nature – Ideal vs. Real

A pattern of visually distinct images was conjured up by participants when they were asked to think of “nature.” The answers were evocative of the romanticized pictures of wilderness often portrayed in media: thick forests, verdant lush and green foliage, bird song, and scenic landscapes (approximately 50% of respondents mentioned trees or forests in their mental image). Some participants went on to describe specific places they have visited, like national parks, exotic vacation destinations, or places that had personal significance to them, like a relative’s house in the country. The emotions accompanying these descriptions tended to center around feelings of peace, tranquility, and relaxation (17%), but also often referenced feelings of solitude (14%).

People distinctly felt the absence of crowds to be integral to their image of nature, and a lot of descriptions (~14%) either deliberately or indirectly touched on the concept of being alone (away from people) or remoteness (i.e., feeling away from civilization and urban life). For example, participant #143 said: *“Walking through a wooded path with little to no anthropogenic sounds or influence,”* and #74 offered: *“Hiking, walking through forests. Solitude. Being removed from the sights, sounds, smells, taste of the city.”* We found that nature was often spoken about using terms such as “escape,” “sanctuary” and “relief,” or something that allowed an individual to remove themselves from the demands and responsibilities of daily life, which corroborated other research findings (Pouso et al., 2020; Soga, et al., 2021). This could be attributed to elements of nostalgia, that are often triggered by nature especially when people are experiencing

times of high uncertainty or anxiety, such as the during the pandemic or now with all the global sociopolitical turmoil (Gammon and Ramshaw, 2020). The response from participant #49 exemplifies this effect:

“I have had some periods of severe anxiety throughout my life. During one of those periods I went outside of my apartment to walk around the pond and calm myself down. As I walked, I looked at the trees and the water and the light. My anxiety stayed the same. At one point as I was walking, I was compelled to reach out and touch a leaf hanging from a branch. As I held the leaf, I immediately felt calm and peaceful. It felt like I was connected to something much deeper than just myself. When I let go, I felt calmer, but the anxiety slowly started to creep back and pretty soon was full force again. I can’t fully describe how I felt, but it was truly profound. I have been able to recreate this experience since then. I’m not sure what it means or why it happens, but it’s really cool!”

Nature’s ability to provide comfort was further supported by the large number of individuals (17%) who shared strong memories from childhood (e.g., visiting their grandparents house on the beach) that are likely fueled by strong emotions associated with family and loved ones and a desire to feel safe.

There was an interesting dichotomy regarding the *types* of human connections that are made due to nature: some respondents appreciated nature for the seclusion and isolation it provided while others valued it because of its ability to foster stronger connections with those around them. For some participants (9%), a lack of other people made a space feel more like nature, while for others the presence of the participant or their group made a space less so. For example: *“I liked that I had both comfort of my friends and the comfort of solitude”* (#176). Some individuals felt that shared experiences in nature facilitated bonding or strengthening of relationships, both with existing friends/family and with strangers who were fellow participants: *“In college, I did a weeklong backpacking trip where a group of seven of us spent all of our time hiking a*

portion of the Appalachian Trail. The contrast between the solitude of our team and our close-knit teammates made us very close by the end of the trip. We stayed in touch closely for years thereafter” (#85). There were also some people (8%) who felt that their experiences allowed them to feel more connected with nature itself: “I always feel I am more connected to nature by interacting with it directly. Just observing organisms and what they do or putting myself in stressful/testing experiences in nature (the ocean or mountains) and having that feeling of individual insignificance but deeper connectedness to the world around” (#174). These sentiments are important since they point towards the concept of an “environmental identity,” which Clayton (2003) describes as how we build our concept of self and the integration of nature into part of who we are. How we view ourselves can be key for generating conservation motivation.

Contrastingly, some respondents had strong negative feelings about the idea of sharing the natural space with people in any way: *“I didn’t love some of the other people that shared the space - I would be taken out of the mindset by a crying child or someone complaining about the rain. I wish it was more individual/isolated” (#23). It is possible that there is some sort of threshold regarding the level of sociality people seek out in nature. This could be predicated on pre-existing familiarity (e.g., friends, family where bonds are already established), or the understanding of a shared lack of familiarity (e.g., people intentionally partaking in a program with other strangers), with the understanding that everyone is in the same shared state of unfamiliarity. Alternatively, it is possible that these feelings are dependent on an individual’s background: e.g., if someone grew up in a more urban, heavily settled location surrounded by people, they might find the seclusion of nature more desirable compared with someone who grew up in that environment or*

vice versa. A few participants (8%) recalled the discomfort they felt the first time they were camping, recognizing the lack of familiar sounds and smells that took them out of their comfort zone.

Participants also spoke about nature based on the various activities they could take part in. Some individuals noted hiking, walking, swimming, and observing animals as the types of activities they were able to enjoy in nature (see Table 3.1). Others spoke about more passive events that occurred, such as chance encounters with wildlife or witnessing ecological phenomena (e.g., storms or a meteor shower), that were particularly memorable to them. This was connected to another common theme, one that related to the necessity of being “immersed” or physically experiencing and interacting with one’s surroundings. Almost half of participants (48%) shared accounts about how it was important to them to witness nature with their own eyes (and other senses). These physical experiences in nature often resulted in feelings of personal transformation or self-reflection, such as described by participant #27 who described a rafting trip:

“It was delightful to be without contact to the human/outside world that we couldn’t reach by phone the whole time. It makes you become closer to the people you are experiencing this with which makes the beautiful place in nature you are in feel even more meaningful and beautiful. I loved Waking up each morning to greet the river, watching it’s water level fluctuate, boiling water from it each day to sustain us, floating down it each day, and falling asleep to its quiet roar at night. Feeling so content and connected and saturated with time outside always feel like a transformative experience, even if in a small way. This trip helped me to see with new perspectives and clarity the life to which I returned when I got back from this trip” (27).

There has been much research on the impacts that emotionally stimulating interactions with nature have on an individual’s desire to adopt more pro-environmental behaviors and integrate the environment as part of their identity (see e.g., Orams, 1995,

1999; Clayton, 2003; Wilson and Tisdell, 2003; Zeppel and Muloin, 2008a, b; Buckley et al., 2012; Wheaton et al., 2016; Macdonald et al., 2017). However, it is still unclear what specific factors are most contributory to a “transformative” or motivating experience, although there have been previous studies that have delved into identifying the direct link between personal experience and motivation to change behavior or integrate nature into one’s identity (Schultz, 2011; Clayton et al., 2016; Ardoin et al., 2020), with one proposed tool being “education.” In other words, is an individual more likely to become more committed to actively contributing to conservation efforts because they were provided with extensive information on an issue, such as through interpretation provided on a wildlife tour. Other research, however, has posited that just because individuals acquire new knowledge on a subject, they can still be reluctant to change their behaviors in any drastic way (Boulstridge and Carrigan, 2000; Kollmuss and Agyeman 2002; McKenzie-Mohr et al., 2012; Juvan and Dolnicar, 2014; Fernández-Llamazares et al., 2020; Buxton et al., 2021). These studies emphasize that educational platforms need to focus on capacity building, or providing participants with the skills and means necessary to grow their confidence to make desired changes. Along these lines, other studies have found that visitors often become discouraged from participating in conservation activities once they are back home if they are not provided with explicit information and guidance from their tour experience about how their personal actions can be contributive (Moscardo, et al., 2004; Yalowitz, 2004). It will be necessary for ecotourism activities, which are dependent on developing sustainable interactions between humans and nature, to ensure their participants are leaving with positive and motivating environmental and conservation associations.

How do people prefer to interact with nature?

Notably, the physicality of the nature-based experiences was not universally positive for all participants. When we asked people what they disliked about their nature experience, quite a few individuals (16%) spoke about the challenges they faced (e.g., being cold, getting injured, risk of death, fear, homesickness) and the feelings of discomfort they had being away from their normal routines and environments (e.g. (#172): “*At the age of six, I experienced an unfortunate incident while camping with my family, where I sustained an injury to my eye from a horsefly bite. Since that time, I have developed a strong aversion towards nature*”). Participants also acknowledged their feelings of “powerlessness” in deference to nature, which they admitted needs to be respected and even feared.

It is possible that while the version of nature that people described at the beginning of the survey follows a specific “idealized” paradigm, it is not fully representative of the current reality (Clayton et al., 2016). As a species, humans may no longer possess the full capability to truly embrace nature in all its variability (both good and bad) given our inability to fully remove ourselves from our modernized world, and the limitations it has posed on us (e.g., our over-dependency on the convenience of our phones; Pilgrim et al., 2007). Soga et al., (2021) defines “capability” as “an individual's psychological and physical capacity to engage in interactions with nature,” and posited that the psychological impact of the pandemic, such as increased levels of fear and uncertainty and the heightened risk of illness, has affected our ability (and interest) to seek out relationships with nature in the first place.

There is growing concern about the growing inaccessibility of nature (termed the “extinction of experience” (Pyle, 1993)) and how that can influence people’s future perceptions of nature, as well as their environmental beliefs and motivations to conserve. Reduced exposure to natural spaces, especially for children, can lead to decreased emotional affinity and desire to experience nature, or even an aversion or fear of natural spaces (Kals et al., 1999; Bixler et al., 2002; Milligan and Bingley 2007; Ward Thompson et al., 2008; Cheng and Monroe 2012) which subsequently be passed to future generations. For example, people who are aversive to nature will likely avoid engagement in outdoor activities and exposing their children, resulting in further disconnection from nature.

This also brings into question some of humanity’s more negative relationships with the natural environment and posits whether there are any parts of the world that could be deemed “pristine” or untouched that would match the images conjured up by our study participants. Are there places in our lives that are completely devoid of people or crowds, or reminders of civilization and the level of support facilitated we have come to expect? During COVID, there were examples of drastic increases in visits to specific natural spaces that were still accessible, leading to overuse and environmental degradation of these habitats (Soga et al., 2021) and potential disruptions to animal behavior (Bötsch et al., 2018). One individual (#159) made a comment along these lines:

“What I loved was have so much of the spaces to myself, due to the fact that I got going later than most other visitors. I took advantage of the fact that it gets dark late in the summer time, and so often I found myself in places that would be packed during the day, almost completely empty by the time I go to them....My fear is that now in the "post" COVID era, the parks have become so incredibly busy, that I may not have the opportunity to experience such quiet in these spaces.”

Several people (7%) reflected on the inextricability of human disturbance and nature, resulting in conflicts such as climate change, pollution, and deforestation. For some people, the negative associations were impossible to avoid: *“It is even hard to write this because it makes me realize when I think of nature now I think of in crisis”* (#144), or *“It makes me reflect on how humans aren't as important as people think. [Animals] don't need us and are better off without us yet we are constantly getting in the way of them”* (#60). These sentiments likely reflect the growing feelings of “eco -anxiety” and “environmental grief” that researchers have observed becoming more prevalent in the recent years (Panu, 2020; Coffey et al., 2021). Eco-grief can often translate into feelings of reluctance or shame over utilizing some forms of travel (e.g., flying), which may have great ramifications for the tourism industry in the future (Mkono, 2020).

Along similar lines, participants (6%) acknowledged that they had not previously realized how much comfort and technology provided them and subsequently how much it is missed when it is absent. One participant described: *“I would say it was a little bit uncomfortable for me to be so isolated. I think I'm very used to having technology at my fingertips and having no questions about getting help, food or Uber Eats quickly if I need it”* (#147). They also expressed surprise in recognizing how much technology has facilitated their interactions with nature, and it is likely that the ubiquity with which people utilize technology throughout our lives is almost unidentifiable at times: *“I definitely don't immediately consider technology as part of my recollections of experiencing nature, even though it's a routine part of it: taking photos, looking for species IDs”* (#86). Six respondents explicitly commented on how technology helped them to feel more at ease and comfortable: *“I think about what's required for me to feel*

happy and safe while in nature and think technology can play a helpful role in regards to feeling safe” (#26); and “Being able to walk along a taken care of and secure pathway amidst a relatively dangerous city was invaluable. After a day of working in an office or doing classes I could walk off the stress in the heat of the sunset and feel safe with security cameras and also the other people walking on the trail” (#107). There is evidence that rather than drawing from more casual encounters with nature as parts of daily life, people now seek out more “managed” experiences that are deliberately planned or cultivated in a way that caters to human needs (rather than being reflective of an ecologically healthier, more raw “wild” system). This preference leads people to continue to maintain unrealistic expectations of natural spaces (Clayton et al., 2016).

There is an ever-growing field of research on the proliferation of “information and communication technology” (ICT) in society and the degree to which we depend on and utilize technology to feel reassured and comfortable (Sharma, 2021). Despite people’s idealistic division between technology and nature, it may be that we don’t consciously recognize how technology is already so fundamentally a part of our day-to-day existence and experiences in nature. Thus, people may find some forms of integrating nature and technology to be more acceptable (if not *necessary*) than initially believed.

What is the perception of technology used to augment nature?

In the later part of our survey, we sought to ascertain how technology is viewed in the context of nature-experiences. What is impactful about a digital experience of nature? And what is technology's role in allowing humans to connect to nature? While almost all respondents preferred a nature-based experience (99.5%), there were many who mentioned the benefits offered by technology that enhanced or contributed to them being

able to foster stronger reactions to their surroundings. These included the ability to notice aspects of the environment that might otherwise be invisible, easier access to knowledge and learning opportunities, and increased ability to share their experience directly with others. By the end of the survey, some participants (11%) even acknowledged that their definition of nature had changed over the course of answering our questions and admitted that they did not see technology and nature existing solely as diametric opposites.

There were several notable themes that emerged from participants' answers about their preconceptions of technology. While many (26%) harbored initially negative perspectives, the reasons were varied. For some respondents, technology was emblematic of "responsibility" and daily life, and they expressed desire for more people to look up from their screens. (e.g.: *"I liked being outside and away from the typical 9-5 office work"* (#26). It is likely that these types of associations have become exacerbated coming out of the pandemic, when requirements of working from home have made daily routines even more inextricable from the usage of computers and phones. The most common type of technology that most participants mentioned using were documentaries or movies about nature or wildlife or phone application programs, although quite a few also mentioned virtual reality experiences and using webcams (both public and private) (Table 3.1).

Table 3.1: Examples of the types of the in-person and technologically augmented activities participants mentioned in their answers.

Experiences In Nature (Q1)	Technologically Augmented Experiences (Q6)
Hiking	Using an app
Travel e.g., Vacation	Playing a video or computer game
Experiencing an emotion	Watching a movie, TV series, or documentary
Wildlife watching	Webcam
Watersports	Virtual Reality
Camping/backpacking	Taking photos/videos
Walking	Watching social media/YouTube videos
Sitting in nature	Setting trail cameras

From the answers, we identified many benefits that people typically associated with technology. Almost half of participants (45%) spoke about how technology enabled them to have access to parts of nature they would not normally be able to see and for the educational opportunities they provide, e.g., the apps on their phones help them identify and learn about plants and birds that they encounter in their daily lives (e.g., backyards). Technology also gave them a means of noticing details that they feel they would have otherwise missed or that typically go unnoticed: *“I enjoyed seeing things I’ll probably never get to see in real life”* (#136), and *“It was memorable because of the high quality images and videos of nature locations that I haven’t (and may never) visited”* (#105). It should be noted that descriptions of learning and increased knowledge were notably absent from any of the answers related to solely nature-based experiences. Conversely, the use of web cameras and YouTube videos gave people a chance to observe animals at

a much closer proximity and observe rare events such as baby birds hatching or a mother bear playing with her cub. They also had the chance to learn from experts in the field and experience their daily routines through videos and photographs. One participant (#200) described:

“I remember feeling like I could see them much closer than I ever could with my own eyes. I really enjoy the feeling of “getting a good shot”. I imagine the feeling is somewhat like what hunters feel. It is exhilarating to watch an animal, almost stalking them, until you get a good shot. I liked that I was able to share this experience and the awe it brought all of us with my friends/co-workers and I loved feeling so blessed and lucky not only to be there and witness it but to be able to capture it so I could revisit the memory in the future.”

While technology cannot emulate certain aspects of an in-person nature-based experience, such as physical sensation, touch, and smell, there are new visual and auditory accomplishments being made every day. VR (virtual reality), MR (mixed reality) and AR (augmented reality) continue to push the boundaries of perception and newer inventions such as curated experiences like “Soarin’ Around the World” at Disney’s California Adventure theme park, a 4D attraction specifically mentioned by one survey participant where the attraction simulates various ecosystems by blowing air, water, and various smells towards the ride-goers, could represent the future of fully immersive experiences. Already there are advancements being made that allow technology to replicate sound (Tsingos et al., 2004), touch (Gutiérrez et al., 2008), and even smell and taste (Washburn and Jones, 2004; Boyd, 2008).

One major concern regarding technologically augmented nature experiences many that many of the deeper emotions that are triggered by in-person experiences may be lost when there is a disconnect provided by a screen. The late wildlife biologist Dr. Michael

Hutchins believed that a truly wild-based experience can never be accurately replicated without being physically present, where you can look into the eyes of a wild animal and feel the exhilaration running through your body (Shaul, 2021). Surprisingly, we found that a decent number of respondents (13%) experienced very strong emotions in response to a technologically augmented experience they had (and often shocked themselves with this reaction). Many commented that watching a video invoked a feeling of calm, that was not dissimilar to those feelings that were experienced through in-person experiences: *“I think truly engaging with nature can bring on a lot of emotions, and that's what this experience does to me. It can create emotions or trade any lingering negative feelings for something lighter”* (#52). Several studies have found that there was little to no difference in the emotions that were elicited within the two groups of participants in VR and real-life experience (Chirico and Gaggioli, 2019; Browning et al., 2020, Yeo et al., 2020). Documentary series like *Planet Earth* that have come out in the last decade have subtly mastered the art of storytelling through skilled filmography, drawing in audiences and making them feel emotionally connected to the animals on the screen solely through visuals. A few participants spoke about the level empathy they felt when watching these intimate documentaries and web cameras, that allowed them to observe animal families interacting with each other; e.g., (#122) *“I got very attached to the eagle family and their successes and challenges. including when they broke protocol to climb into the nest to rescue injured eaglet!”* So, while it may not be evident from the onset, there does appear to be a way for technology to provide emotional connections for participants and allow them to still feel empathetically connected to wildlife and other elements of nature.

What is the relationship between the technology and nature?

At the end of the survey we asked participants explicitly whether they had been surprised by any of the recollections they had described or that had been evoked by the questions, and again the answers were divided. Many people (22%) said they were not and that they frequently thought about these concepts, while others (7%) *were* shocked by how vividly they had been able to recall their memories. Some individuals (8%) expressed fear about the unparalleled rise in the popularity of technology and were worried it would have unforeseen ramifications for how we are able to connect with nature in the future. (e.g.: “*Are they going to put us in Matrix-like pods and show us nature*” (#119)). Meanwhile, other participants (~22%) were surprised to recognize that their technological experience *had* allowed them to feel more connected with nature: “*I was surprised at my immediate recollection of the audio captured of a coral reef. Before the question was posed I had not even considered that to be a nature experience, but it was very impactful in my perception of nature*” (#185).

The exponential growth in the innovation and development of technology is no coincidence; it has allowed human society to make incredible achievements in healthcare, science, and engineering, and aided in countless new discoveries. This study was not meant to suggest that technology should seek to replace nature, but merely act to augment what is there and to enhance participants’ experiences. I believe it is worth evaluating the increased perspectives that technology provides, whether it be removing geographic barriers and allowing a person in South America to watch a polar bear on their computer

or allowing someone to see the intricate details of a previously unknown flower in their backyard – these are all integral to making the benefits of nature more accessible.

Many study participants (15%) shared the view that there were many ways to experience and connect with nature and that it can be different for everyone. Some also admitted how privileged they felt to be able to have had the experiences they did and wished that more people could have the same access:

“There are so many ways to experience nature. You can experience it whether you are physically there or if you aren't. I think there it is wonderful that nature can be accessible to those who don't have a tendency to experience it in person but also to those who cannot do the hikes, or snorkeling adventures. Respectfully derived content of nature is a great thing, as long as it is done in a way that is not making nature an object but rather a being or creature that we treat well while doing it” (#52).

At the conclusion of the survey, we showed participants a video of a humpback whale and her calf that was shot using a drone and asked them whether this use of technology would be something they would appreciate. While most participants (41%) were favorable towards this concept, others were skeptical (21%) or disagreed (30%). Many spoke about previous experiences observing wildlife out in nature and expressed a strong preference for allowing animals to remain undisturbed by human presence, since they knew it would be more beneficial to the animals: *“This seems really cool because boats can cause damage to marine life, and this provides a great way to both experience the animals up close, while also keeping them safe from human harm” (#159).* A desire to mitigate the impacts of humanity on nature was a sentiment that was shared by many survey respondents (21%), which seemingly contrasted with their expressed preference for in-person experiences. It is important to consider how we can strike a balance

between our desire to immerse ourselves in nature and respecting the nature by admiring it from afar. There were some people who thought that this utilization of technology would be an effective means of addressing the needs of wider audiences, and allow guests to have a more equitable experience:

“I think this is an excellent way to merge real life nature experiences with technologically augmentation. It allows folks who are mobility challenged to still see the whales and also allows the boat to stay further away as to not disturb them. Everyone gets the same image — it's similar to having huge screens projecting the artist at live concerts so everyone has a chance to see the performers at least somewhat in the same way” (#70).

The ability to access nature is not available equally to all of society. Travel to exotic and remote places is typically something enjoyed primarily by those in the traditionally upper and upper-middle classes: those with the resources to travel and time for vacations. In recent decades, social scientists have begun questioning whether access to natural spaces in a broader sense was even equitable, particularly in urban settings where significant portions of the world’s population live and are projected to reside in the future (Cutter, 1996). As of 2020, approximately 83% of the population in North America and 56% of the global population resides in urban environments, and this number is projected to grow (McPhearson et al., 2013; Zhang et al., 2013; United Nations, 2018). Within urban populations, individuals from ethnic and racial minorities are the majority, and by 2050 will likely comprise 9 out of every 10 urban-dwelling citizens (Stanfield et al., 2005). This trend appeared to be somewhat reflected in the demographics of our survey pool, with 45% of respondents identifying as growing up in an “urban” environment, and ~20% identifying as coming from a rural background (and 35%

choosing “suburban,” which may contain urbanized elements, depending on the specific location).

While public spaces may technically be accessible to everyone, studies have shown that the actual rates of visitation vary depending on age, gender, cultural background, preferences, socioeconomic advantage (or disadvantage) and park characteristics (Elmendorf et al., 2005; Jones et al., 2009; McCormack et al., 2010; Reis et al., 2012; Lin et al., 2014). One study in 2009 in Bristol UK revealed that 40% of people from the most advantaged socio-economic group visited their local parks, compared with only 27% of those in the least-advantaged group, despite the greater provision in their area (Jones et al., 2009) Thus, a delineation must be made between natural space that is physically available, and that which is used. Just because city planners create a public green space, it does not automatically mean that it will be equitably used, with the benefits of a connection with nature enjoyed by all.

The discrepancy of nature-access is further amplified by historical practices such as redlining in urban neighborhoods, which has substantially altered the physical composition of urban environments. “Redlining” was an infamous example of structural racism where neighborhoods are deliberately segregated by race and used to suppress black American communities (Mills, 2017). Neighborhoods were rated on their racial composition, amenities, environmental quality, and several other factors, and the ratings were used to allocate funding and ultimately suppress specific racial populations. Although redlining is no longer “actively” practiced, the impact of historical redlining on today’s urban ecosystems is still evident (Grove et al., 2018; Locke et al., 2020). Because redlined neighborhoods were suppressed and generally poorer, natural ecosystems in

these neighborhoods are ecologically different, having less vegetation and tree cover via something known as the “luxury effect” (Leong et al., 2018), which increases ambient temperatures in these locations. Heat islands trap hotter temperatures in locations that have less vegetation that can provide mitigation. The reduction in plant life also influences the biodiversity and numbers of animals that also inhabit these areas. The species that do tend to persist in historically redlined areas are traditionally those that are commonly viewed as “harmful” or “pest” species (e.g., raccoons, coyotes, mice, cockroaches), which can cause potentially significant health risks and structural damage to buildings (Leong et al., 2018; Katz et al., 2020).

As a result, the residents of these neighborhoods could potentially develop completely different (or partial) views of nature compared to individuals in wealthier neighborhoods, who typically have greater access to wider ranges of biodiversity and natural landscapes. As emerging research shows that urban-dwelling residents are less likely to experience positive and meaningful encounters with nature due to lack of early exposures and access, we must ask what this means for current and future generations growing up in these environments, who may increasingly feel they don’t “belong” in natural spaces (Buijs et al., 2009; Schell et al., 2020; Wilson et al., 2020). The diversity of species, and interactions between them are all shaped by the environment in which they inhabit and the stimuli they experience, whether that be in a natural or urban setting (Pickett et al., 1997; Grimm et al., 2008; Alberti, 2015). Thus, the behaviors of humans and urban wildlife are deeply intertwined, particularly in urban environments, and the decisions that humans make not only impact our ability to experience and enjoy nature but also impact the animals and their behaviors in substantial ways.

Looking Ahead

It is worth considering whether the increasing digitization of the world will allow for the development of new potential mediums that could make travel more widely accessible and immersive for a wider range of audiences. There will need to be deeper investigation into what types of experiences are best suited to allow people to establish and strengthen their relationships with the natural world. This will be especially true as the tourism industry remains constrained by added safety and health protocols (e.g., visitor limits, extra cleaning and sanitization efforts, higher quality requirements), as these added costs are usually transferred onto visitors, making tourism travel potentially even more restricted to just the wealthy.

Recent research has shown that the pandemic has affected tourists' level of risk perception and general attitude towards travel, with the potential to greatly influence future travel-behavior (Rahman et al., 2021). More impetus will be placed on developers to incorporate alternative formats of travel that meet tourists demands for managing risk while also keeping costs affordable, which provides an opening for the innovations for virtual tourism (Zhang et al., 2022). It has been posited whether the increased affordability provided by this new means of travel could simultaneously make tourism more attractive to certain groups (e.g., younger travelers) which could thereby make people more accepting of the idea of replacing a physical experience with a virtual one (Guttentag, 2020). Our need to understand the interplay of technology and nature experiences increases as these experiences become more common and replace traditional,

in-person nature experiences. However, technology could be the new equalizer that allows for a wider audience to receive the sustainability and conservation education benefits of WBE.

Limitations

The aim of this research was to explore people's preconceptions regarding nature and technology and to assess the potential for a platform that addresses the perceptions of both. We were only able to do this exploration on a preliminary level, and there are several limitations that would be good for future research endeavors to avoid. First, this study was only conducted on an extremely small portion of the population and as the dispersal mechanism employed depended on word of mouth among personal social circles and sharing with individuals directly (e.g., a snowball sampling method), it is very likely that we were only able to sample from a biased sample of people who already shared similar interests and motivations. In future, it would be very interesting to conduct this study on a national level, with wider demographic diversity (e.g., obtaining a larger sample of people who grew up in predominantly rural areas), and ideally from a wider range of ages. Given the growing volume of research concerning the impacts of the pandemic on children's education (which includes their access to nature-based experiences), it would be valuable to deliberately incorporate the perspectives of children. This is especially relevant as technology will continue to become more prevalent for younger individuals, who will become exposed to it at even younger ages (Fischer et al., 2022). Additionally, we were only able to collect a minimal amount of quantitative data from our surveys, compared with the extensive amount of qualitative data. Our quantitative results revealed only a minor significant correlation between an

individual's location where they grew up (rural, urban, other) and their satisfaction with the example of a drone integrated in a whale watch ($p = 0.05619$); Appendix: C.2).

However, again it would be interesting to see this study repeated with a wider and more varied pool of respondents to see if this pattern held across a larger population.

Conclusion

The onset of COVID and the resulting shift to working from home and dependency on screens to connect has likely contributed to the even greater exaggeration of the distinction between natural and not-natural spaces in our lives. "Nature" was cast into a stark binary division with the indoor confinement we endured daily. "The outdoors" came to signify safety; we were encouraged to hold events, meals, meetings, anything outside to prevent spread of COVID. Even now that most pandemic restrictions have eased, it is likely that people still view nature as a means of escape and to disconnect from work responsibilities (which was still the case in 1989; Kaplan and Kaplan, 1984). However, we run the risk that nature may come to be more idealized to a physically unattainable standard. In other words, in the quest to seek out places that are completely remote and away from any vestige of human presence may be unsuccessful and disappointed. How does a place like this physically exist in today's modern and industrialized world?

Even as the worst of the COVID-19 pandemic is hopefully behind us, it will be necessary for tourism management to incorporate some of the lessons learned from the event so they can be better prepared for future perturbations. Our modern lives have become so intertwined with technology it is inevitable we will need to continuously develop innovative methods of delivering important environmental messages to a wider,

global audience. While there will always be portions of the population who will reject the incorporation of technological platforms into nature in any form and prefer the purity of an immersive and “disconnected” experience, there are benefits to this integration that should not be overlooked. Primarily, this includes allowing people from all sectors of the population to witness and experience “the wild” and to maintain their sought-after connection with nature, while gradually lessening dependence and over-utilization. The desire to keep nature protected from the negative aspects of human development and presence align with the original goals of WBE of encouraging sustainable visitor practices that reduce negative impacts on the local environment (Ceballos-Lascurain, 1996), and which will only become more necessary as global challenges such as climate change worsen.

It is our hope that researchers will continue to investigate the emerging questions regarding what the future of sustainable ecotourism will look like. Many participants from this study expressed their appreciation in being given the chance to consider the relationship nature and technology through this novel lens, and the generation of more studies like this could hopefully foster more thoughtful conversations and discussions going forward. Our results provide a glimpse into at least part of current spectrum of thought regarding the concept of technological integration into nature experiences, and with the right applications, it could prove to be widely appreciated and accepted. Zhang et al., (2022) proposed that there is a way for both traditional, in-person and virtual formats of tourism to be equally utilized and promoted, if they are both held to high quality standards. In their paper, Horau-Heemstra and Hjalager (2021) describe a hypothetical future scenario where whale watching has fully embraced integrated

technology (which they term “eco-innovation”) and utilizes AR (augmented reality), to provide low-impact yet highly desired ecotourism experiences, complete with holograms, underwater drones and AR glasses that provide tourists with live action visuals and educational information. In this reality, the authors see in-situ wildlife experiences becoming even more special and prized, to the point where they become even more exclusive and therefore treasured. Conversely, the opposite might come to pass: the ability for in-person experiences to deliver unique experiences will diminish, creating more incentive for people to engage with a separate and increasingly digitized world.

One foreseeable challenge is how virtual tourism must continue to be seen as innovative and diversified in the experiences it provides, (as it was during the pandemic) to allow this platform to continue to hold audiences’ attention, even as they are no longer motivated by such drastic circumstances (Guttentag, 2008). Concepts such as “perceived obsolescence” and societal status pressure keep audiences always hungry for the next innovation, and it is imaginable that eco-innovation will be subjected to these same pressures. Despite this, the future is still very unexplored with regards to tech, but there remains high potential for future integration to help us better ensure that interactions between humans and wildlife are significant, and each person walks away fundamentally changed by what has happened. And perhaps, then we can start to realign society towards a world where wildlife is not utilized or exploited, but mutually cared for and respected as fellow inhabitants of the planet.

SYNTHESIS AND CONCLUSION

As the human population increases, the frequency of interactions between humans and wildlife has intensified. The development of mitigation approaches to conflict between humans and wildlife is a global sustainability priority. For industries like wildlife-based tourism, which are built entirely on the ability and interest of humans to make meaningful connections to nature, there is an even greater need for conservation to ensure the longevity of this intra-species relationships. In places like the Las Perlas archipelago in Panama, where wildlife-based tourism sectors are at early stages of development, early intervention can ensure a sustainable trajectory for both local communities and wildlife populations. Early intervention will also ensure that such locations do not follow the trajectory of other popular destinations that have suffered ecologically from mismanagement and over saturated tourism levels. As my research in Chapter 1 has shown, we are already starting to see the negative impacts that result from an unmanaged system.

Research has shown that top-down regulation and stricter enforcement of regulations do not always yield effective compliance and acceptance. In Las Perlas, it will be important to develop community engagement strategies to ensure that all members of the system are being included and heard. The inclusion of multiple sources of knowledge, motivations and goals will serve to create an adaptive management paradigm that will serve to be responsive to changes in the needs of its stakeholders, flexible in response to any disturbances (e.g., future pandemics) and aimed at protecting the livelihoods of all involved (including wildlife).

The overall aim of this dissertation project was to identify the various factors that are implicated in the development of sustainable and low-impact wildlife-based ecotourism. These include variables that relate directly to the cetaceans, including their physiology, well-being, and behavior (Chapter 1); those related to the social (human) part of the system and the practices of the tourist industry (Chapter 2); and those pertaining to the environment and the interactions between all (Chapter 3). Each factor on its own must be closely examined to better understand the cultural, scientific, and economic influences that shape them, and their interactions a complex system. The challenge in this type of exploration is further undermined by existing conflicts and lack of consensus in existing literature such as uncertainty about the level of anthropogenic disturbance on wildlife behavior. Optimistically, despite the challenges currently posed, whale watching can still be upheld as a generally positive alternative to the more harmful practice of whaling. The results of this research provide hope that this industry can achieve its goals of sustainability and promoting conservation worldwide.

As society continues to evolve and change, it is inevitable that human perceptions towards wildlife and nature will shift as well. Tourism experiences that are built on facilitating positive interactions between people and animals will continue to serve as valuable contrasts to more controversial and consumptive relationships, yet the format of these experiences will have to adapt to meet the changing demands of a larger and more diverse audience. Additionally, the growing dependency we have on technology will undoubtedly further affect our motivation and desire to seek out interactions with the natural world around us, and the corresponding potential to develop an interest in preserving or conserving it. As we cannot predict the pace and format these changes will

take, it will be imperative to view WBE development from a wide-angle, to most effectively consider how this industry, (including its conservation goals), fit into a broader social, cultural, and ecological context that will only continue to evolve.

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APPENDIX A
SUPPLEMENTARY MATERIALS FOR CHAPTER 1

A.1

IACUC Protocol Approval



**Smithsonian Tropical Research Institute
Instituto Smithsonian de Investigaciones Tropicales**

STRI Animal Care and Use Committee (ACUC) Amendment Approval Letter

Date Proposal Received: March 3, 2020.

Proposal Title: Movement Ecology and Demography of Small and Large Cetaceans.

Principle Investigator(s): Dr. Hector Guzman.

Collaborator (s): Juan Capella, Katie Surrey, Candy Real, Jorge Urban.

Proposal Number: 2020-0305-2023.

Proposal Expiration Date: March 5, 2023.

Proposal Materials Complete: Yes No

Review Process Determination: Approved: Withheld Approval:
Tabled pending additional information:

Comments:

Your protocol has been approved. We would like to stress the importance of reporting changes in your research or any problems you encounter during your research period.

Approval Date of Record: *March 5, 2020*

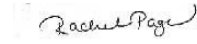
Important Notes:

Please notify the IACUC in writing immediately if any problems develop in association with your project. If you intend to make significant changes to your study including changes to methodology, study species, key personnel, or project title, please submit a STRI IACUC addendum form.

The STRI IACUC conducts semi-annual site inspections, during which your project is subject to review.

Upon conclusion of your project, we ask you to submit a report summarizing the results of your project, the number of animals used, and any unforeseen events including animal injuries or deaths. Please include successes or shortcomings of the methodology used. New protocols will not be reviewed until end-of-project reports are received.

Please be advised that it is your responsibility to obtain all permits and/or authorizations from the Panamanian government that are required to conduct this research or to import or export any biological samples.



Rachel Page
IACUC Chair

APPENDIX B

SUPPLEMENTARY MATERIALS FOR CHAPTER 2

B.1

TOURIST SURVEY QUESTIONS

1. What was your main reason for wanting to go on this tour? Please pick one option.

- See whales
 Spend a day on the water
 Fun activity (for family/kids)
 Learn/do something new
 Sightseeing/explore the local area

Other: _____

2. Was a major reason to visit Panama for wildlife tourism (e.g., *bird watching, whale watch*)? Y / N

If not, what was it: _____

3. On scale 1 to 5, how satisfied were you with the whale watch tour experience?

- (not at all) 1 2 3 4 5 (extremely)

4. Did you see whales on your tour? Y / N

5. Would you have enjoyed the whale watch, even if you had not seen a whale? Y / N

Please explain why: _____

6. What contributed to your enjoyment of the whale watching tour (select up to 3 options):

- seeing whales
 being on the water
 getting close to whales
 enjoyable weather
 exploring the local area
 learning something new about whales/the ocean
 knowledge of operator
 supporting local community
 tour operator
 comfort/cleanliness of boat
 better wave conditions

Other: _____

7. Was there a specific whale behavior(s) you were hoping to see? (see chart) Y / N

If so, what: _____

8. What would have made the experience more enjoyable? (select up to 3 options):

- seeing more whales
 getting closer to whales
 better weather
 comfort/cleanliness of boat
 knowledge of operator
 fewer boats
 learning something new about whales/the ocean
 better wave conditions

Other: _____

9. How much did you pay for your tour? \$ _____

10. Would you be willing to pay more for a tour that included the improvements you noted in Question 8? Y / N

11. Would you be willing to pay more if the money went directly to whale conservation? Y / N

12. Did you encounter any situations such as the one in the example? Y / N

13. Were you comfortable with the number of boats watching also whales on your tour? Y / N

Please elaborate why/why not: _____

14. On a scale of 1 to 5, how concerned do you think your tour operator was about whales?

1 (not at all concerned)	2	3	4	5 (extremely concerned)
▼	▼	▼	▼	▼
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Demographic Questions:

A1. What country are you visiting from?

A2. Have you ever participated in a whale watch before anywhere in the world?
Y / N

A3. From 1 to 5 how would you rate your knowledge of the following topics before your whale watching trip (s) in Las Perlas?

	1	2	3	4	5
	None at all				Extensive
	▼	▼	▼	▼	▼
Whale behavior (reproduction, migration, diving)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Threats to whales.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conservation and protection of whales.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Regulations regarding whale watching.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A4. Where would you say you have learned the most about whales? (Please circle one)

School

TV/Movies

Newspapers/Journals

Friends/Family

Social media

Other (please describe): _____

A5. To what extent do you agree or disagree with each of the following statements?

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
	▼	▼	▼	▼	▼
I consider myself environmentally conscious (knowledgeable about pollution, recycling, climate change etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I consider myself environmentally active (I recycle, buy eco-friendly products, reduce personal emissions)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think people should be environmentally conscious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I actively educate others about environmental /conservation issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I agree with establishing protected areas, even if it means reduced access for people.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A6. How much do you agree or disagree with each of the following statements?

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
	▼	▼	▼	▼	▼
The public should be educated about the threatened status of whale populations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Whales are well-protected worldwide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There are benefits to keeping whales in captivity.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Whale watching teaches people about conservation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel I have a responsibility to help conserve whales	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think it is important for people to participate in a whale watch.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

B.2

SEMI STRUCTURED INTERVIEW GUIDE – TOUR OPERATORS

1. How long have you been offering whale watching tours?
2. What led you to start offering whale watching tours?
3. What benefits do you receive from whale watching tours?
4. What do you enjoy about your job offering whale watching tours?
5. What do you think tourists enjoy about whale watch tours?
6. From the time you started offering whale watching tours to just before the pandemic, did you notice an increase, decrease, or about the same number of whales in the area?
 - Increase
 - Decrease
 - Numbers are the same

Why do you think that might be?

7. On a scale from 1-5 (one is “far less,” five is “far more”) - compared to tourists, how much would you say you know about whales?

[If uncertain of question] For example: (e.g., biology, conservation efforts, behavior)

1 (far less)	2	3 (about the same)	4	5 (far more)
▼	▼	▼	▼	▼
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[4 or higher on scale]: Where did you learn this knowledge?

[3 or lower]: Would you like the opportunity to learn more (about whales)?

8. What is something you know about whales that you think is interesting, or that you often share with tourists?
9. What is something you would like to know about whales?

10. Do you think tourists care about whales?

[If only Y/N answer: Why or why not?]

11. Do you think people should care about whales?

[If only Y/N answer: Why or why not?]

12. What do know about existing regulations in Panama regarding whale watching?

[If they DO know]:

12A. What do you think about the existing regulations?

[If participant is confused: for example: do you think they help protect whales? Do they make it harder for your business? Do you think they need to be improved?

12B: (If they need to be improved): How?

12C: Do you think other tour operators adhere to them?

[If DON'T know]: What regulations do you think would be beneficial to have?

13. Do you think whales get stressed by the presence or activity of boats? Y / N

[If Yes]: What specific practices do you implement in your whale watching tours to reduce stress on whales?

14. If free trainings/educational opportunities that could improve your whale watching business were to be provided, would you participate? Y / N

14A. [If Yes]: What trainings or educational opportunities would you want?

[If uncertain]: Examples: those that would allow you to learn more about whales to teach tourists, or finance/language skills to help improve your business

14B. [If No]: In what other ways could the government support your business?

Additional Comments

Please use the space below to add any comments you have about this conversation or any of the topics we mentioned.

B.3

IRB EXEMPTION



EXEMPTION GRANTED

[Leah Gerber](#)
[CLAS-NS: Life Sciences, School of \(SOLS\)](#)
480/727-3109
Leah.Gerber@asu.edu

Dear [Leah Gerber](#):

On 6/5/2022 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	The coupled human-nature system dynamics of wildlife-based tourism in Panama
Investigator:	Leah Gerber
IRB ID:	STUDY00016049
Funding:	Name: Arizona State University (ASU)
Grant Title:	
Grant ID:	
Documents Reviewed:	<ul style="list-style-type: none">• ASU IRB Approval, Category: Off-site authorizations (school permission, other IRB approvals, Tribal permission etc);• Biology and Society - Unusual Student Project Grant Award Letter, Category: Sponsor Attachment;• Consent_Form_TouristMotivation, Category: Consent Form;• Consent_Form_TouristMotivation_Interview, Category: Consent Form;• IRB Social Behavioral Protocol, Category: IRB Protocol;• STRI-ASU Collaboration Initiative Funding Letter, Category: Sponsor Attachment;• Tour Operator_Interview Questions, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);• Tourist_Survey Questions, Category: Measures (Survey questions/Interview questions /interview

	guides/focus group questions);
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The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 6/5/2022.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

If any changes are made to the study, the IRB must be notified at research.integrity@asu.edu to determine if additional reviews/approvals are required. Changes may include but not limited to revisions to data collection, survey and/or interview questions, and vulnerable populations, etc.

REMINDER - - Effective January 12, 2022, in-person interactions with human subjects require adherence to all current policies for ASU faculty, staff, students and visitors. Up-to-date information regarding ASU's COVID-19 Management Strategy can be found [here](#). IRB approval is related to the research activity involving human subjects, all other protocols related to COVID-19 management including face coverings, health checks, facility access, etc. are governed by current ASU policy.

Sincerely,

IRB Administrator

cc: Katie Surrey

SUPPLEMENTARY MATERIALS FOR CHAPTER 3

C.1

ONLINE PARTICIPANT SURVEY QUESTIONS

1. What comes to mind when you're asked to think about experiencing nature? Please describe.
2. Describe an impactful experience you've had in nature. Provide as much detail as you feel comfortable providing.
2a. What did you like and/or dislike about this experience? Why?
2b. Why was this experience memorable or emotionally engaging?
2c. What was something you remember telling other people about it?
2d. Was this something you would want to experience again?
3. Describe an impactful technologically augmented experience of nature you've had. For example, documentaries, using a species ID app, a nature themed video game or watching live nature webcam. Provide as much detail as you feel comfortable providing.
3b. What did you like and/or dislike about this experience? Why?
3b. Why was this experience memorable or emotionally engaging?
3c. What was something you remember telling other people about it?
3d. Was this something you would want to experience again?
4. Comparing your responses to questions 2 and 3, which experience was overall more significant to you?
4a. In what way(s) was it more significant? Why?
5. Imagine that you are on a whale watch excursion and the captain spots whales off in the distance. The boat stops and the staff navigate a drone into the air which flies over to the whales and provides this footage which is shared on monitors on the boat. The following questions relate to the video below, which represents the type of footage you might see.
https://www.youtube.com/watch?v=M84o6zCJlcU&feature=youtu.be
5a. How would you feel about experiencing this technologically augmented activity in this type of setting? [using the scale from Strongly Disagree to Strongly Agree]
5b. This video would make the experience more meaningful
5c. This video would disrupt my enjoyment of the experience
5d. This video would make me more engaged with the experience

6. After all these questions, what comes to mind when you're asked to think about experiencing nature?
7. After taking this survey, were there any memories/images that surprised you to recall? Provide as much detail as you feel comfortable providing.

C.2

Quantitative analysis of differences between average satisfaction rating between participants based on location growing up

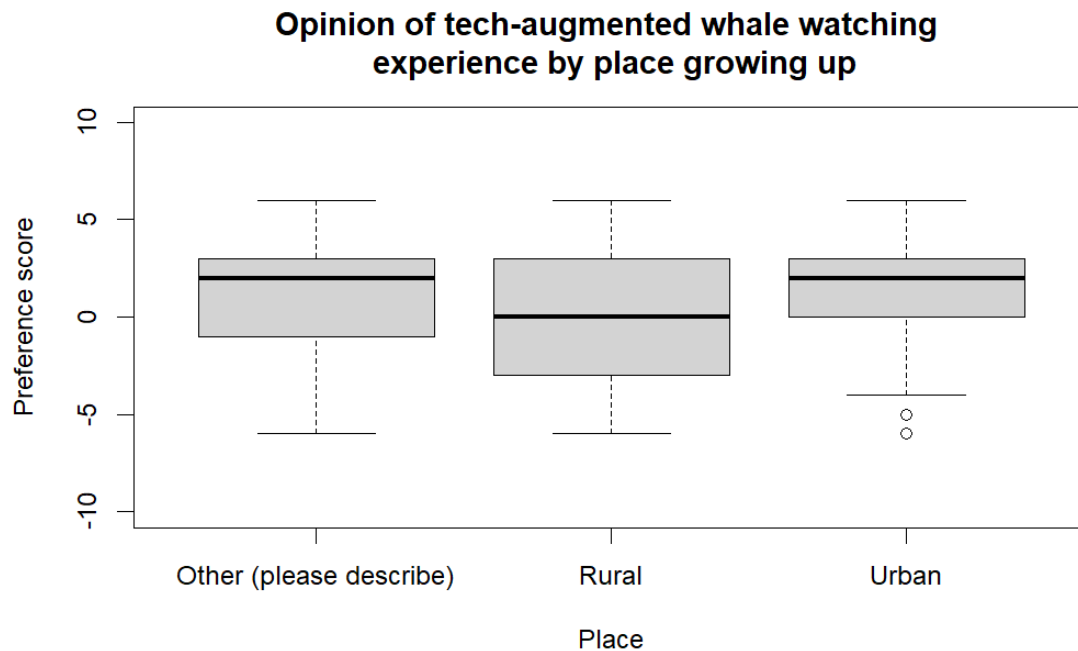


Figure 2.4: There was a very small significant difference between the average satisfaction level (whale watching score) of participants based on where they identified growing up (Place) (Kruskal Wallis: Chi-square = 5.75, df = 2, p = 0.05619). We used a non-parametric test due to the lack of normality in our data set. “Preference Score” was coded based on the answers to 5b, 5c, 5d (on scale of -2 (Strongly Disagree) to 2 (Strongly Agree)) that corresponded to preference for having an experience like the whale watching video.

C.3

IRB EXEMPTION



EXEMPTION GRANTED

Ben Minter
CLAS-NS: Life Sciences, School of (SOLS)
480/965-4632
Ben.Minter@asu.edu

Dear [Ben Minter](#):

On 12/20/2022 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Examining Perceptions about the Role of Technology in Experiences of Nature
Investigator:	Ben Minter
IRB ID:	STUDY00017155
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	<ul style="list-style-type: none">• Experiences of Nature_ IRB Social Behavioral.docx, Category: IRB Protocol;• Informed Consent Form.pdf, Category: Consent Form;• Nature Flier.pdf, Category: Recruitment Materials;• University Office of Evaluation and Educational Effectiveness - Approval.pdf, Category: Off-site authorizations (school permission, other IRB approvals, Tribal permission etc);• Updated_Survey Questions.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);• UVA and Concord Academy Confirmation, Category: Off-site authorizations (school permission, other IRB approvals, Tribal permission etc);

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2)(i) Tests, surveys, interviews, or observation (non-identifiable), (2)(ii) Tests, surveys, interviews, or observation (low risk) on 12/20/2022.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

If any changes are made to the study, the IRB must be notified at research.integrity@asu.edu to determine if additional reviews/approvals are required. Changes may include but not limited to revisions to data collection, survey and/or interview questions, and vulnerable populations, etc.

Sincerely,

Susan Metosky
IRB Administrator

cc: Katie Surrey
Katie Surrey
Cassandra Lyon
Amalie Strange