

**OWLS, OTTERS, OCTOPUSES, AND US: EXAMINING HUMAN-WILDLIFE  
RELATIONSHIPS, ATTITUDES, AND PERCEPTIONS**

by

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## **Abstract**

Human and non-human animals have had a rich and complicated relationship throughout history, with each having a profound influence on the survival and development of the other. Increasing population and environmental pressures facing both groups have altered these relationships considerably, and have inspired scholars across fields to look more closely at the nature and defining factors of human-animal relations. This dissertation seeks to examine more fully the relationship between humans and animals, specifically wildlife, in order to characterize more deeply the relationships and experiences of humans and animals, the ways in which animals are being perceived by human communities, and the changing state of these perceptions in the current period.

The thesis itself comprises four different studies examining elements of this human-wildlife interface. The first study looks at existing literatures on human-wildlife relationships and I identify emerging trends, including determinations of “wild,” perceptions of wildlife, and dimensions of relationality, in addition to exploring the advantages and disadvantages of multi-disciplinary work. The second study explores a case study of animals residing at an aquarium to consider temporally enduring human-wildlife relationships. I show the need for a spectrum of analysis to evaluate animals as opposed to simple terms of wild or tame. This spectrum more closely approximates the wide variety of living animals and also addresses the labor of wilding and de-wilding animals that is necessary in an aquarium setting. The third study examines perceptions people hold towards a wide range of wildlife species. I show how people ascribe many different cognitive and emotive traits and capabilities onto species, which is itself dependent upon taxa. Counter to expectation, cognitive traits are ascribed more than emotive

traits. The fourth study experiments with an educational card game featuring animals and their host ecosystems. I show that by using this mode of engagement, perceptions of wildlife can be changed and subsequent behaviors linked to those perceptions may also change. Combined, these chapters seek to understand and categorize the various ways in which humans and wildlife relate to one another with the hope of ultimately identifying strategies to facilitate the survival and success of both.



## **Lay Summary**

Rising human populations increasingly encroach on the available space and livelihood of wild animals. Thus, it is necessary to investigate the overall nature of the human-wildlife relationship in order to address ecological challenges that result from this situation. I explored how and why relationships develop and found it is necessary to broaden the definition of “wild” away from just “wild and tame” to include a spectrum of different categories. I also found that people’s perceptions of wild animals are based in part on the class of animal and focus more on the intellectual attributes of animals as compared to emotional ones. Finally, I showed that methods such as a card game can teach people about animals and ecosystems in an interactive way in order to affect their perceptions, knowledge, and behavior.

## **Preface**

Chapters 2, 3, 4, 5 are intended to be published as distinct manuscripts in academic journals.

Because they are intended to be standalone pieces, there is some repetition across chapters especially when describing the research context. Additionally, all the chapters are intended to be published as co-authored articles and as such use the plural voice.

Chapter 2 is based on my own original empirical research. I am the lead author for the paper and collected and analyzed the data and wrote the manuscript. Co-author T. Satterfield provided guidance and support for the design, analysis, and writing of the chapter as well as feedback on the manuscript.

I am the lead author for chapter 3. Co-author T. Satterfield and I designed the study, I conducted all the interviews, coded the transcripts, conducted the analysis, and wrote the manuscript. T. Satterfield provided detailed guidance on interview protocols and support on the analysis and the writing. Chapter 3 was approved by UBC Behavioral Research Ethics Board approval (#H18-00169).

Chapter 4 has been published in a peer-reviewed journal. I am the lead author for the publication. I designed the survey and collected data. I also performed the data analysis, data visualization, and wrote the manuscript. T. Satterfield and J. Zhao helped with research design, data analysis, and provided feedback for the manuscript. J. Zhao also helped acquire research funding. The chapter was approved by UBC Behavioral Research Ethics Board approval (#H16-01907).

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Chapter 5 has been published in a peer-review journal. I am the lead author for the publication. I designed the study along with A. Echeverri with assistance from J. Zhao, T. Satterfield, and D. Ng. I collected data along with A. Echeverri and six research assistants (A. Chhina, E. Edge, C. Honda, C. Kim, G. McKeown, and I. Simm). I analyzed the data, created the data visualizations and wrote the manuscript. A. Echeverri assisted with data analysis, data visualization, and writing. T. Satterfield and J. Zhao provided feedback to the manuscript and support in data analysis. D. Ng also provided feedback for the manuscript and helped acquire research funding. The chapter was approved by UBC Behavioral Research Ethics Board approval (#H16-03088).

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## List of Symbols

$d$	Cohen's d
F	Fisher's test
$M$	Mean
n	Sample size
$\eta_p^2$	Partial eta squared
$p$	Symbol used to refer to p-values
$p_{adj}$	Symbol referring to p-values with Bonferroni corrections in Chapter 5
$t$	Student's t-test statistic
$\chi^2$	Chi-squared symbol, referring to the results of the chi-squared tests

## **List of Abbreviations**

ANOVA	Analysis of Variance
AESD	Agricultural and Environmental Search Database (Proquest0
BAM	Belief in Animal Mind
BC	British Columbia
CAD	Canadian dollar
df	Degrees of freedom
HPA	Hypothalamic-pituitary-adrenal
HSP	Human Subject Pool
IAT	Implicit Association Test
MRI	Magnetic Resonance Imaging
Mturk	Mechanical Turk
PANAS	Positive and Negative Affect Schedule
PAIS	Public Affairs Information Service (Proquest)
SD	Standard Deviation
SE	Standard Error
STEM	Science, Technology, Engineering, and Mathematics
Tukey HSD	Tukey's Honestly Significant Difference test
UBC	University of British Columbia
US	United States

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## **Dedication**

To my parents and to Finn who all taught me the joy that comes with loving animals and that the most important thing to be is kind.

## Chapter 1: Introduction

*“I care about mammals, but I also care about larval fish, I care about crabs, I care about all these different things because they’re all part and parcel of it.”*  
—Aquarium trainer #13 (2018)

The multidimensional relationship between humans and nonhuman animals extends from the beginning of collective consciousness to the present, and will likely take on even more profound importance in the future. However, while human societies are advancing and expanding, nonhuman animal species are facing inordinately high levels of extinction (Díaz et al., 2019). Humans and nonhuman animals (hereafter referred to as animals for the sake of brevity) are interacting more frequently due to increasing human population and decreasing animal habitat (Soulsbury & White, 2015). As a result, humans are intentionally and unintentionally shaping species and ecosystems through their actions, by impacting land use, polluting natural systems, and precipitating climate change (Brodie, 2016; Frishkoff et al., 2014). However, improving our understanding of the nature of human-animal relationships may have many effects, such as decreasing conflict, increasing welfare, and even potentially promoting conservation. Coexistence goals and methodology have shifted from a focus on keeping human and animal populations separate, by protecting intact areas devoid of human presence, to ones that focus instead on ecosystems and relationships of which humans are an inevitable and integral part (Mace, 2014). It has been shown that direct interactions with animals and positive human perceptions of animals may drive positive relationships (Clayton, Litchfield, & Geller, 2013). But in order to improve relationships between humans and animals, more is needed to fully grasp the underlying intricacies of human-animal relationships. Given these goals, the field of human-animal studies has blossomed in the past few decades (Hosey & Melfi, 2014; Shapiro



& DeMello, 2010) and seeks to evaluate the relationships, interactions, and bonds between humans and animals (DeMello, 2012; Shapiro, 2020).

The field of “human-animal studies” explores what animals mean to humans (DeMello, 2012), looking at the animal as an active participant in the relationship, not just as a symbol (Knight, 2005). It attempts to combat much of “us versus them” thinking, or the belief that animals are separate and opposite humans (Hurn, 2012), though it should be noted that even the name of human-animal studies falls victim to anthropocentrizing as it distinguishes humans as something separate from animals (Tonutti, 2011). Similarly, this division underscores how pervasive anthropocentrism is within human experience (Nimmo, 2011) and how it represents a tension with nature and animals (Boddice, 2011). While humans are often hesitant to question anthropocentrizing due to the long-held beliefs that humans are special (Hurn, 2012), it can be harmful when humans consider the human condition to be the only one that matters in the relationship (Balcombe, 2011). However, given the complexity and the necessity of the human-animal relationship it is essential to more closely evaluate all facets and all participants of the relationship.

The field of human-animal studies encompasses many different disciplines to explore a wide range of questions involving the human-animal relationship. However, while domesticated animals are often considered in studies of human-animal relationships, much less research is conducted regarding wild animals (Hosey & Melfi, 2014; Serpell, 1996). In this dissertation I engage with the field of human-animal studies to ask the question: how do we characterize relationships that exist between humans and *wild* animals, across all gradations of “wild?” This must necessitate a workable definition of “wild,” a further understanding of human perceptions of animal capabilities, more detailed examinations of examples of sustained human-wildlife

relationships, and possible ways to improve ecosystem and species-specific knowledge and conservation support. Given the complexities of relationships as well as the many disciplines encompassed by the overall field, I draw from a broad range of different theories and methodology to examine these inherent elements found within the human-wildlife relationship.

## **1.1 Animal-Human Studies**

### **1.1.1 History of human-animal relationships**

While the dedicated field of human-animal studies is still relatively nascent in comparison to other fields of study, the roles of humans and animals in society have evolved for thousands of years. Wolves were commonly thought to be the first animal domesticated over 15,000 years ago (DeMello, 2012), and all of the well-known plants and animals were domesticated and had become a part of human society by around 2,000 BCE (Serpell, 1996). This is not to say that humans have always played an active role in domestication. In the case of wolves, those individual wolves who were less fearful and more willing to approach humans, especially humans' refuse piles, had better access to the food and eventually the lines favoring those traits were passed on and led to closer and closer associations with wolves. This has continued to evolve up to today, where domestic dogs are better at reading human signals than wolves or even chimpanzees (Herzog, 2010).

Animals have been integrated into all parts of human society, existing in visible settings such as circuses and zoos and less visible ones such as factory farms or laboratories. But despite these close associations, the place of animals within the confines of human society is often disputed (Berger, 2009; Kendall, 2011). This is particularly true within a legal framework. The legal system in the United States, until recently, saw animals as owned property (Arluke, 2009). However, the Great Ape Project in the 1990s was an attempt to legalize animal personhood,

giving moral standing and legal benefits to some animals (Knight, 2005), though in the United States, animals are still often viewed as legal property. Indeed, legalistic dilemmas of the standing of animals have increased in conjunction with the rise in studies focusing on animal behavior, cognition, and the relationships they share with humans (Manfredo, Teel, & Henry, 2009). Furthermore, in many different societies, animals are traditionally afforded personhood (Bird David, 1999; Knight, 2005; Kohn, 2008; Nadasdy, 2008; Nelson, 1983). This longstanding relationship, honed over thousands of years, continues to evolve and thus it is essential to more fully examine it across different animal and human populations.

### **1.1.2 The human-animal relationship and animal agency**

Categorizing and exploring the human-animal relationship is complicated given the need to understand and access both participants. Thus it is understandable that the most commonly researched type of relationship is the pet-human relationship (Serpell, 1996). Many studies have discussed the benefits humans obtain from interacting with a pet, although it should be noted that studies examining the effects on the animals are significantly fewer. Benefits to humans may include lowering heart rate by petting an animal (Vormbrock & Grossberg, 1988) as well as encouraging communication and interaction between people. Additionally, there is also evidence that dogs may be able to detect hypoglycemia (Chen et al., 2000; Lim, Wilcox, Fisher, & Burns-Cox, 1992), imminent seizures (Dalziel, Uthman, McGorray, & Reep, 2003; Flegg & Kirton, 2005; Strong, Brown, & Walker, 1999; Strong, Brown, Huyton, & Coyle, 2002), and perhaps even cancer (Lippi & Cervellin, 2012; McCulloch et al., 2006; Pickel, Manucy, Walker, Hall, & Walker, 2004; Willis et al., 2004).

Beyond pets and domesticated animals, it becomes more difficult to examine human-animal relationships. Contrived settings where animals and humans are brought into controlled

contact such as zoos, aquaria, and ecotourism are thus unique and interesting situations. Research often examines the nature of animals in zoos, contrasting the benefits such as education and species survival against costs to the animals such as captivity and mistreatment (Hurn, 2012). Some feel that ecotourism is a more “authentic” way to satiate the human appetite for leisure in the wild, while still protecting and gathering resources for the animals. However, ecotourism still carries an expectation on the human side for a performance. It can disrupt the natural behaviors of animals and they may show their disdain of the intrusion (Dawkins, 2012).

Apart from the contrived settings, an increasingly important theme in the field is research regarding animals in the wild. Such work delves into benefits, conflict, coexistence, and engagement among others. In general though, benefits for wildlife are defined as conserving an entire species rather than an individual animal, prioritizing the population over the individual (Lane & Jackson, 2013). However, urban animals, such as crows, are increasingly receiving attention regarding the benefits they may receive from animal-human interactions (Marzluff & Angell, 2008). Despite some studies on benefits and coexistence, the majority of the wildlife-human interaction literature focuses on conflict (Bhatia, Redpath, Suryawanshi, & Mishra, 2019; Woodroffe, Thirgood, & Rabinowitz, 2005). Finally, some research focuses on the relative engagement and detachment of the public or even researchers themselves with animals (Candea, 2010).

One of the biggest disagreements and points of contention across different disciplines, is whether or not animals are active participants and have agency within the human-animal relationship. Many ecological and cultural analyses of human-animal interactions and relationships do not take animals as active agents in the relationship (Nadasdy, 2008). Anthropology in particular often attempts to maintain a difference between humans and animals,

as the discipline intrinsically and traditionally has studied humans (Nadasdy, 2008). However, in general, the field of human-animal studies is elucidating additional factors that suggest agency. Many studies are acknowledging that animals can think, commonly citing animals such as dolphins, parrots, crows, great apes, and other nonhuman primates (Burghardt, 2009). Research seems to be moving further outward in the direction of trying to discern other capabilities related to consciousness, such as problem solving and self-awareness across a range of species (de Waal, 2016). For example, can animals, like the chimpanzee, understand what is in the mind of another chimpanzee (Dawkins, 2012)? Additionally, studies have examined animal emotions, finding animals certainly experience primary emotions (Panksepp & Biven, 2012) and indeed share many core emotions with humans (Dawkins, 2012). In order to examine some of these concepts, the field of human-animal studies as a whole often draws heavily on ethology, the goals of which include better understanding of physiological mechanisms, development, history, evolution, and function of behavior in animals (Burghardt, 2009; Tinbergen, 1963).

Studies of the so-called “animal mind” are central to the examination of animal agency and its role in human-animal relationships has increased in frequency and complexity (Bavidge & Ground, 1994; Dawkins, 2003; Griffin, 2013). The use of technology such as functional MRIs and more standardized testing with regard to problem-solving, self-awareness, and other cognitive and emotional parameters are leading to increased awareness of the complexity of animals and the relationships they may share with humans (Berns, Brooks, & Spivak, 2012; Van der Linden, Van Camp, Ramos-Cabrera, & Hoehn, 2007). Studies of behavior have identified elements previously thought to exist only within humans such as ritualization, empathy, or collective wisdom. For example, crows watch their parents and neighbors to identify strategies for dealing with nest predators, indicating it is not just a process of trial and error, but a learned

response that is passed on through generations (Marzluff & Angell, 2008). Also, a classic study demonstrated how the Japanese monkey Imo started a habit of washing potatoes and wheat in the water to facilitate easier eating and it soon spread throughout all the monkeys in the area, indicating learning and culture (Kawai, 1965). The increasing insights into animal minds and behaviors only serve to underscore the need to evaluate the interactions and relationships that animals share with humans from the perspective of and attuned to the needs of both participants.

### **1.1.3 Researching human-animal studies across the globe**

The interpretation of human-animal studies is complicated by variations across worldviews, since each culturally specific group may manifest its own distinct relationship between humans and animals (Ingold, 1988). For example, in some places animals are revered as gods, whereas in others they are relegated to servant status, attending to human needs (Hurn, 2012). That this is an indoctrination into a certain mindset (that is, a taught belief) and not a hardwired belief is bolstered by the fact that children may be more likely to give animals equal moral status to humans, indicating there may be societal and cultural pressures that change those assumptions as they grow (Mundkur, 1988; Tiffin, 2007).

Historically, many studies of human-animal relations are influenced by the idea that there is a clear distinction between humans and animals, where animals are not capable of possessing many of the same attributes as humans (Cottingham, 1978; Nadasdy, 2008; Russell, 2010). This foundational assumption is more commonly seen in those countries and areas that have been significantly influenced by Abrahamic religions, subsequent European scholarship and their associated language, religion, customs, and governance. The various influences of pastoralist culture, biblical interpretations, and various denominational traditions are involved in this notion of human dominion or governance (Preece & Fraser, 2000). The fact that these theories were

prominent in human-animal studies is due in part to the fact that until very recently, the capital and publishing power had come largely from the global north. In addition, from a historical viewpoint, these areas have changed more rapidly in terms of their relationship with animals, likely due in large part to rapid technological advances (Preece, 2006). Viewing the human-animal relationship as one of duality utilizes a structure focused on power hierarchy and differential (Daston & Mitman, 2009). Furthermore, this belief of domination (such as rich over poor, masculine over feminine) has influenced the understanding of and interactions that humans have with nature (de Jonge, 2011). This is not to say all examinations of human-animal relations fall prey to this viewpoint. Many people view themselves not from a position of master, instead assuming themselves to be on the same level as animals or even lower (Ingold, 1988). However, it is necessary to consider the historical underpinnings that have influenced research in the field and acknowledge that the field itself continues to work with and against its historical leanings.

To give an example, one particular area influenced by dualism in which there has been both contention and change in regard to studying animals, is the status of anthropomorphism (Knight, Vrij, Bard, & Brandon, 2009). Anthropomorphic descriptions of animals (defined by some as attributing emotions to animals) were often viewed as detrimental to objective scientific investigation (Wynne, 2004). Indeed, some scientists have criticized others for their reliance on anthropomorphism, such as the American scientists who criticized their Japanese compatriots for their anthropomorphic descriptions in many of their studies on primates (de Waal, 2003). However, this is changing with anthropomorphism being utilized and defended by such notable scholars as Jane Goodall, Barbara Smuts, and Frans de Waal. In addition, recent studies have shown that in general, humans are beginning to view animals in more beneficial and mutualistic arrangements as opposed to adopting viewpoints of human dominion over animals (Manfredo et

al., 2009). Historical influences such as duality with and dominion over animals have traditionally had a large influence on the field of human-animal studies, but it is important to recognize these are not the only considerations and that there have been rapid changes in the field and that will likely continue, if not increase, in the years to come.

#### **1.1.4 Multidisciplinary nature of human-animal studies**

The field of human-animal studies is by necessity interdisciplinary. In order to understand a single relationship for example, scholars might need to draw from disciplines such as anthropology and psychology (to understand human and societal behavior towards animals), ethology (to understand animal behavior), and animal welfare (to consider the effects on animals), to name but a few. There are many disciplines that contribute to human-animal studies including, but not limited to, social and cultural anthropology, archeology, biology, psychology, philosophy, feminist studies, science and technology, cultural studies, social history, cultural geography, sociology, ethology, economics, political science, animal welfare, and animal rights (Echeverri, Karp, Naidoo, Zhao, & Chan, 2018; Franklin & White, 2001; Shapiro, 2002; 2020). In addition, there are many types of relationships between humans and animals and each cannot necessarily be investigated in the same way. An animal is not merely categorized as “animal,” but instead may be a mythical animal of the ancient world, the companion animal of modern society, the agricultural animal, the entertainment animal, the war animal, or the experimental animal and each necessitates its own careful consideration and study.

Human-animal studies itself has not yet fully enjoyed stand-alone status given these wide-ranging requirements for understanding relationships, but rather draws on many different disciplines. There are conferences, classes, and symposia that are being developed to start to draw these disciplines together, accompanied by the publication of such dedicated journals as



*Anthrozoös*, *Society & Animals*, and *Humanimalia*. However, with so many disciplines contributing ideas and research, there is understandably a great deal of inconsistency. For example, the theories and research across disciplines alternatively contradict or draw from one another. As a result there are different questions being asked, different methods employed, and different conclusions reached. Thus, the field of human-animals studies as a whole faces a dilemma moving forward linked to this multidisciplinary approach. Should it come together and officially claim its own freestanding academic domain, or should it form a distinct area of study within the disciplines in which it already exists? Certainly there are benefits to creating a distinct field that would aid in standardizing methodologies and approaches and could synthesize many of the theories already present within the field. But on the other hand, such a field would have to compete against established disciplines for resources (Shapiro, 2002). If it instead stayed within the various other disciplines it would receive the support of each, but would face disparate and often competing takes on similar topics. These remain necessary questions to consider when addressing the overall field.

In this dissertation I examine and seek to understand and categorize the human-animal relationship. Given the many disciplines that comprise the field of human-animal studies, I build upon existing literature and utilize a mixed-methods approach to attempt to draw from a variety of different disciplines and arrive at more nuanced conclusions. Specifically, I use tenets of systematic literature review to examine the question of how the field of human-animal studies explores relationships with wild animals. I explore a case study at an aquarium to delve into questions of how sustained human-wildlife relationships are developed and shaped to accommodate the wild nature of the animals and the needs of the human participant. I utilize an online survey to explore people's perceptions of the capabilities of wild animals and finally I test

a card game using an in-lab design to explore ways to improve perceptions and knowledge of species and ecosystems as well as the impact on conservation donation behavior. In addition, a driving force of this dissertation is an examination of the relationships that exist between humans and wild animals, since traditionally the field has been far more attuned to domesticated and agricultural settings (Hosey & Melfi, 2014; Serpell, 1996) despite the critical relationships that exist between humans and wild animals.

## **1.2 Looking at wild animals**

Any focus on and inclusion of wild animals in regard to human-animal relationships necessitates a more nuanced understanding of what actually constitutes a “wild animal.” Traditionally animals have been understood to be either “wild” or “tame,” however the roles animals inhabit are often far more varied than such overly simplistic categories suggest. Wild was initially perceived to be an existence devoid of human interaction. However, especially in the current era where humans and animals increasingly come into contact, wild animals can be affected by humans, their cars, their houses, even their trash (Nagy & Johnson, 2013). In addition, relationships may form between humans and animals who live freely in the wild (Smuts, 2001). Given this, the definition of wild must necessarily be more encompassing, and has been broadened to nonhuman, free-living animals (Magle, 2018). However, there are still questions regarding how to define animals and as such many types of animals may fall somewhere between the wild through tame spectrum. These may include zoo animals (Birke, Hosey, & Melfi, 2019; Braverman, 2011), urban wildlife (Magle, 2018), and feral animals (Buckley, 2018), among others. Some animals may live in the wild among their own species for part of the year and with humans for other parts (Aghbali, 2016) and this creates a struggle as to their classification. Additionally, there are rehabilitation and release facilities, sanctuaries,

wildlife parks, research institutes, and urban parks that all represent different ways in which animals may or may not be deemed as “wild.” While daily human-animal interactions occur more often with more domesticated animals, it is the interactions humans have with wild animals across all nodes of the wild-tame spectrum that can shed valuable light on human perceptions, ideas, and beliefs about wild animals and ultimately influence their relationships. The questions that emerge from discussions of determining wild are necessarily varied and complex and thus evaluations must be equally broad. To determine definitions of wild animals it is first necessary to examine classifications of wild animals. This leads to the question: how does the current literature seek to examine such issues as defining and classifying wild animals and does that sufficiently capture all variations (Chapter 2)? Additionally, exploration of specific instances of human-wild animal relationships in some of the questionable categories (e.g., zoos) can shed light on the fact that wild animals exist in many contexts. From this emerges the question: how might we more fully encompass all expressions of the “wild through tame” spectrum and what are the ways that animals might exist and move upon that spectrum (Chapter 3)?

### **1.3 Perceiving Animals**

While much has been said about the overall field of human-animal studies and its goal of seeking to understand more about the inherent relationships between humans and animals, one necessary factor in determining such relationships is examining the behaviors that humans manifest when dealing with animals and the factors that affect those behaviors. In many cases, it is perceptions and attitudes that influence and drive behaviors and influence the actions that people take towards animals. Perception is generally thought to represent how sensory inputs from the world are absorbed and processed, essentially how something is understood (Manfredo, 2009)—at its core, how brains process information. The theory of reasoned action (Fishbein &

Ajzen, 1975) says that the best individual indicator of behavior is intention. If people perceive doing something as positive and there is a normative pressure to do so, then they will likely follow through with that behavior. Attitudes are faster-forming cognitions that may either be generated in the moment or arise from memory. They may contain affective (emotion-based), cognitive (belief-based), and/or a conative (action-based) dimensions (Manfredo et al., 2009). Attitude studies are the basis of much of the research that examines the human side of human-wildlife interactions (Manfredo et al., 2009). At its most basic: positive attitudes may facilitate better interactions, and negative attitudes toward animals may results in less humane behavior towards animals (Serpell, 2004).

But many other factors have been found to drive perceptions and attitudes towards animals. Some are intrinsic to the animal themselves. For example the phylogenetic closeness of an animal (how similar they are to humans) is often positively correlated with favorable attitudes and responses to animals (Batt, 2009; Eddy, Gallup, & Povinelli, 1993; Nakajima, Arimitsu, & Lattal, 2002). For this reason, many studies have found that when looking at taxonomic distinctions, people generally rank mammals as highest followed by birds, reptiles, amphibians, and fish, an order which echoes the phylogenetic distinctions (Batt, 2009; Driscoll, 1995; Moss & Esson, 2010; Tisdell, Wilson, & Swarna Nantha, 2006). Animals that are less popular with humans tend to be more morphologically distinct from humans and it has been theorized that one reason people may like them less is they remind humans of their own “creatureliness” (Batt, 2009). The animal traits most preferred by humans include a large size and neotenic (juvenile) features, which are often considered “cute” (Archer & Monton, 2011). Other traits that influence attitudes include animals’ shape, type of locomotion, posture, surface texture, and color (Stokes, 2007). For example, some of the most important qualities for visual appeal are colors, curiosity,

movement, balance, symmetry, and functionality (Grinde, 1996). Traits that allow an animal to be more easily anthropomorphized often lead to more positive perceptions of the animal (Woods, 2000). Additionally, animals that are seen as “useful” to humans, providing some sort of service are often more preferred (Woods, 2000). Finally, perceptions of the relative rarity or vulnerability of an animal may also influence preference, with those that are perceived to be more vulnerable frequently being seen in a more positive light (Gunnthorsdottir, 2001; Serpell, 2004).

While the actions and appearances of animals are often central to human perceptions and attitudes, many studies have shown that different biological and sociocultural factors can also be influential in this regard. Children and younger adults, for instance, are more likely to believe in what we above referred to as the animal mind (Kupsala, Vinnari, Jokinen, & Rasanen, 2016), and pro-animal attitudes have been shown to decrease with age (Binngießer, Wilhelm, & Randler, 2015). This is logical, given that a critical period in the development of attitudes occurs in childhood (Kellert, 2005; Teel, Manfred, & Stinchfield, 2007). Another commonly cited distinction in regard to perceptions of and attitudes towards animals is gender. Women are generally more empathetic towards animals and more likely to ascribe traits (e.g., intelligence, emotions) to animals (Herzog & Galvin, 1997; Hills, 2015). Women similarly have been found to have more affectively loaded perceptions of animals (they recognize emotions in animals), while men tend to have more utilitarian views (they look for the value in animals) (Kellert & Berry, 1980). However, it should be noted many of these studies took place in North America. A pan-African survey found the influence of gender to be opposite to the above-cited North American results (Browne-Núñez & Jonker, 2008). Aside from age and gender, some additional factors that have been shown to influence perceptions include locations (Serpell, 2004; Woods,

2000), conservation organization membership (Falk & Adelman, 2003; Williams, Ericsson, & Heberlein, 2002), education (Maust-Mohl, Fraser, & Morrison, 2012), and cultural beliefs and values (Carter, Riley, Shortridge, Shrestha, & Liu, 2013; Gurusamy, Tribe, Toukhsati, & Phillips, 2015; Mitchell, Bruyere, Otieno, Bhalla, & Teel, 2018).

While understanding human perceptions and attitudes is important to comprehending and predicting subsequent behavior, it is also important to consider ways in which behavior and perceptions may be influenced. Imparting additional knowledge through directed education can be particularly useful. For example, increasing ecoliteracy, the basic understanding of natural systems (Goodwin, 2016; Orr, 1992), can lead to increased emphases on sustainability and biodiversity conservation (McBride, Brewer, Berkowitz, & Borrie, 2013). While wildlife populations are rapidly decreasing, human attitudes towards the need for and the right approach to conserving animal populations vary greatly (Ehrlich, 2002).

While the literature on perceptions of animals in general is increasing, human perceptions of wild animals are not as clearly understood as those regarding more domesticated animals. Additionally, as mentioned above, many of the studies focus on the physical features and appearance of the animals. However, an equally and perhaps more important question is what types of traits and capabilities do people perceive wild animals as having, given this may also help us anticipate co-existence (Chapter 4)? Finally, it is important to understand assumptions and knowledge regarding different wildlife, as well as how these form and whether or not they can change. The question that then follows is: what tools and methods may be utilized to affect perceptions and knowledge to potentially aid in the creation of more effective conservation messaging (Chapter 5)?

#### **1.4 Coexistence and Improving Human-Wildlife Relations**

The ultimate goal of any study of human-animal relationships must necessarily be the betterment of both parties involved. With increasing levels of extinction in the wild, humans continue to play a defining role in affecting wild populations either positively or negatively (Blom, van Zalinge, Mbea, Heitkonig, & Prins, 2004; Halpern et al., 2008), and the circular nature of ecological principles ensures that actions towards wildlife will have a subsequent effect on humans as well. While E.O. Wilson has recently proposed setting aside half the earth for wildlife to protect against impending extinctions (Wilson, 2016), this is not likely to occur fully or quickly given the rapid increase in human populations and settlements. Thus, it is necessary to understand and explore not only ways in which humans and wildlife currently exist, but explore whether such co-existence can be improved. Understanding the relationships that exist as well as the perceptions, attitudes, and knowledge that influence those relationships can lead to improved situations across increasingly shared landscapes.

Understanding people's perceptions of animals is important as they may influence people's attitudes and behaviors towards animals (Cox & Montrose, 2016; Pelé, Georges, Matsuzawa, & Sueur, 2021). For example, seeing species can increase interest in those species (Smith & Sutton, 2008). Similarly, with increased urbanization and increased focus on virtual technology, people are spending less time in nature, and are thus less aware of and knowledgeable about nature, consequently leading to less prioritization and care (Louv, 2008; Soga & Gaston, 2016). Finding ways to increase knowledge and interest in nature, specifically species, can have beneficial effects by increasing desire to effect positive environmental change (McBride et al., 2013).

Even though predicting human behavior can be very complicated (Kollmuss & Agyeman, 2010), human behavior may have a large impact on biodiversity conservation (Selinske et al., 2018). This is understandable given that conservation behavior may be driven by a number of factors including attitudes (Manfredo et al., 2009), preferences (Kaplan, 1987), values (Atran, Medin, & Ross, 2005; Manfredo et al., 2009), and perceptions (Selge, Fischer, & van der Wal, 2011; Verbrugge, Van den Born, & Lenders, 2013). Thus it is necessary to further analyze these elements of the human-wildlife relationship (e.g., perceptions, knowledge, and conservation behavior) in order to highlight ways in which it might be improved.

### **1.5 Research goals and Dissertation structure**

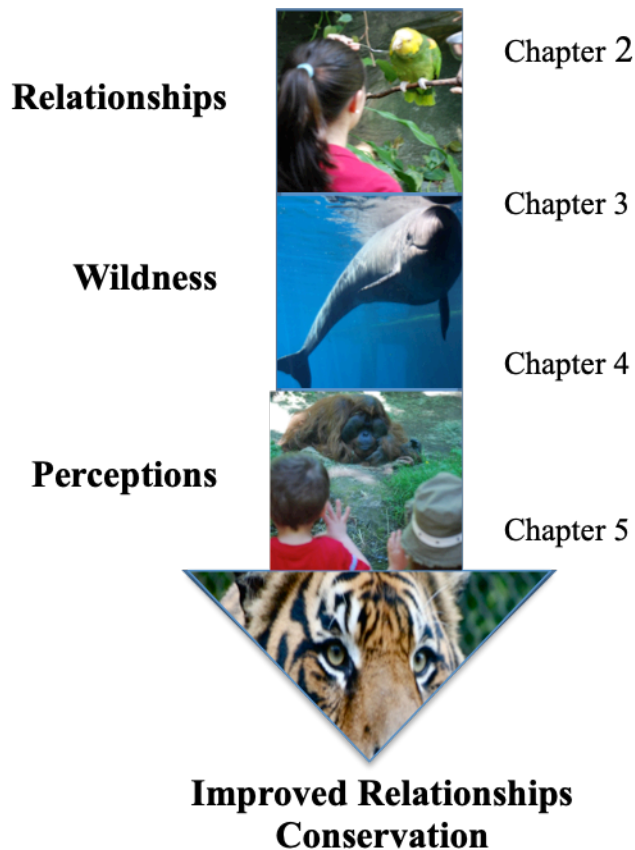
Human-wildlife relationships embody the complexity inherent within any relationship, as they must balance a number of considerations and thus require a broad approach for study. The field of human-animal studies, despite its newer status, comprises many different disciplines which all aid in evaluating the nature of relationships. Also, relationships with wild animals comprise a significantly smaller portion of the overall knowledge base in this emerging field, despite wild animals' essential roles within necessary biomes and ecosystems. This dissertation is thus underscored by the desire to explore the human-animal relationship, specifically focused on wild animals, utilizing a wide range of topics and methodologies. Being cognizant of the complexities surrounding understanding and categorizing human-wildlife relationships, I worked with my supervisory committee to design a number of studies to meet three overarching goals for the research. Simply stated, these goals were: 1) To examine and understand human-wildlife relationships and interactions within the field of human-animal studies, as well as to explore sustained instances of human-wildlife relationships, 2) To examine public perceptions of



wildlife, and 3) To test and identify ways in which perceptions, knowledge, and conservation behavior towards wild animals and ecosystems might be influenced.

To explore these goals my dissertation seeks to understand and characterize the human-wildlife relationship in regard to sustained and ephemeral relationships and examine ways in which they may be altered. Given the multidisciplinary nature of the field, I strive to incorporate different academic approaches into my methodology and utilize conservation psychology, anthropology, and to a lesser extent, ethology to drive my work in understanding human-wildlife relationships. Figure 1.1 illustrates the conceptual framework with some of the main factors (relationships, wild, and perceptions) leading towards an ultimate goal of aiding in improving human-wildlife relationships. Though these goals are not necessarily fully achieved within the limited scope of the dissertation, it is nonetheless important to consider ultimate goals regarding the study of humans and wildlife. The chapters are situated within these frameworks as illustrated in the figure.

I initially focus on the field of human-wildlife studies in general, examining the multitude of disciplines that comprise it. I then examine specific sustained wildlife-human relationships and the behaviors inherent within those relationships to elucidate the nature and categorization of “wild.” Using the ever-expanding breadth of academic knowledge on animal capabilities, I question what perceptions the general public expresses towards wildlife. I finally end by examining new ways, specifically a novel card game, to alter perceptions and knowledge towards wildlife and ecosystems. My questions are situated both in specific locations and in more general conceptions. In the following chapter descriptions I discuss the specific contexts and goals for each of the projects.



**Figure 1.1 Dissertation structure showing the general themes of the dissertation.** Illustrates where the chapters are situated in regard to those themes.

### 1.5.1 Chapter 2

The second chapter is focused on examining the field of human-animal studies specifically regarding human-wildlife relationships, interactions, and bonds. While many studies have examined the field of human animal studies (e.g., Amiot & Bastian, 2015; Echeverri et al., 2018; Hosey & Melfi, 2014; Shapiro, 2020; Shapiro & DeMello, 2010), only a few studies seem to focus solely on the human-wildlife literature. Those that do have examined it largely through a framework of conflict-based interactions (Bhatia et al., 2019) and thus it is instrumental to examine the relevant themes and future trajectories of the field.

In this chapter, I explore the human-wildlife literature and utilize review methodologies in order to identify existing and emerging trends in the field. I identify three general topics of

inquiry that illustrate the current dimensions of the field: determining wildness, perceiving wildlife, and dimensions of relationality. Furthermore, I examine the varied disciplines that comprise the field as a whole, discuss the relative multidisciplinary of the field (that is, that scholars may draw from many different disciplines though they remain situated in their own discipline (Choi & Pak, 2006)), and recommend adopting further interdisciplinary structures (combining and integrating different disciplines) as well as standardization of terminology.

### **1.5.2 Chapter 3**

Chapter 3 examines some of the categories highlighted in chapter 2, notably sustained relationships and the disputed classification of animals as “wild.” The definition of “wild” animals can no longer be one of animals completely separate from humans, but it remains unclear as to what animals can be considered wild (Buckley, 2018; Herzog, 2010; Magle, 2018). Animals in zoos and aquariums are notable for their placement in both domestic and wild frameworks (Birke et al., 2019; Braverman, 2011; Ward & Sherwen, 2018). Furthermore, zoos have been identified as areas in which humans and animals experience more sustained relationships and form bonds (Birke et al., 2019; Hosey & Melfi, 2010; Ward & Melfi, 2015). While there has been some research into the re-wilding or de-wilding of zoo animals (Birke et al., 2019), this remains an underexplored area of study, and few studies examine relationships within an aquarium setting. Thus, I address the questions of: How and why should zoo/aquarium animals be managed along the spectrum of wild to de-wild? What techniques and relationships do trainers use to manage the spectrum? And how do those practices influence public or trainer-animal interactions and relationships along the spectrum?

To examine these questions I consider a case study at an aquarium where I conducted semi-structured interviews with 19 different trainers regarding their relationships with the

animals in their care. I consider the spectrum of wild to dewild in the aquarium context and show the labor involved in wildling and dewilding aquarium animals, a process necessarily comprised of care and mutual trust. I further speculate on the briefer interactions that comprise the visitor-animal relationships.

### **1.5.3 Chapter 4**

Relationships are often dictated and influenced by perceptions, and thus Chapter 4 attempts to classify perceptions of animals by the general public. While those who work closely with animals may readily imbue them with different traits of cognition and emotion, the general public is often less informed about the capabilities of animal species, especially those with which they have little interaction (Maust-Mohl et al., 2012). Current studies on perceptions often focus on broader concepts of animal mind instead of identifying perceptions regarding more specific animal capabilities (Maust-Mohl et al., 2012; Waytz, Gray, Epley, & Wegner, 2010b). However, perceptions and preferences of animals are important to elucidate, given that they can affect conservation campaigns, as more preferred animals are often better supported and funded (Martín-López, Montes, & Benayas, 2007). Thus I aimed to evaluate perceptions guided by the following questions: Do people distinguish between traits in animals and what capabilities define those traits? Does the perceived capability relate to animal class? And finally, do people over-ascribe one trait compared to the other?

To examine my questions, I explored perceptions of 36 different wildlife species evenly dispersed across mammal, bird, reptile, amphibian, fish, and invertebrate classes. I used an online survey of 2,342 participants to examine 40 different proven animal capabilities. I showed that people do differentiate between animal capabilities, sorting them into cognitive and emotive categories, which vary generally along lines of animal class.

#### **1.5.4 Chapter 5**

While there is increasing work looking at categorizing and understanding perceptions of wildlife, equally important are burgeoning methods to influence perceptions and knowledge towards wildlife. To combat feelings of helplessness in the current environmental age (McKinley, 2008), conservationists are exploring new avenues of engaging the public and promoting ecoliteracy (Balmford et al., 2004; Curtis, Reid, & Reeve, 2014; Fletcher, 2017; Silk, Crowley, Woodhead, & Nuno, 2017; Verma, van der Wal, & Fischer, 2015).

In this chapter I utilized the Phylo Trading Card game to examine its ability to influence ecological perceptions towards wildlife and the ecosystems they inhabit, as well as affecting education and conservation support. Using a before-and-after-control-impact design in a laboratory setting, 209 participants were sorted into three conditions where they either played the Phylo game, a control game, or viewed a slideshow featuring information from the cards. I showed that the game did influence ecological perceptions and knowledge, as well as donation behavior, which highlights the ability of nontraditional engagement tools for increasing ecoliteracy and potentially conservation behavior.

#### **1.5.5 Chapter 6**

Within the final chapter, I conclude the dissertation with the main findings of my work and some final thoughts on the nature of the human-wildlife relationship. I examine the limitations of my research, the ways in which my findings may be used, and how my findings might be built upon for future studies. A relationship, by definition, is a form of mutualism, but the nature of the human-animal relationship, especially in regard to wildlife, adds special challenges to its interpretation. With different communication styles, uneven statuses, and varying definitions of goals between the participants, the need for additional understanding is

clear. With this in mind I seek to elucidate additional challenges and possibilities for the field of human-animal studies in order to improve overall human-wild animal relationships.

## **1.6 Personal positionality**

When conducting my research I sought to maintain objectivity. To achieve this commonly cited essential trait, I realize it is necessary to recognize and divulge my own positionality. Since human-animal relationships are often dependent on cultural and locational groundings (e.g., Carter et al., 2013; Mitchell et al., 2018), it is important to note my own background and personal journey. I grew up in the United States and have long had an affinity for all different types of animals. Indeed it was family lore that my first word was not the typical “Mama” or “Dada” but rather the name of our dog. At a very early age, I reportedly engaged in a spirited debate with a stern Sunday School teacher who insisted animals did not possess souls. I have shared my home with animals ranging from insects, fish, crabs, and frogs, to rabbits, birds, cats, and dogs. But it was my work volunteering at a local wildlife rehabilitation center, helping to rehabilitate injured or abandoned raccoons, fawns, opossums, raptors, and the occasional beaver or otter, that started my questioning of the overall relationships humans and wildlife share. Rehabilitation centers see both the destruction that humans may cause to wildlife, but also the lengths to which humans can go to aid their fellow creatures (Duke, 2003; Wimberger & Downs, 2010). While my past experiences certainly influence my overall interests, I attempted to conduct my research from a distance as much as possible, and to not let my own experiences overpower the information and data I was receiving.

## **1.7 A note on ethics**

Given the broad range of questions, methods, and disciplines that my dissertation encompassed, I sought to enlist significant aid for the conception and completion of the

dissertation, while also ensuring its utility for not only the general reader, but when possible, the participants and collaborators. My committee members had backgrounds in the diverse disciplines that inspired my work and provided significant assistance in designing and running my studies as well as guiding my work. I also worked with additional partners whenever possible who were directly engaged in human-animal relationships or in areas of enacting perceptual and behavioral change. This was the case in Chapter 3 where the research was guided by the input of the participants from the aquarium during their interviews, especially in regard to the viewing public and what the participants wanted and hoped that the public perceived. Similarly in Chapter 5 regarding the Phylo card game, I also sought to collaborate with and incorporate the input of the creator of the game, who was a co-author on the paper. The study was completed with his full cooperation and support, as he wanted to explore the efficacy of the game as a tool for ultimately enacting conservation support.

My work dealt with populations that were not generally considered vulnerable or at risk (i.e., students, aquarium staff, online participants). However, when possible I tried to incorporate their desires and goals into my work in order to ensure they also benefited. This was the case regarding my work with the aquarium in Chapter 3. In my initial discussions with aquarium staff I had planned to conduct additional public perception studies to combine with information I gathered on what the trainers hoped was being conveyed. These would serve to hopefully allow the aquarium to see what messages were being disseminated, either intentionally or unintentionally, and compare that to the messages they hoped to impart. However, the Covid-19 crisis of 2020-2021 indefinitely shut down the aquarium to visitors and so I have been thus far unable to complete work on public perceptions. I hope my work to date can provide some useful

information to and about the aquarium and hopefully I can engage in further public studies when full reopening becomes possible

## **1.8 Conclusion**

Together these chapters seek to shed further light upon the complex and essential entity that is the human-wildlife relationship. The backgrounds of human-animal studies, animal perceptions, and human-animal coexistence provided a context for the deeper examination of the elements inherent within the human-wild animal framework. This was achieved through the diverse, but complementary explorations of the three categories elucidated above: defining wild, understanding perceptions of animals and their capabilities, and examining ways to affect perceptual and educational change as well as conservation support. It is my hope that some of my findings may facilitate future work and ultimately improve relationships between humans and our wild animal neighbors.



## **Chapter 2: Wild About Wild: Emerging Trends of Relationality, Perceptions, and Wildness in Human-Wildlife Literature**

*“And I think the years of human ignorance need to be set aside and we really do need to look at things scientifically.”*  
—Aquarium trainer #13 (2018)

### **2.1 Introduction**

Human-nonhuman animal interaction has been elemental in the direct or indirect experience of all humans dating back long before written language began to document it (Serpell, 1996). Cave paintings from 32,000 years ago illustrate many different nonhuman animals (referred to as animals in the remainder of this paper) and hinted at their interactions with humans (Kalof, 2007). While once such relationships may have been referred to as simple predator-prey dynamics, interpretations of expressions of animal lives have grown to encompass the complex roles as guardians, companions, and often rivals to one another. Humans use animals for food, clothing, tools, and entertainment, but simultaneously care for and have absorbed animals into all forms of society. Indeed animals inspire modern artistic endeavors of dance, photography, painting and sculpture (Morris-Kay, 2010). This close association will likely continue as the world moves further into the Anthropocene era.

While these relationships have existed for thousands of years, research into the nature, continuity, and change of animal-human dynamics is relatively more recent, and the field of study attending to this dynamic has expanded considerably in the last 30 years (Hosey & Melfi, 2014; Shapiro, 2020). Termed “human-animal studies,” “anthrozoology,” and “animal studies” among others (DeMello, 2012), the field is beginning to flourish. In what follows and in agreement with Echeverri et al. (2018) and Hurn (2010), we will utilize the terminology “human-

animal studies” as this broader category traditionally encompasses anthrozoology and animal studies among other disciplines and sub-disciplines. As a field, human-animal studies can be understood as a general umbrella set of different disciplines that intersect as they evaluate the relationships between humans and animals, and tend to encompass terminologies of “interaction” or “bond,” depending in part on the discipline examining the relation (Shapiro, 2020). Indeed human-animal studies comprises many different academic disciplines and sub-disciplines (e.g., animal geography, human ecology, and animal law), with previous examinations indicating between 24 and 27 disciplines (Echeverri et al., 2018; Shapiro, 2020). However, there remain questions of how well those disciplines work together, and whether there is as yet any standardization across distinct disciplines that contribute to this new field (Hosey & Melfi, 2014; Shapiro, 2020).

Previous reviews (e.g., Amiot & Bastian, 2015; Dhont, Hodson, Loughnan, & Amiot, 2019; Echeverri et al., 2018; Hosey & Melfi, 2014) have examined the interface of human-animal relationships, which often heavily feature domestic and agricultural animals. Interactions between humans and domestic or agricultural animals are easy to find and observe given their prevalence and importance in human lives. Within that domestic focus, quantitative benefits to humans are readily examined (Barker & Wolen, 2008), making it a useful and attractively easy form of study. Considering pets for example: In the United States, around 60% of the population owns a pet (Applebaum, Peek, & Zsembik, 2020) and in 2019 in the US alone, \$95.7 billion dollars were spent on pets (APPA, 2019). The study of “wild animals” or “wildlife” in relation to humans is a distinct subsection of the overall literature, though significantly smaller than subsections related to agricultural or domestic animals. Additionally, “zoo animals” are often identified as a separate subsection. Indeed, some reviews have focused solely on zoos and

examined elements ranging from animal welfare (Maple & Perdue, 2013) to the educational programs within zoos (Khalil & Ardoin, 2011).

Wild animals are generally considered to be those creatures who breed and live largely outside human control and are described as nonhuman, free-living animals (Magle, 2018). However, with increasing human-animal interactions due to land use change and population pressures, these boundaries are becoming more blurred. Urban wildlife (Magle, 2018), urban cultivated animals (Melfi & Hosey, 2018), feral and introduced animals (Buckley, 2018), and even zoo animals (Birke et al., 2019; Ward & Sherwen, 2018) have all been recently discussed as occupying a unique position of “wild-but-not-wild” at the same time. This suggests the potential utility of considering animals as occupying a place on a spectrum of wildness rather than existing in discrete and bifurcated categories.

Classificatory and definitional debates aside, an additional aspect of human-animal studies is the focus on understanding how people perceive different animals (e.g., Kellert & Berry, 1982; Rasmussen, Rajecki, & Craft, 1993). Factors shown to influence perceptions of animals include attributes of the perceiving participant (e.g., socioeconomic status (Serpell, 2004)), and specific behaviors or features of the animal (e.g., neotenic features, often described as “cute” features (Archer & Monton, 2011; Lorenz, 1943)). Perceptions and preferences towards animals are necessary to examine as they have been shown to predict subsequent human behavior, such as relevant conservation actions (Martín-López et al., 2007; White & Lovett, 1999). While these early efforts are foundational to the field, examining people’s perceptions of animals and animal worlds remains an active area of study, particularly as new research attempts to effect significant change in regard to human-animal relationships and interactions across various settings (Frank, Glikman, & Marchini, 2019; Knight, 2005).

While questions of wildness and work on perceptions are active areas of study in human-animal relations, much of the overall work of human-animal studies attends to direct interactions between the two parties and the ramifications for those two separate species. Humans have often been shown to influence and shape animal behavior (Gaynor, Hojnowski, Carter, & Brashares, 2018; Wilson et al., 2020), however animals are coming to be better recognized as both shaping and being integral to human lives. This recognition has produced, of late, a new preoccupation with the systems of relationality that bind humans and animals together, as interacting and interdependent agents as opposed to beings whose *modus operandi* is conflict or its avoidance (Bhatia et al., 2019). This includes, but is not limited to, studies of coexistence or at least the absence of conflict (Bhatia et al., 2019; Woodroffe et al., 2005; Zinn, Manfredo, & Decker, 2008).

In sum, current work in the field of human-animal studies often focuses primarily on domestic and agricultural animal relations and necessarily incorporates many different disciplines. In addition, while studies of human-animal worlds in reference to wild animals may be emerging as its own subfield, the definition of what constitutes a wild animal is in flux—especially in regard to zoo and urban animals. Further, no systematic reviews exist as yet that address human-animal studies solely in reference to wild animals, including all elements of wild (e.g., those living in urban areas or zoos). Given these current omissions we sought to explore the literature that pertains to human-wild animal relationships in order to identify: 1) Current themes prevalent in the literature in regard to how relationships are studied, 2) Publication trends (e.g., journals, year of publication), including what type of species are evaluated, and 3) The disciplines and sub-disciplines that are involved in addressing the various interests active in this field of work and the potential limitations of this literature to date.

## 2.2 Methods

To address these goals, we chose a literature review format that utilized elements of a systematic review (e.g., employing broad encompassing search terms and compiling all relevant results across numerous search engines). We also sought to identify themes or topical foci, and to look at characteristics of and disciplines associated with publications in the field. We identified a number of different academic search engines that included relevant studies. In order to reach all possible articles, we opted to use the following search engines for our study: Web of Science, ProQuest Agricultural and Environmental Science Database (AESD), ProQuest Public Affairs Information Service (PAIS), and JSTOR. Additional searches were later conducted with Google Scholar to ensure saturation of the material. For Google Scholar, we went through the first 20 pages of results (ordered by “relevance”) and imported any relevant article that had not previously been included through searches of the other search engines. Search terms included “human-animal” or “animal-human” and either “relation\*” “interact\*” or “bond\*” and “wild\*” was also included. After conducting searches on all of the selected indices using those search terms, we then replaced “human-animal” and “animal-human” with “wildlife-human” and “human-wildlife” to ensure papers pertaining to wild animals were located. One additional search on Web of Science included the word “coexistence” in relation to human-wildlife, as we noted a couple papers identified from that search engine used coexistence in place of relationship. Some have cited the lack of standardization in the human-animal studies field (e.g., Echeverri et al., 2018; Hosey & Melfi, 2014) and thus we wanted to ensure as many of the known terms were utilized as possible. Our goal was to make certain we had identified a maximum of available studies relevant to the field. We did, however, limit our search to English language journal articles that were peer-reviewed.

The papers were imported to RefWorks Reference Management Software, where a total sample of  $n=1,125$  was secured. Duplicates were then removed leading to a sample of  $n=809$ . All titles and abstracts were then evaluated to see if they met the following criteria. This resulted in a retained total sample of just under 200 peer-reviewed papers ( $n=197$ ). To remain eligible for the review, papers had to address or incorporate any type of wild animal (including urban wild, feral, or zoo), in addition to the more conventionally defined wild animals such as those living in areas traditionally designated as animal habitat or ecosystems. Papers also had to address a specific and/or direct relationship or interaction between the animal and a human or humans that had an effect on one or both members of the interaction. Conversely, we removed papers that focused solely on domestic and agricultural animals and we removed papers that did not involve specific animal-human relationships or perceptions of these. By this we mean papers that predominately included studies of human-animal interactions that produced zoonotic diseases (e.g., only made mention of an animal to note that it was a potential vector of a disease). We also removed papers or essays that provided no new data, that is, were opinion- or interpretation-based summaries. Similarly, we sought to only include primary studies and thus did not include existing reviews. While we included papers from all date ranges, we excluded papers where the focus was on more historical events (e.g., studies looking at how Romans may have interacted with and viewed animals in gladiatorial events, based on reports from the era), focusing instead on recent events where the bulk of the relationships described or examined occurred within the last 30 or so years. Though rare, per necessity we finally removed any papers we could not access through the University of British Columbia's library permissions.

Once all ineligible papers were removed, we compiled the remaining papers in an Excel document. This interface allowed easy access to identify and compare relevant trends and themes

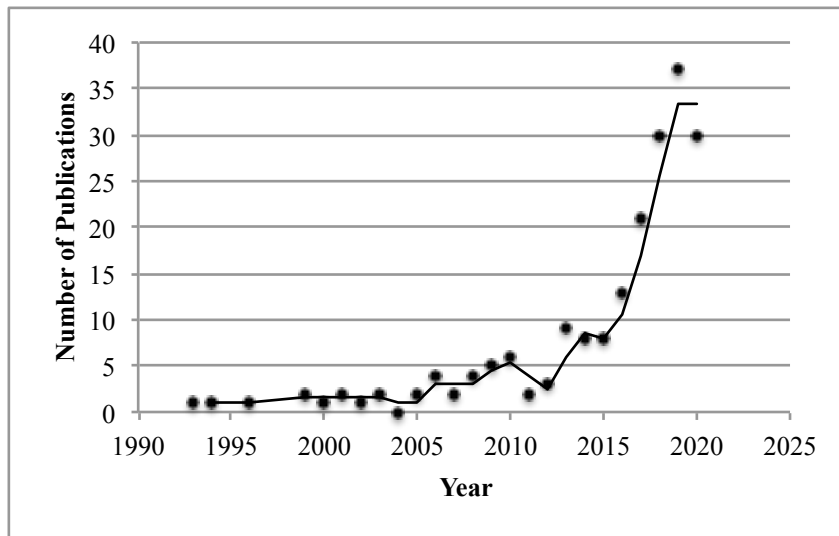
regarding the publications and their topics. We included details about each study, the year of publication, the type of animal(s) and human(s) involved in the study, the location of the study, the methodology utilized, and the journal of publication. We further identified the disciplines from which the study appeared to draw methodologies, theories, or background. We identified disciplines through a number of different criteria, notably: the journal professional organization (e.g., Zoological Association of America), the department affiliations of the authors, and our own analysis of the methodologies used (e.g., a paper using cortisol or behavioral indicators of stress in animals was assumed to be linked to animal welfare). We next completed a more in-depth examination of the studies and initially we focused on the relationality types within the papers and identified four distinct types of relationships. Papers were included in this general category if they presented a specific relationship between an animal or animals and a human or humans. They were further divided into distinct types of relationships based on the conclusions of the paper that focused on the impacts to the participants (human, animal, both) or presented a conflict-based relationship. However, we also saw that quite a few papers focused on human perceptions of animals, more so than a specific relationship, and thus sorted these separately. Papers were included in this category if the emphasis was not on the impact of the relationship itself, but the perceptions that arose from the relationship, though potential impacts may have been discussed as well. Finally, we identified a number of papers that, while examining distinct relationships, focused more heavily on questions of wildness in animals, as these figured heavily across papers. Papers were included in this category if the discussion of the relationship centered not around the impacts to or perceptions of the participants, but instead centered on the nature of wildness and domestication or tameness in animals. We thus ended our review finding three distinct themes within the literature: relationality, perceptions, and wild.

## **2.3 Results**

### **2.3.1 General Findings: The When, The Who, The Where, and The What**

In our compilation of 197 articles we found some illuminating trends regarding publication dates, focus species, and research locations that illustrate the rapid growth of the field, the breadth of study, and the reliance on certain species. (See Appendix B for full list of articles). Eligible publications indicating any focus on human-animal relations with wild species were virtually absent until very early the 1990's. A few began to emerge in this earlier period (1993-2005), and then began to expand considerably thereafter, particularly within the last 10 years (Figure 2.1). This finding echoes previous studies (Hosey & Melfi, 2014) that showed studies published across the field of human-animal studies were increasing, although most of the work cited in this review (as noted above) captured relations and bonds between humans and companion or domestic animals. Wild animal studies as an isolated subgroup are also increasing in tandem with the field, indicating a necessary interest in and focus on wild animals as essential research terrain. Given the time of publication, Hosey & Melfi (2014) looked at studies published up until 2013, but did also show a steep increase in the later years. Our findings illustrate that the increase in human-wild animal publications not only increases before 2013, but indeed experienced near exponential growth after that time period and through the current year.

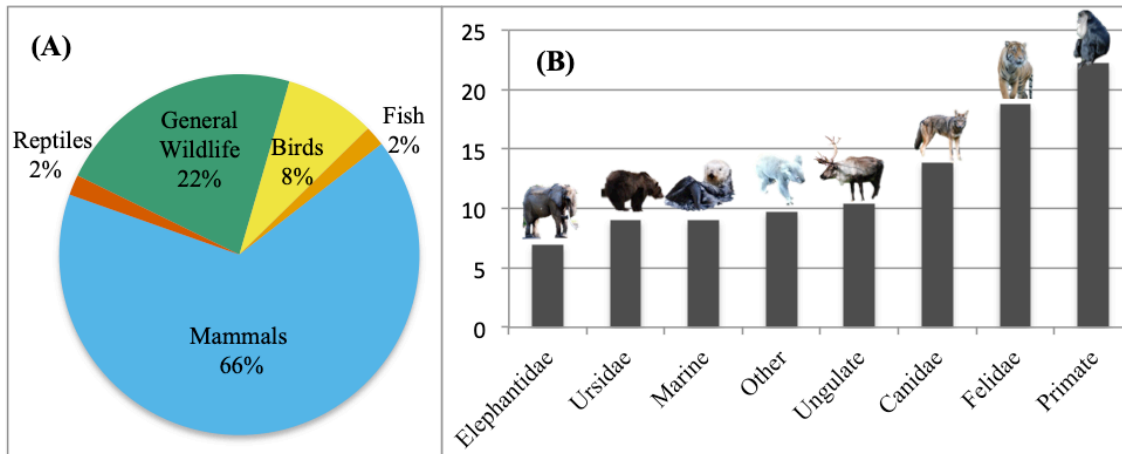




**Figure 2.1 Number of publications pertaining to human-wild animal relationships from 1993 to 2020.**

To further our goal of identifying common trends of publications, we compiled the species examined across the studies and predictably found an over-reliance on mammal species. Even when we included studies that focused on “general wildlife,” that is, a study looking at “wildlife” as a whole, or focused on too many species to individually separate (e.g., 120 distinct species), the focus on mammals was still great at nearly 66% (n=145, 65.91%). After General Wildlife (n=49, 22.27%), Birds comprised the second most studied taxon (n=18, 8.18%) followed by Fish and Reptiles (n=4, 1.81% for both). Some studies examined a few different species and were thus double included (e.g., if a study examined both a bird and mammal it would be placed in both categories) (Figure 2.2). When we examined the mammal taxon more closely we found there was a more even distribution of species. Primates (a combination of the Cercopithecidae, Callirichidae, and Homindae families) were the most studied group (n=32, 22.22%), followed by members of the family Felidae (n=27, 18.75%) and Canidae (n=20, 13.89%). Other groups studied were Ungulates (n=15, 10.42%), Other (comprising animals such as bats, marsupials, and sloths that were only seen in one or two studies apiece) (n=14, 9.72%),

Marine (comprising marine mammals such as dolphins, orcas, and sea otters) (n=13, 9.03%), Ursidae (n=13, 9.03%), and Elephantidae (n=10, 6.94%) (Figure 2.2).



**Figure 2.2 Pie and Bar charts illustrating the animals featured in the papers.** (A) Shows the breakdown of the percentage of total papers featuring each of four taxonomic group (Mammals, Birds, Fish, and Reptiles) and General Wildlife. (B) Shows the further breakdown of the mammal category into the total percentage for various orders and families. “Primates” includes the cercopithecidae, callirichidae, and homindae families, “Marine” includes marines mammals such as dolphins, orcas and sea otters, while “Other” includes animals only featured in one or two studies that were not members of previously identified families (e.g., bats, meerkats).

The high focus on mammals is likely due to a number of factors. Given their generally larger size, the public may be more likely to have experiential knowledge of mammals. Additionally, significantly more work has been done examining the cognitive capabilities and processes in mammals (and our perceptions of these) as compared to other species/taxa, although calls for examining mental processes in other groups are evident (Burghardt, 2013). The increased understanding of mental processes in animals, combined with the similarities between humans and mammals, especially primates, may lend itself to easier study of those relationships, as the motivations and actions of the animals may be more easily elucidated. Finally, animals that are phylogenetically closer to humans, that is, more similar to humans, are often perceived to

have higher cognition and emotion (Eddy et al., 1993; Harrison & Hall, 2010; Howell, Toukhsati, Conduit, & Bennett, 2013) and thus are often more readily singled out for study. This could have an effect both on the number of viable interactions for study, if people are more likely to interact with animals they care more about, as well as the choices of researchers regarding species to study. It may even be that scientists, despite their presumed neutrality, may express an affinity for those creatures that seem to be closer to their “own.”

To continue our goal of identifying relevant trends of publications, we next examined the geographical locations where the studies were based and found a large range that included 64 different countries. The four most common countries were the United States (n=24, 12.90%), India (n=21, 11.29%), Brazil (n=13, 6.99%), and Australia (n=13, 6.99%). While there were a number of different country locations where studies took place, we found that many of the papers focused on human-wildlife interactions in zoos and aquariums. This makes sense, as while discussions are ongoing as to whether zoo animals are wildlife, stand-ins for wild animals, or not wild (Birke et al., 2019; Braverman, 2011), zoos remain one of the most accessible locations for long-term human-animal relationships. Indeed keepers often note their strong bonds with animals, and studies have shown the effects the keeper-animal relationship can have on both participants (Birke et al., 2019; Hosey & Melfi, 2010). In addition to sustained relationships, zoos also provide case studies for more transient relationships in the form of zoo visitors. These interactions are often measured in terms of the effect of the visitors on the animals, or the physical or emotional effects of the zoo on the visitors (Braverman, 2011; Sakagami & Ohta, 2010).

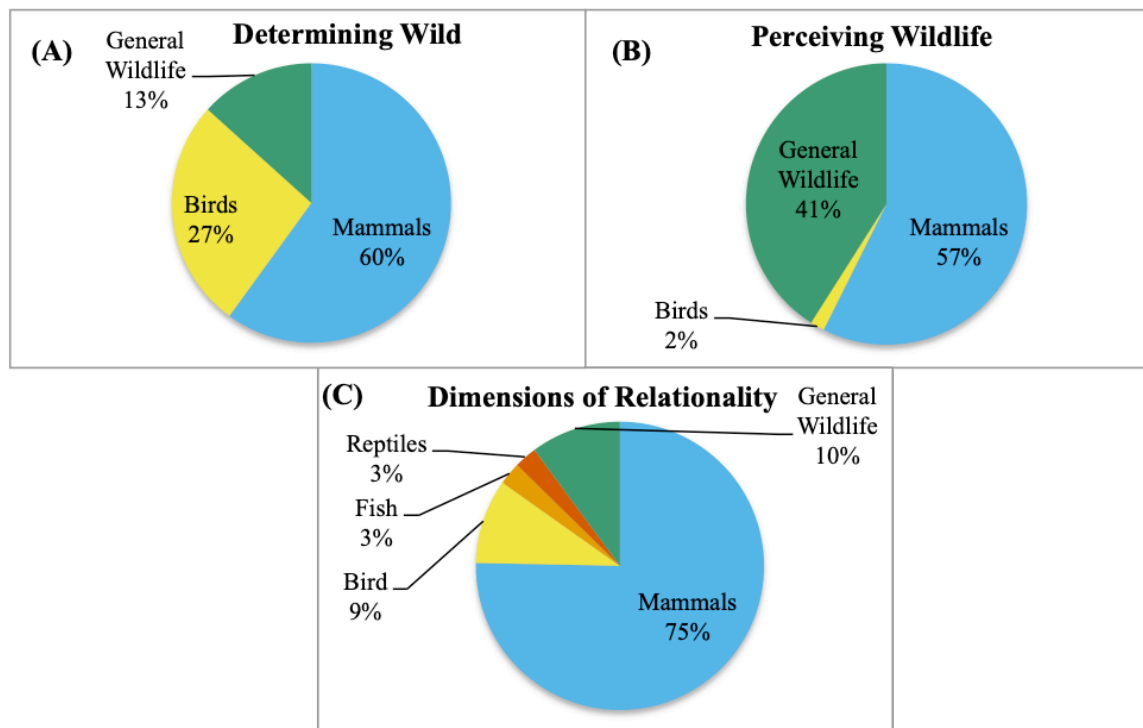
Finally, we examined the journals in which the studies were found and the interdisciplinary nature of this emerging class of studies was readily apparent. Articles were

found in 91 different journals with 16 different journals having three or more articles. The journals with the most articles were *Anthrozoös* (25 articles), *Human Dimensions of Wildlife* (10 articles), and *Applied Animal Behavioral Science* (9 articles). These journals are comparatively newer (1987, 1996, and 1984 respectively) illustrating the more recent emergence and growth of the field. While articles were predominately found in journals focusing on biological concepts (e.g., animal physiology, animal behavior, human-animal conflict), articles were also found in journals dealing with or dedicated to social work, economic policy, law, discourse, public health, forensic science, religion and politics, social anthropology, and hospitality and tourism.

Three main categories emerged as encompassing all studies. Studies examined how wildness is determined in animals and perceptions of animals, but the majority of studies addressed different types of relationality between humans and animals. We thus refer to those categories as “determining wildness” which comprised 7.61% (n=15) of the total articles, “perceiving wildlife” which comprised 29.44% (n=58), and “dimensions of relationality” which comprised 62.94% (n=124). Our “dimensions of relationality” category could further be divided into four subcategories: “mutual impact relationships” which comprised 28.23% (n=35) of the total “dimensions of relationality” studies, “animal impact relationships” (39.52%, n=49), “human impact relationships” (12.10%, n=15), and “conflict relationships” (20.16%, n=25).

After identifying our distinct categories, we further compared the distributions of species within our three identified categories and found a similar reliance on mammals across all categories (Figure 2.3). In our “determining wildness” category, birds comprised a larger proportion of studies than in our other categories, though overall that category represented a significantly smaller portion of the total sample. This higher proportion of birds is likely due to their emergence and visibility within urban settings, the availability of tracing software such as

eBird, and a long tradition of birding groups. From the typical songbirds to the rarer and often more newsworthy raptors, the presence of birds is generally common in urban areas throughout the world. Thus given their reliance on and/or presence in the cities, the general public's familiarity with the birds may lead to questions as to whether or not the birds are in fact wild species (Clucas & Marzluff, 2012; Hunold, 2017). Predictably our "perceiving wildlife" category had the largest percentage of studies focused on more general wildlife, as studies either focused on a large number of species (e.g., Nakajima et al., 2002, who explored ranking of animal intelligence for 56 different species) or asked questions regarding general animal populations such as "wild animals" or "zoo animals" (e.g., Clayton, Fraser, & Saunders, 2009, who examined zoo visitors' responses to individual animals, species, and the zoo in general). Finally our "dimensions of relationality" category had the widest range of species classes, incorporating both fish and reptile classes. However it was notable that most of those studies on both fish and reptiles often focused on more negative impacts either for the animals or the humans (e.g., one study explored how, despite humans professing their awareness for and respect of reptiles near and on roads, their actions showed otherwise (Wolfe, Fleming, & Bateman, 2019)). It is often difficult to fully examine closer relationships between humans and classes such as reptiles and fish given the differences in communication, thus it was understandable that 75% of the studies featured mammals, as mammals are often more easily examined in regard to their relationships with humans.



**Figure 2.3 Pie charts illustrating the breakdown of animal classes.** Animal classes include Mammal, Bird, Reptile, and Fish. Additionally General Wildlife (studies that focused on a wide range of species or animals instead of individuals) is included. The breakdown is shown in the (A) Determining wildness category (n=15), the (B) Perceiving wildlife category (n=58), and the (C) Dimensions of relationality category (n=123).

### 2.3.2 Determining Wildness

Overall there is a preoccupation with categorizing animals in regard to their fundamental wildness (that is, that wild animals live in natural systems, removed from, or distant from human settlements), however much other fields have moved on to thinking about ecology as a socioecological system. We found that a smaller portion of articles dealt with questions of whether or not animals could still be classified as wild if they lived adjacent to or even under human control and what that meant for relationships of care. However, despite the smaller number of articles, this category was nonetheless an integral component in regard to human-wildlife relationships and interactions due to the questions and insights it raised. Given that

wildlife is often colloquially categorized as animals separate from humans, studying human-wildlife interactions is difficult as many such interactions are ephemeral in nature. However, by expanding and exploring the definition of what is in essence “wild,” the kind of relationships that are now captured are more extensive than “glimpses in the wild.” They have thus expanded to better incorporate contexts of encounters such as interactions that humans have with wild animals in the shared borders of human and animal realms. Studies are thus beginning to account for interactions with wild animals in cities, in sanctuaries, in zoos, as well as with native and non-native species alike (Birke et al., 2019; Buckley, 2018; Magle, 2018).

Much of the scholarship that addresses the wildness of animals often utilizes case studies and surveys to explore this presumed animal nature. A central focus of this work included positional and ethical questions such as whether humans intervening to help preserve the lives of wild animals blurs the line between captive and wild (Cohen, 2013; Doubleday, 2017). This illuminates such questions as: If an animal is receiving aid and support from a human, does that remove some of its intrinsic wildness? That is, if he or she can no longer survive without a human, is that animal being no longer wild and does he or she in essence re-wild if it becomes self-sufficient again, such as in the case of rescued and rehabilitated animals? The role of cities was also a central topic of investigation, including whether or not urban animals are still wild if they adapt their non-urban behaviors to survive (Connolly, 2016). Additionally, case studies explored the often blurred line surrounding wild and tame. One case study examined a kakapo, a type of parrot, who was hand-reared and came to be representative of the struggle to articulate the difference between wild and tame in Thailand (Chambers & Main, 2014).

While many studies posed questions, we found some common themes, notably that the definition of wild as separate from humans is far too limiting a classification to be useful for

understanding human-animal forms. Additionally, we found that both familiarity and commonality seem to be important variables that help determine where humans place animals on any wild/not wild spectrum. For example, in a study looking at the increased sightings of deer in suburban settings, greater numbers of sightings resulted in confusion as to whether the animals were considered by observers to be wild or tame. Interestingly, when sightings were less common, interviewees also placed higher value on those animals (Leong, 2009).

#### **2.3.2.1 Wild Cities**

A further common element found in this literature includes determining the wildness of animals which had adapted to and populated urban environments. Given the daily presence of such animals many studies examined human responses to such creatures when attempting to identify their role. For example, the ubiquitous nature of swiftlets in cities in Malaysia resulted in calls for culling (Connolly, 2016), while in New York City there were calls for more protection of hawks who nested within city limits (Hunold, 2017). In the case of the swiftlets the move into urban territories and subsequent modifications of their behaviors seemed an intrusion and the swiftlets became merely a part of the city. In contrast, hawks were viewed as a benefit, a way to view wildlife still seen as separate from urban life, though still behaviorally different from their wild relatives.

While swiftlets and hawks adapted from wild areas to urban ones, we found studies also examined those animals who had adapted in reverse, notably feral animals. Feral cat adaptations and the subsequent attitudes and behaviors towards them by the urban human populations often highlighted questions as to whether or not the animals could still be considered tame or domesticated, or if they should be classified as fully wild (Davey, Zhao, & Khor, 2019; Van Patter & Hovorka, 2017). While some of the feral cats were supported by humans, they were



often referred to as “not pets.” That is, they could no longer be considered tame or de-wilded, but the question arises whether a species that has been bred to be adapted to a domesticated lifestyle can then ever be considered wild? It is these questions and cases regarding urban wildlife that emerged from the literature and illuminated the need to consider animals in more than simply a binary wild or tame way.

#### **2.3.2.2 Welfare Responsibility and Dewilding**

Animal welfare is a long-standing and important consideration (Fraser, 2013), but is also closely linked to the unsettled state of distinguishing what is wild or not. For example, the relative responsibility, or lack thereof, on the part of the human actors within any specified human-animal relationship, becomes quite problematic when these two questions (“what is wild?” and “what is welfare?”) are considered in tandem. One study evaluated the case study of Machali, a Bengal tigress in the Ranthambore National Park in India (Doubleday, 2017). She was a wild tigress that was heavily featured in documentaries and photographs and engendered a significant amount of empathy and care from the general public. In her later years she became unable to sustain herself and park rangers stepped in to help feed her. While she did not live in human confines, she nonetheless could not survive without human intervention. This situation highlights questions to which animals are de-wilded and given that, what the level of human responsibility is for the welfare of animals that have become a part of human society.

In addition, articles detailed how management of animals that have become habituated to humans presents a special challenge within the wild spectrum. Animal welfare questions and concerns arise as people seek to care for animals in a wise and compassionate manner. Much has been written with regard to the ease or difficulty of reintroducing animals to a wild habitat versus offering life-long care. Animals confiscated from the pet trade and transferred to rehab facilities

are examples of such difficulty (Collard, 2013). Due to human actions such as the illegal pet trade, animals may not be able to survive on their own in the wild and as such humans must bear the responsibility for welfare and care. However, in some cases the best form of welfare may be the progressive removal of all aid, as evidenced by a study that determined that horses can be successfully de-domesticated by limiting daily contact with human (Górecka-Bruzda et al., 2017). Another tenet of welfare evident in the papers reviewed explicitly attends to habituation of animals. For example, de-wilding may provide improved welfare in some species such as in the “creation” of tamer chicks by imprinting those chicks on humans rather than the standard raising procedures, which enables the chicks to be more comfortable with human presence and display fewer stress indicators (Bonato, Malecki, Wang, & Cloete, 2013).

Determining the nature of what is “wild” in relation to animals, is thus not merely an academic pursuit, but has tangible effects on the human-animal relationship and the subsequent welfare of the participants. Animals may inhabit different wild or domesticated roles considering their location and reliance upon humans. Additionally those roles may affect the way in which humans think about and act towards wildlife, and thus is necessary to fully explore and seek to quantify.

### **2.3.3 Perceiving Wildlife**

#### **2.3.3.1 It Depends on the Person**

Despite the overall goal of focusing on the mutual relationships shared by humans and wildlife, there is also evidence of work focused on exclusively elucidating human understandings of animals. Generally speaking, these studies address human perceptions of wildlife, or how people “view” wildlife. A smaller portion of this work also addresses the attitudes and behaviors that arise from those perceptions. Perception is generally conceptualized as how sensory inputs

from the world are absorbed and cognitively processed, leading to explanations of how an event or an idea is understood intellectually or affectively (Clayton & Myers, 2011). The literature in this “perceiving wildlife” section of our findings highlighted many of the variables that are thought to influence perceptions of species and many newer studies also echo previous ones. These included variables such as age, education, culture, risk perception, and socioeconomic status. For example, one study found that age was a factor in influencing attitudes towards animals, and that pro-animal attitudes decreased as age increased (Binngießer et al., 2015). Education was also predictive of attitudes, for example, one study found that both knowledge and opinion of bats in a high bat-density area were equally low and emphasized the need for increased education to increase positive perceptions (Bhattacharjee et al., 2018). Many studies mentioned location and culture. For example, in one study attitudes towards elephants in zoos were found to be different among Australian and South Asian respondents, which was explained by different cultural beliefs, especially for the latter (Gurusamy et al., 2015). In another study, cultural values were found to influence positive attitudes towards leopards despite the fact leopards were perceived to have high capacity for conflict with humans. Conversely, negative attitudes towards African wild dogs were not reduced by relatively lower levels of perceived conflict with humans (Mitchell et al., 2018). A specific focus on perceived risk is also a facet of this subset of studies. For example in the Indian Himalaya, people’s overall perceptions of wolves were found to be based on their assessment of the danger wolves posed (Bhatia, Suryawanshi, Redpath, & Mishra, 2020). Finally, one study found that socioeconomic and cultural factors had a greater influence on attitudes towards tigers than people’s past experiences with tigers (Carter et al., 2013). Together, these studies all focused on the human attributes that influenced people’s perceptions of animals. Though the field of human-animal studies in general

strives to look at the effects of the relationship on both participants, the literature clearly slants towards a need or desire to evaluate and understand human perceptions.

### **2.3.3.2 Animal Experience**

In the reviewed literature, we found a combination of studies that focused on individual species and ones that instead evaluated a range of species. Interestingly, the studies on specific species often focused on direct relationships that had already occurred, and sought to elucidate the perspectives and attitudes of the people (e.g., a study looking at attitudes towards Eurasian otters in a specific park in order to aid conservation (Špur, Žunič Gomboc, & Šorgo, 2018)). On the other hand, studies featuring a larger range of animals often surveyed people that had not had direct interactions with the species in question (e.g., one study looked at general attitudes towards wild and zoo animals in Swiss populations (Fehlbaum, Waiblinger, & Turner, 2013)). Overall, 55.36% of the perception studies looked at understanding perceptions and attitudes of people who had had direct interaction with animals, while in 44.64% of the studies, the participants did not necessarily have any direct interaction with the wildlife in question. While both types of study can be useful, single species studies based on direct interaction tended to find more tangible and immediate behavioral influences, usually in the form of conservation. Meanwhile, studies looking at attitudes to animals in general indicated areas for subsequent research or education.

Perceptions and subsequent attitudes are often examined because they can have effects on behavior, specifically conservation behavior (Callahan, Echeverri, Ng, Zhao, & Satterfield, 2019; Manfredo et al., 2009). Such conservation behavior may take the form of donations, or may address conservation indirectly by illustrating what perceptions of species need to be addressed in order to support conservation considerations more broadly. Indeed, many of the articles

mentioned their applicability for conservation. For example, one study on perceptions of high-school students living in an area with many bat colonies stated the necessity of understanding perceptions towards bats in order to increase conservation attitudes towards bats (Bhattacharjee et al., 2018).

#### **2.3.4 Dimensions of Relationality**

Despite examinations of wildness and perception, the bulk of the literature does in fact explore dimensions of relationality between humans and animals. But echoing the complexities of relationships in general, no consistent method or finding was evident. However, it was notable that although such a large proportion of articles reflected a relational focus, very few were preoccupied with the wildness of the animals in question. When wildness was addressed, it was usually mentioned as a facet of the overall relationship and the articles did not provide significant detail (e.g., articles where farmers mention the wild nature of certain predators, but the focus of the article is primarily on the conflict relationship between the two). We further separated the group into four subgroups: Mutual relationships, Animal impact relationships, Human impact relationships, and Conflict relationships.

##### **2.3.4.1 Mutual Relationships: It's You and Me**

A focus on mutuality defines much of the relational literature and theoretically that framing is the basis of human-animal studies. Central then is both the impact to the animal and to human participants; each are equally investigated and evaluated. Mutual relationships do not necessarily imply mutual benefits. The key is the finding that both participants are considered despite the fact that the impact to the participants may be either positive or negative, or a mix. An example of this are studies that look at the relationship between mahouts and their elephants and the effects their relationships have on one another (e.g., one study found instances of both

violence and affection between elephants and mahouts as they work in partnership in the forest (Münster, 2014)).

As with mammals above, certain human-animal relationships were heavily represented in the mutual relationships studies, notably the roles of researchers, keepers, and tradesmen. Studies of researcher effects primarily examined the role of field researchers, their relationship with their study animals, and the habituation of the animals (Hanson & Riley, 2017; Rapchan & Neves, 2019). The studies often equally focused on the effects of human presence on animals, as well as the role of the researcher in cultivating specific outcomes or failing to do so (e.g., one study explored the habituation that occurred for Moor macaques in Indonesia as they became accustomed to human presence, and the effects that had on not only the macaques, but the researchers themselves (Hanson & Riley, 2017)). Other studies looked at the keeper-animal dynamic in zoos where dyads (bonds between humans and animals) are often formed (Ward & Melfi, 2015). Stable keeper-animal interactions often provide enrichment and comfort to the animal, while keepers cite the positive emotional benefits they feel from the relationships (Birke et al., 2019; Khadpekar, Whiteman, Durrant, Owen, & Prakash, 2018). Another form of mutually beneficial relationships focused on daily relationships formed with animals by tradesmen. For example, fisherman often form relationships with dolphins where both parties aid each other in the collection of fish (da Rosa, Hanazaki, Cantor, Simões-Lopes, & Daura-Jorge, 2020).

In the mutual relationship subset of papers, animals were often described in a number of different terms—often reflecting cultural variation across particular expectations for appropriate relationships between humans and animals. In some accounts, animals were referred to as familial relatives such as the Mi'kmaq people (Algonquian speaking people of eastern Canada) who consider or loosely classify animals as siblings (Robinson, 2014). Elsewhere, animals have

been described not as family members per se, but as beings possessing agency and acting as guides or protectors that are appreciated in kind (McGinnis, Tesarek Kincaid, Barrett, Ham, & Group, 2019). While these may place animals on a more equal plane as humans, in some cases animals exist on a higher plane in cosmological or religious worlds. In parts of Northeast India, elephants are viewed as god-like (Keil, 2017). Thus, it is worth adding the caveat that within particular places, there exists much nuance as to the classification of what an animal is, where it fits in the social order of beings, and what might then constitute a mutual attachment, reverence, or dependency.

#### **2.3.4.2 Animal Impact Relationships: It's Not Me, It's You**

While studies often examine impacts to both members of the relationship, an equal portion of the literature concerns the effect of an interaction or relationship on the animal alone. We found both positive effects, such as how interactions with keepers at zoos provide enrichment and reduce stress in some species (Carlstead, 2009) as well as negative impacts, such as how interactions with the public result in increases in abnormal behaviors with some zoo species, such as capuchins (Van Patter & Hovorka, 2017). It should be noted that articles emphasizing impact or consequence for animals, especially potentially negative implications for animals, are usually based on incidental events. That is, the humans involved were not actively striving to endanger or negatively impact the animal, but instead incurred unintended effects by their presence or everyday activity. Indeed, human disturbance has resulted in remarkable changes in animal behaviors, going so far as to inculcate more animals into becoming more nocturnal—an observation across all taxa (Gaynor et al., 2018; Wilson et al., 2020).

Given the lengths to which animals may be influenced by humans, many of the articles addressing impacts on animals necessarily also addressed animal welfare. The findings as

concerns welfare are, to date, diverse. For example in the case of zoo animals, welfare did not seem to be affected by visitor presences in species such as meerkats (Sherwen, Magrath, Butler, Phillips, & Hemsworth, 2014) and lemurs (Collins et al., 2017). However penguins displayed more huddling and increased aggression (Sherwen, Magrath, Butler, & Hemsworth, 2015), and quokkas were more fearful (Learmonth, Sherwen, & Hemsworth, 2018). In addition to zoo visitors, tourist impacts on animals were also often studied. For example, one study indicated how tourists impacted pinniped behavior noting that while the animals eventually became habituated, it could take years even whole generations (Burns, 2006). Another example characterized more direct interaction where tourists that engaged with sloths were found to commonly hold them in ways that negatively affected animal welfare (Carder et al., 2018). In general, animals that were seen as “cute” were more likely to be touched, fed, and chased (Marx, 2019b), impacting their welfare in largely negative ways.

One additional common element in this subset of “impact” studies was the search for any implications of proximity of humans to wild animals and the effects that proximity caused. For example, in a study of a wildlife rehabilitation center, they found that those animals most impacted were those living close to humans, in part because humans tend to intervene even when the animal is better off left alone. This was especially true in cases where baby animals were thought to be abandoned, but were still under the care and protection of parents temporarily absent due to hunting or foraging (Wimberger & Downs, 2010). However, animals may also benefit from proximity to humans as was the case where guanacos were found to preferentially stay near man-made roads given their openness, ensuring the ability to more rapidly locate predators (Cappa, Giannoni, & Borghi, 2017).



#### **2.3.4.3 Human Impact Relationships: It's Not You, It's Me**

As against the studies referenced above, we also identified a number of papers wherein the focus of the article was on the derivative benefits and risks for the human and forgoing any notable attention to the effect on the animal or animals. In these examples, impacts on humans may be positive or negative in nature, though the majority of studies addressed positive examples. Positive impacts were often ones where an interaction or relationship induced joy or improved mental wellbeing in the human participant. For example, one-on-one interactions with cetaceans were found to serve as a cause for “peak,” even transcendental, experiences for humans (DeMares, 2015). Interestingly, one of the most common themes throughout studies on the impact to humans of human-animal relationships was the emphasis on cetacean interaction. It was often cited as especially meaningful, with participants in various studies using words such as “kinship” “communication” and “joyful” (Amante-Helweg, 1996; DeMares, 2015; Yerbury & Boyd, 2018).

Fewer studies of negative impacts were evident and those that did offer this focus predominantly looked at people’s negative responses to animal presence or interaction, such as with mice in forest camps (Marx, 2019a). Additionally, while various animal interactions may have an impact on humans, interactions with wild animals were found to have greater positive impacts than interactions with animals in prescribed settings such as ecotourist offerings. Regardless, ecotourist interactions were still found to have greater impacts than interactions with captive animals (Yerbury & Weiler, 2020).

#### **2.3.4.4 Conflict Relationships: It's You vs. Me**

While human impact and animal impact studies look at one participant and mutual relationships look at impacts to both, a final dimension that comprises a significant portion of the

studies we compiled sought to characterize specific types of relationships, especially conflict-based relationships. This is true to the extent that conflict studies make up a large proportion of the overall human-animal literature (Bhatia et al., 2019) and this was echoed to a degree in our results as well. We tried to limit the articles we included to ones in which a relationship was also discussed. For example, one article detailed a unique relationship occurring between macaques and humans. Macaques are increasingly infringing on human territory due to the fact human residence expansion has destroyed a significant proportion of macaques territory. Humans were characterized in these examples as justifying their own behavior by way of referencing the different nature of the animals. Culling the population of macaques was justified by viewing their behavior as failing to meet human expectations. Animals would thus be referred to as failing to “know better” or needed to exercise “self-discipline,” essentially seeing the macaques as both human and sub-human (Yeo & Neo, 2010).

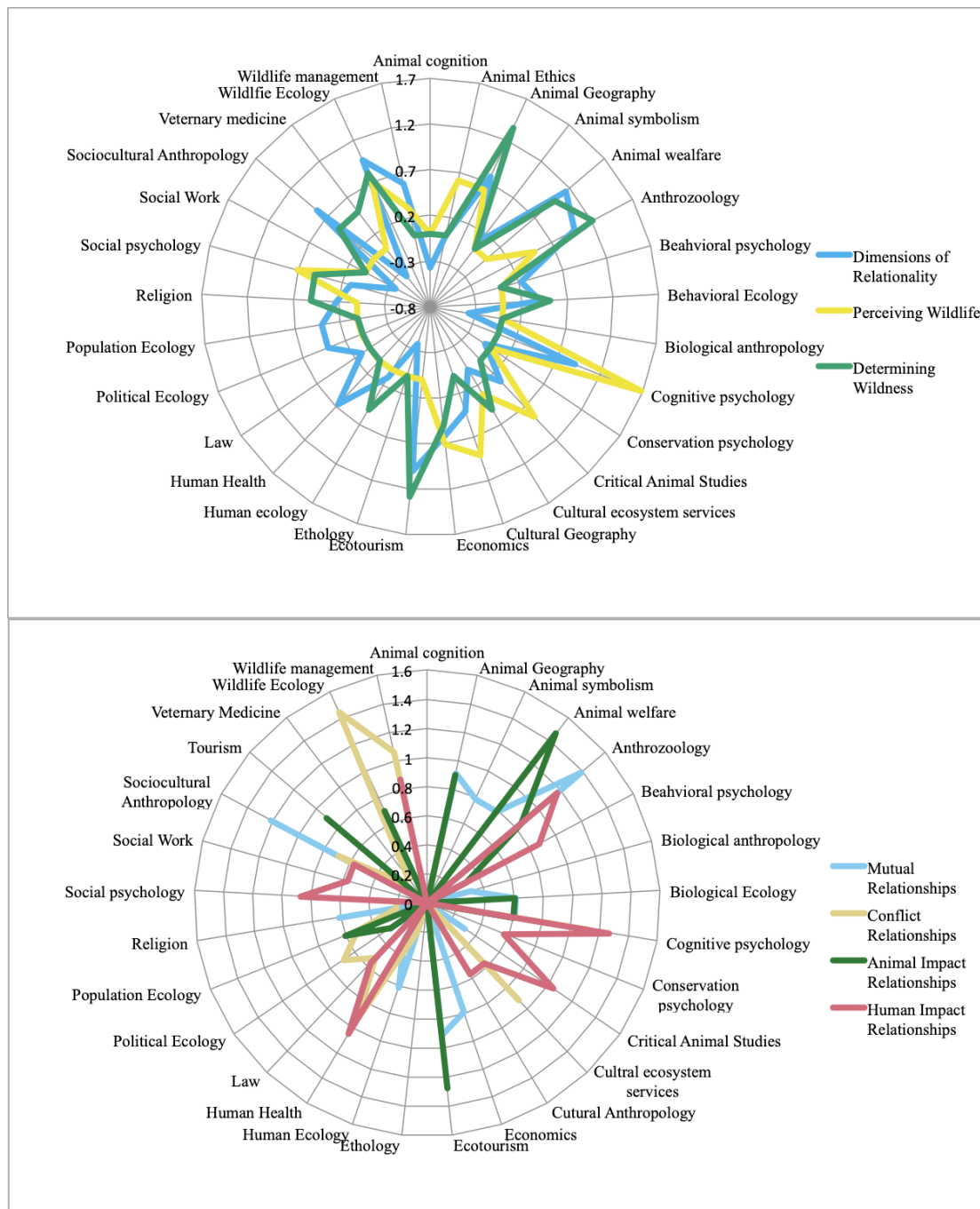
Lastly, the emphasis on conflict reported in the impact literature is largely based on animal threats to human livelihoods (e.g., monkey raids on farms in Kenya (Siljander, Kuronen, Johansson, Munyao, & Pellikka, 2020)). Conflict studies, however, are not always based on negative impacts; indeed many articles evaluated the potential for mitigating measures, finding win-win or more balanced human-animal or human-conservation outcomes. For example fortified bomas in Tanzania were beneficial in reducing predation (Mkonyi, Estes, Msuha, Lichtenfeld, & Durant, 2017), and beehive fences in Mozambique helped to alleviate pressures from elephants as well as provided additional sources of revenue from honey production (Branco et al., 2020). While tourism revenue and governmental laws were often cited as ways to alleviate conflict, a number of studies did highlight the difficulties with relying on public sector inputs. For example, one study found that landowners were likely to resort to illegal methods to control

wolf populations, citing low trust in government (Højberg, Nielsen, & Jacobsen, 2016). In addition to practical methods such as fencing, studies also examined emotional and philosophical ways in which people dealt with and rationalized human-animal conflict. For example, religious beliefs and the belief of elephants as gods and avengers of wrong-doing helped villagers in India cope with elephant-induced damage (Gogoi, 2018). Additionally, despite the number of hyena attacks on people and people attacks on hyenas, villagers in Ethiopia felt more comfortable with the hyenas, citing their ability to dispose of diseased carcasses and eat unseen spirits (Baynes-Rock, 2015).

### **2.3.5 Disciplines**

Our final goal involved identifying the disciplines and sub-disciplines that drove the categories found within the human-wildlife literature by cross-referencing themes with disciplines or sub-discipline. Thereafter we consider the limitations inherent given the foci of each discipline. Given the relative newness of the field of human-animal studies, it is necessarily influenced and comprised of established disciplines and sub-disciplines. What appears to be the case at the time of this writing is the sheer breadth of studies and the relative cacophony of approaches. After evaluating journals, authors, and methodology for each study, we identified 30 engaged disciplines and sub-disciplines, ranging from the various sub-disciplines of psychology (such as cognitive psychology and conservation psychology) to the discipline of economics to the sub-discipline of animal welfare. We tallied which disciplines and sub-disciplines were present within each of our three categories, as well as for the subcategories within the “dimensions of relationality” category (Figure 2.4). Some disciplines were heavily utilized in one category while not found as regularly in others. For example, conservation psychology was found to be used in 47.96% (n=42) of the studies in our “perceiving wildlife” category, while it

was found in only 8.02% (n=19) of articles addressing some aspect of relationality and was not found in any of the studies in the “determining wildness” category. Other disciplines were more commonly seen across categories, such as ecology (mostly wildlife ecology), which contributed to all three categories and was found in 9.28% (n=22) of the “dimensions of relationality: articles, 5.10% (n=5) of the “perceiving wildlife” category, and 6.45% (n=2) of the “determining wildness” category.



**Figure 2.4 Radar plot showing the relative frequency of categories per discipline and sub-discipline.** Each axis is a separate discipline. (A) Shows the three overall categories, where each is coded as gridlines where blue is “dimensions of relationality,” yellow is “perceiving wildlife,” and green is “determining wildness.” (B) Shows the four subcategories for Relationships where light blue is “mutual relationships,” tan is “conflict relationships,” green is “animal impact relationships,” and pink is “human impact relationships.” The scale is a logarithmic scale and is reported in log values, it ranges from 0.42% to 47.96% (-0.8 to 1.7 in logarithmic scale) for (A) and 1.63% to 27.86% (0 to 1.45 in logarithmic scale) for (B).

Ultimately, the only observation that can be made in this early state of an emerging field is that a wide range of sub-disciplines and disciplines have turned their attention to human-animal studies. Thus far, this also appears to be a multi-disciplinary field but not necessarily a cross-fertilizing or interdisciplinary one. Other reviews have similarly identified research across a large range of disciplines (e.g., Echeverri et al., 2018; Shapiro, 2020). But given our focus on wildlife, some of our results were understandably different from more generalized human-animal studies that included domestic and agricultural animals. For example, sub-disciplines such as wildlife ecology and wildlife management were more prominently seen in our categories as opposed to reviews that focus on the more general field of human-animal studies. In addition, given our focus on relationships that predominately occurred within the last 30 or so years, certain fields were not found in our review, such as zooarcheology (the study of remains to elucidate information about past animals and humans).

As noted above, articles in our “dimensions of relationality and “determining wildness” categories often incorporated or alluded to elements of welfare and this was illustrated by the fact that disciplines such as animal welfare and ethology were more commonly used in those categories as compared to our “perceiving wildlife” category. Very few studies of perceptions examined people’s attitudes towards animal welfare or concerns about wild animals. When studies of perception did focus on welfare they addressed laboratory or agricultural animals, while perceptions of wild animal were not phrased in such terms. The few studies that included questions of welfare regarding “perceiving wildlife” were predominately about zoo animals and only asked about welfare in a more general sense and not in relation to specific animals (e.g., questions such as “are zoo animals treated well?”). Additionally, the studies that addressed welfare concerns in the categories of “dimensions of relationality,” and to a lesser extent in

“determining wildness,” often focused on zoo and captive animals. This is likely due to the relative ease of employing general welfare methods for zoo animals as opposed to wild animals. It is easier to observe changes in behavior of zoo animals, whose behavior is regularly monitored. Additionally, tests such as blood or saliva samples that give information on stress hormones present may be more easily procured from animals in a stationary location as opposed to ones in the wild.

## **2.4 Discussion**

The field of human-animal studies is still new, but has already produced a vast quantity of studies regarding the interactions and relationships that exist between humans and animals. While previous studies have shown that the number of papers within the field of human-animal studies is increasing (Hosey & Melfi, 2014), our study illustrates that a similar increase is occurring even with papers solely focused on wild (and not domestic or companion) animals. This is an important finding as it emphasizes the centrality of study of wild animals to the field of human-animal studies as a whole. The escalation of interactions between humans and wild animals due to decreasing availability of land presents a complex confrontation that may require significant adaptation, especially as concerns animal behavioral and welfare effects (Gaynor et al., 2018; Wilson et al., 2020) and thus deserves to be explored and emphasized as a separate and crucial entity.

Our analysis of three main themes that underpin the literature on human-wild animal relationships serves to highlight the current thinking about wildlife. Our findings highlight a preoccupation with the categorization of what is “wild,” often due to the increasing interactions of humans and wild animals and the need for justification either for saving animals, disposing of them, or determining new strategies for co-existence. Additionally, while there is a focus on the

relationship itself, our findings illustrate that as well, humans are necessarily focused on their own perceptions towards animals. This is likely an important category of study because of the insight that perceptions and attitudes may give to subsequent behaviors, often those affecting conservation (Clayton & Myers, 2011). Finally, relationships in general are complex, and human-wild animal relationships are equally diverse and, as demonstrated by the studies reviewed, cannot be easily packaged into one specific type. Therefore, a diverse range of methodologies and viewpoints is necessary.

A number of articles have illustrated the different fields that are found in human-animal studies (DeMello, 2012; Echeverri et al., 2018; Hosey & Melfi, 2014). While we wanted to focus directly on wild animals, we also attempted to illustrate the variation of those disciplines active across different sub-categories and how there is both overlap and divide between the various subsections. While human-animal studies are commonly referred to as an interdisciplinary field, our analysis seemed to indicate it was more multidisciplinary than interdisciplinary. By multidisciplinary we mean that while scholars draw across fields in their methodology, they remain in their own fields and publish accordingly (Choi & Pak, 2006). Interdisciplinary, by contrast, involves the combination and integration of different fields and the resulting work is a synthesis of fields. However, given the broad nature of human-animal studies, many scholars touch upon it from their own backgrounds, and focus on their own field and the publications necessitated by that field (Shapiro, 2020). Additionally, methodological differences may create issues for the later combination or cross-referencing of fields. Echeverri et al. (2018) cite an additional barrier for interdisciplinary work given the types and timelines of publications across fields. While some publish regularly in journals (i.e., psychology), others may publish less frequently or in book format (i.e., history).



In addition to the difficulties of creating a truly interdisciplinary field, there is the additional difficulty of standardization given the range of disciplines, theories, and methods within the field. For example, biology studies may focus on measurable amounts of observable phenomena such as stress indicators determined by hormones levels, or areas of activity in functional brain scans, whereas psychology studies may focus on observable behavioral aberrations such as a drop in stereotypical activities. Thus, studies often default to the applicable terminology or testing measures unique to their respective fields. This likely affected the works that we were able to locate and review. While we attempted a broad search, we always used the terms “human-animal,” “animal-human,” “wildlife-human,” or “human-wildlife.” However, there may be many other works that would have fit into one of our three categories that were not captured by the criteria because of differing and as yet undetected terminology. Indeed, one of the main issues that arises from the field of human-animal studies is that there lacks a standardization of any kind due to the quantity of participating disciplines (Echeverri et al., 2018; Griffin, McCune, Maholmes, & Hurley, 2011; Hosey & Melfi, 2014). It seems a continuous call for interdisciplinarity, whose core theme revolves around the linking of fields rather than just including fields, as well as increased standardization of terminology are important factors in ensuring full access of the entire human-animal studies field.

There are calls to continue and expand the study of wild animal-human relations (Hosey & Melfi, 2014). However, there remain many logistical concerns with studying human-wildlife relationships that are not as applicable to other human-animal relationships. While relationships with pets may be studied in the lab or in the home, wild animals must necessarily be studied in the field where access can be limited. Additionally, since by some definitions wild animals are ones without much human contact, sustained relationships may be difficult to find. Given these

restrictions, the utilization of zoo studies and urban wildlife studies remain a useful addition, though they also are limited in number, and need to be increased (Ward & Sherwen, 2018).

At a time when humans and wild animals of all different definitions are forced into various different relationships and interactions, it is central to the meaningful survival of all to consider the breadth of these relationships. While it is heartening to note the rapid increase in studies, it is important to temper that with concerns over the lack of interdisciplinarity and standardization across fields, since essential information could be missed within the current, somewhat piecemeal, approach. Determining what actually constitutes wildlife, examining perceptions, and considering the deeper nature of relationality are all vital steps in determining the way forward and each of those themes deserves additional and ongoing study.

## **Chapter 3: Beyond Wild: The Role of Caregiver-Animal Relationships in the Understanding and Management of Wild and Dewild Aquarium Species**

*“We get into this field because we love our animals and we are the lucky few that actually do have animals that we can interact with and build strong bonds with.”*  
—Aquarium trainer #8 (2018)

### **3.1 Introduction**

Nonhuman animals (hereafter referred to as “animals”) are often designated as either “wild” or “domestic,” where wild refers to existing apart from humans and domestic refers to those animals linked with or dependent upon humans, usually encompassing both companion and agricultural animals. However, increasingly animals are being recognized to inhabit roles far beyond the more binary “wild” or “domesticated” framework (Nagy & Johnson, 2013). Instead, many animals occupy a category we refer to here as “de-wilded.” This interstitial category is, if anything, expanding as wild and long-inhabited social-ecological systems are absorbed by the growth of human population and per-household consumption as well as the agricultural and forestry productions that support these (Díaz et al., 2019). For this reason, wild animals have more recently required clearer delineation and have been described as nonhuman, free-living animals (Magle, 2018) in an attempt to incorporate questions that arise regarding urban wildlife (Magle, 2018), differences within species such as feral, introduced, and native (Buckley, 2018), and hybrids (Herzog, 2010). Varying levels of domesticated animals are equally and increasingly broad as they too incorporate diverse categories that refer to whether they are animals raised for food, groomed for hunting, or bred to provide companionship as pets (Herzog, 2010). Further, any classification depends upon the animal location and the human relationship involved as these come to co-define animal spectra. A spectrum might refer more accurately and inclusively to the

variation involved in the management of wild reserves, urban cultivated animals, or captive animals (Melfi & Hosey, 2018).

Zoos, aquariums, and many wildlife reserves are notable for their role in encompassing the concepts of both wild and domesticated animals, often in the face of contention or public opposition about the appropriate roles for these institutions. Historically, there has been little agreement as to which role animals in the zoos actually possess. Where the definition of domestication is one of animals being genetically altered through breeding to adapt to humans, zoos animals fail any such assumptions and the category “domestic” does not hold (Price, 2002; Ward & Sherwen, 2018). The counter-argument for domesticated status is that zoo or aquarium animals are not wild given the fact that so-called wild animals are those that live apart and do not submit to human inspection as zoo animals must (Braverman, 2011). Others have postulated that while zoo animals are not wild themselves, they are instead representations, stand-ins, or even ambassadors for their wild counterparts (Birke et al., 2019; Braverman, 2011). Indeed, it would seem that zoo animals clearly inhabit some kind of middle ground between wild and domesticated; but how close to one side or the other they are is a matter for debate. Keepers report that their animals are both wild and tame (Birke et al., 2019) and it is in large part the keepers themselves who must manage this identity and at times steward it one way or another.

At the heart of this delicate balance—between cultivating wildness and encouraging some elements of domestication—is the broader social question of what it means to co-exist well in a variety of contexts that incorporate human and non-human animals, where the latter are not fully domesticated and yet may not be able to be fully wild. At the very least, the full autonomy of many wild and semi-wild animals has and will likely be more fully compromised as colonial institutions and anthropogenic change continue (Parreñas, 2018). Zoos are but one setting in

which to explore this question. Recent attention on zookeeper-animal relationships are emerging (Hosey & Melfi, 2014; Ward & Sherwen, 2018), and one study has drawn particular attention to needs for managing wild and de-wild animals (Birke et al., 2019). But little evaluative information exists for how this wildness is managed, what that ‘management’ looks like or how relationships between human and nonhuman are negotiated in these constrained contexts. Additionally, what role does a viewing public play when present and how might they affect the caregiver relationship with animals. Furthermore, the majority of studies that do exist occur in zoos, with aquariums receiving less attention. To these ends, the questions of this study are as follows: (i) How and why should zoo/aquarium animals be managed along the spectrum of wild to de-wild? (ii) What techniques and relationships do trainers use to manage this spectrum? And (iii) How do these practices influence the public or trainer-animal interactions and relationships along this spectrum?

### **3.1.1 Literature Review: Zookeeper Beliefs and Thinking about Wildness**

Zookeepers must necessarily engage in some sort of relationship with the animals in their care and as a result, scholars of human-animal relations have begun to examine the relationship between trainers and animals. Studies have identified a variety of behaviors and beliefs about the “wildness” or “de-wildness” of zoo animals and a diversity of characterizations are notable. Some keepers say that the bonds they form with the animals make the animals less wild, especially in situations of younger hand-reared, or home-reared animals where they become almost pet-like before having to readapt to a wilder setting in the enclosures (Birke et al., 2019). Similarly, the training of the animals may lead to domestication, as a necessary level of trust must be reached by both parties (Melfi & Thomas, 2015). In some cases, staff may also come to view zoo animals as “pets” (Grazian, 2017), even though most keepers do differentiate their

bonds with animals versus their bonds with pets (Hosey, Birke, Shaw, & Melfi, 2018). Zookeepers also report that they utilize techniques to try and keep or encourage wild-like behaviors across animals in their care, for example in Abyssinian colobus monkeys it was shown that increased training by keepers actually decreased colobus-human interactions and allowed for more natural behaviors (Melfi & Thomas, 2015). Especially important within this “wild” context are animals that are rehabbing in a center after an injury or abandonment, and habituation with humans may threaten their successful wild reintegration. For example, hand-reared animals must be able to reintegrate back with their family groups and thus must not be too habituated to or reliant on human presence, in other words too de-wilded (Birke et al., 2019; Collard, 2013). Conversely, there are times where reinforcing some necessary domestic behaviors is needed, such as when animals are deemed un-releasable and must remain in human care or when captive animals must receive ongoing physiologic maintenance, veterinary care, or be safely near keepers.

Through their daily interactions, and in some cases the relative necessities of de-wilding or re-wilding animals, zoo animals and keepers are reported as having formed bonds (Birke et al., 2019; Hosey & Melfi, 2010; 2014; Ward & Melfi, 2015), referring in particular to mutually beneficial relationship between species (see Hosey & Melfi, 2010). These keeper-animal bonds form across different species, but are often thought to be different and less strong than those bonds with pets (Hosey et al., 2018). Somewhat surprisingly there are keepers who report that bonds with animals are not appropriate. Such keepers also report a lower level of attachment with their pets than those keepers who believed it was appropriate to form bonds with zoo animals (Hosey et al., 2018). Despite this, in one study, 92% of keepers reported having a bond

with at least one animal, a majority of those animals being larger mammals (Hosey & Melfi, 2010).

Bonds, by their nature, are reciprocal. That is, both parties are considered and they are often mutually beneficial to both parties involved. In regard to keeper benefits, these may be measured through ease of working with the animals, but there are also many benefits to humans with positive human-animal interactions. For example, bonds between people and their pets often increase people's welfare (Hosey et al., 2018). However, what is often overlooked when considering bonds is the animal perspective. It has been reported that zoo animals respond differently to different keepers, suggesting specific individuals may engender a unique response (Ward & Melfi, 2015). Martin and Melfi (2016), for example, found that a number of species such as African elephants, Brazilian tapirs, and slender-tailed meerkats all avoided unfamiliar keepers, preferring familiar keepers (Martin & Melfi, 2016).

Within the many relationships that zookeepers and animals have, some may be positive while others may be more aversive (Hosey et al., 2018). Positive interactions may take the form of interacting, playing, talking, all of which have been shown to promote positive animal welfare in zoo and laboratory animals (see Hosey & Melfi, 2014). These relationships have been deemed cyclical where positive keeper-animal interactions lead to positive responses from animals which in turn lead to positive animal welfare, which continues the cycle (Ward & Melfi, 2013). Each relationship may have its own intrinsic benefits or costs. Benefits to keepers and zoo animals have been noted in two ways: operational benefits which can aid in animal management, and affective benefits which lead to increased emotional benefits (Hosey & Melfi, 2010). Keeper-animal relationships can also have an effect on zoo animal welfare (Ward & Sherwen, 2018), with positive human-animal relationships leading to better welfare than negative, neutral, or

weakly positive human-animal relationships (Melfi & Hosey, 2018). Benefits along these lines have also been said to include tangible physical benefits: a study looking at felids found that when there were positive interactions with keepers the felids had lower corticoid levels (which are an indicator of stress) (Wielebnowski, Fletchall, Carlstead, Busso, & Brown, 2002). This has also been demonstrated in other environments characterized by their human-animal interactions. For example, in laboratory chimpanzees, positive interactions with staff have been reported to lead to less indicators of stress such as an increase in grooming (an indicator of positive welfare) and a decrease in regurgitation (an indicator of negative welfare) (see Baker et al., 2004). Animal welfare in zoos can be measured by factors such as reproductive success, behavior, and hypothalamic-pituitary-adrenal (HPA) activity. For example Davis et al. (2005) used HPA analysis to assess zoo visitor effect on spider monkeys (Davis, Schaffner, & Smith, 2005). Behavior has itself become, in some studies, a measure of welfare where wild-like behaviors are used for evaluative purposes (e.g., with more wild-like behaviors representing greater welfare (Melfi & Thomas, 2015)).

Negative interactions can and do result in costs for both the animals and keepers. In agriculture, for example, negative interactions between humans and animals have been shown to result in significantly lower creation of products by animals, such as egg laying (Edwards, Coleman, Butler, & Hemsworth, 2019) and milk production (Rushen, de Passillé, & Munksgaard, 1999), which signifies lower welfare (Hemsworth, 2003; Rushen, de Passillé, Keyserlingk, & Weary, 2007; Rushen, Taylor, & de Passillé, 1999). In a zoo environment, an animal that develops a bond with a keeper can be adversely affected when either the animal or keeper leave the facility (Hosey et al., 2018). Keepers report having to maintain their distance emotionally in order to adapt as animals leave to other collections, die, or must be killed, and this



puts an enormous strain on both the animal and the keeper's emotional welfare. Even though the degree of distance varies by keeper (Birke et al., 2019), negative responses to death or transferring of an animal understandably often occur. Indeed, not surprisingly, it has been shown that people have negative reactions and emotions (such as guilt or grief) when they are forced to euthanize animals in experiments (Arluke, 2009).

While zookeepers and animals comprise a majority of the interactions at a zoo or aquarium, the public also interacts with both the keepers and animals and can be influenced by each. Since wildlife encounters in the wild are often limited for the public, wildlife may often be perceived as negative because people are known to rely largely on myths and rumor rather than scientific fact (Magle, 2018). Zoos are often constructed to allow the public to have the feeling of being in the "wild" while viewing the animals housed there, otherwise known as the "exhibits." Although this may contribute to education by suggesting a natural habitat, it might also preclude the public's ability to see the interactions that the keepers have with the animals (Birke et al., 2019). For these and other reasons, the experience and job of the zookeepers isn't always recognized by the public (Grazian, 2017).

Zoos may also affect in situ or later actions by visiting individuals and public groups. Animal shows and interactions with animals can increase positive attitudes and behaviors toward animals and their broader environments (Miller et al., 2012). Seeing an animal in person and especially seeing it interacting can be more powerful than viewing it on a TV or in a book (Braverman, 2011). Visiting a zoo can create a bond or emotional relationship with a particular species that leads to an increased concern about the well-being of that animal (Ballantyne, Packer, Hughes, & Dierking, 2007; Clayton et al., 2009). Such concern can potentially lead to tangible benefits, such as public willingness to financially contribute to the protection of some

species (Magle, 2018). This is a key consideration given the fact the zoos and aquariums depend in large part on revenues from paying visitors. Studies of biophysical responses to engagement at zoos also indicates measured benefits from visiting a zoo, such as decreased blood pressure and increased physical activity (Sakagami & Ohta, 2010).

In sum, since random wildlife encounters are fewer and more transient, they tend to be more difficult to examine broadly. Application of the wild-dewilding spectrum concept allows a framework where such an exploration can capitalize on situations where human-animal interactions can be consistently and reliably studied. Much can be learned from communication with those humans whose careers are dominated by working with and caring for the animals. Few studies have looked deeply into relationships to explore issues of de-wild and wild and even fewer look at relationships in an aquarium context. By probing the close relationships with a variety of species at an aquarium, caregivers can assist with a deeper look at the nature of the bonds formed and also give insight as to what messages they hope the visiting public may be receiving.

### **3.2 Methods**

Given that the essence of this study is to identify and characterize the nature of a wilding-dewilding spectrum and to examine the effects and requirements that such spectrum concept places on the human-animal relationship therein, we chose a qualitative design. We further sought to evaluate situations in which there was a sustained human-animal relationship where we could more fully delve into the daily routines and requirements that influenced such a relationship. To this end, we connected with a prominent aquarium and were able to further examine the necessary relationships all staff share with their animals and could evaluate how those were viewed within the overall wild to dewild spectrum. Thus, interviews were conducted

with 19 trainers at the Aquarium as well as other staff members who worked directly with the animals. The interviewees represented a wide range of positions, time employed, and animals with which they worked. Positions of interviewees included assistant curators, lead aquarists, trainers, and assistant trainers. The employment time ranged from 1 month to 24 years, with an average time of 8.18 years.

The animals that trainers reported working with were diverse and included: sea lions, fur seals, penguins, dolphins, seals, jellyfish, sea otters, walruses, frogs, snakes, birds, Arctic fish/invertebrates, British Columbian fish/invertebrates, monkeys, sloths, bats, and insects. It was important to interview trainers and staff that worked with a broad range of species as animals are at the aquarium for a number of different reasons and thus the interactions between trainer and animal necessarily deviate. Some animals are born there either for propagation and research (like many of the fish species), or in order to be released back into the wild (e.g., a program encouraging repopulation of the Oregon spotted frog). But others come in directly from the wild. Some, like the sea lions, are taken to provide essential conservation research, but many are rescues deemed un-releasable by the government because they would be unable to survive in the wild. This is usually because they have an injury or were forced to become human dependent because of their young age, thus rendering re-wilding impossible (e.g., sea otters that were found as babies, a sea lion that was shot and blinded, a Pacific white-sided dolphin whose pectoral fins had to be partially amputated). There are also many animals that are rescued from the wild, rehabilitated, and released back into the wild. While this occasionally happens at the aquarium itself, usually those animals are housed at an affiliated rescue center offsite.

The interviews were semi-structured and were all conducted at the aquarium. The study was approved by the University of British Columbia Ethics Board and all interviewees were

volunteers and given the option to remove themselves from the study at any point. There was no set time frame and the interviews ranged in time from around 40 minutes to 2 hours depending on the availability and interest of the interviewee. Some of the interviews were conducted in a sit-down environment, but many of them were conducted while the interviewees were participating in the normal daily activities. Observations were made during the interviews and after regarding the human-animal interactions that occurred and the behavior of the animals. Some of the activities that were observed during the interviews included feeding, cleaning habitats, getting animals on and off scales, practice with husbandry behaviors, and medical procedures. Subsequent observations included the demonstrations for the public where similar actions were taken, but often while speaking to and with the public.

Questions were developed to touch on a wide range of topics. Our initial questions fell generally into 5 different categories: General information, relationships, understanding of animals, experiences, and public interactions and perceptions. We often asked questions such as “Can you describe a normal day of work for you?” or “What type of interactions do you have with [animal]?” to get a general idea of the relationships, before delving into questions regarding their understandings of the animals, their experiences, and information regarding their interactions with and knowledge of the public. For example, in order to elicit ideas regarding their understanding of the animals, we asked questions such as “Are there any events that have occurred at the Aquarium that have changed your relationship with or perception of the animals?” (See full interview script in Appendix C). However, our questions were often driven by the stories of the participants as well as the actions of the participant through their daily activities and thus often extended beyond the original interview script.

Interviews were recorded with permission from the interviewees. The interviews were then transcribed verbatim and individual transcripts were uploaded to NVivo 12 (version 12.5.0) and then coded. The interviews were coded using non-hierarchical axial coding and codes were derived after a detailed manual review of the interviews. In our preliminary review of the interviews we identified themes relevant to our initial interview-based categories (such as public and relationship), however a secondary review also highlighted other elements that came up across many of the interviews (such as the deeper bonds shared by trainers and animals). These themes that emerged from the interviews throughout our coding process were consolidated into three main points: wild and de-wild (how animals are viewed in regard to their placement and movement on the wild to dewild spectrum), relationships and bonds (how trainers and animals form bonds and the ways in which they interact), and public perceptions (how the viewing public may see the animals and the relationships between animals and trainers).

### **3.3 Results**

#### **3.3.1 Wild and De-wild: “Don’t Lie Down with the Walrus”**

The wild to de-wild spectrum with its overlaps and numerous graduations presents unique challenges to the staff and the animal residents of the Aquarium. The staff must balance the needs of each animal with its natural individual requirements. These vary based on whether the animal is a lifelong aquarium resident, or has the potential for release. Additional factors to be considered include safety concerns for both keepers and animals, as well as the need to recognize and hone an animal’s physical, emotional, and intellectual needs. One theme that emerged from the interviews was the ways in which animals at the aquarium represent in public engagement contexts both wild and de-wilded animals. Interviewees emphasized that the animals they worked with were still wild animals generally for one of two reasons: To either impress the need

for encouraging natural and wild behaviors, or to demonstrate how the trainers needed to remember the animals wild nature for their own safety. For example:

*They're still wild animals and we want to encourage all their wild behaviors including predator/prey responses. (8)*

*I think it's just being able to take a step back and remind yourself that [they are wild animals] and I think as long as that's in your brain somewhere there's obvious lines you don't cross. You wouldn't go and lay down with a walrus, you know that's not a good idea, or put yourself into a corner when you're working with them. (17)*

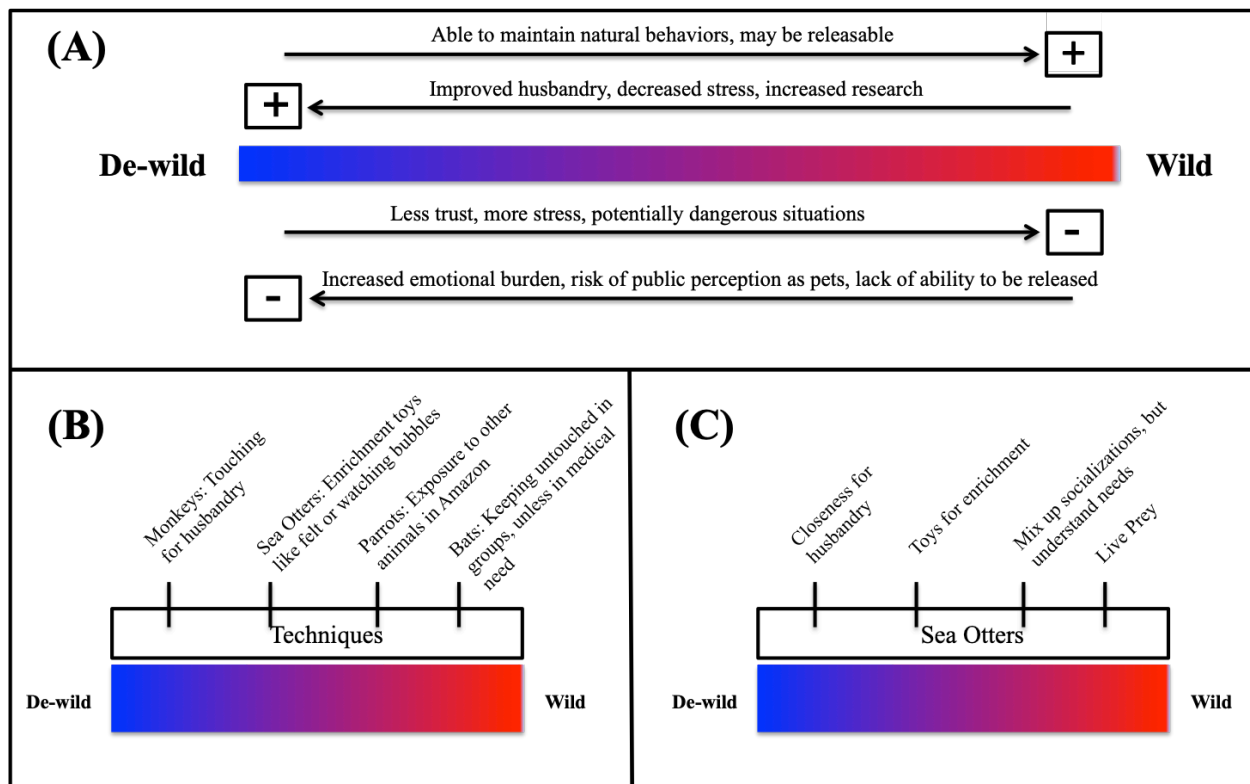
One interviewee did say they were not “wild critters” emphasizing the fact they are different given their existence in an environment that is decidedly “not wild.” Thus interviewees often used languages for the absence of wild such as an emphasis on the animals as “not pets.” However, a few people did refer to the animals as being like their children, alluding to the idea that they felt a familial relationship with the animals.

While not explicitly stated, comments made in the interviews and observations throughout the day illustrated how the interactions that the trainers have with the animals often serve to facilitate behaviors from the animals that are either more wild or more de-wild in nature. These actions have both positives and negatives for both the animals and trainers involved. Facilitating the de-wilding of an animal can lead to allowing the trainers more close physical access to the animals, thus ensuring greater attention to husbandry issues, while causing less stress to the animals. It may also help with research as the animals are able to actively participate. However, these types of interactions usually ensure that the animal is unable to be released back in the wild. In addition, while it may facilitate a greater bond between trainer and animal, that can increase the risk of the visiting public seeing them more as pets rather than wild animals as well as increasing the emotional burden that trainers and sometimes the animals face

if they are separated through relocation or death. As one trainer emphasized, even though it is a job, they still form attachments with the animals they work with, which can increase the emotional burden they face.

*But yeah we do get attached and it is also a job, right. So we do have to recognize that and be professional, but it is really hard. It's definitely hard, we spend more time with our animals than we do with our families. Because we're here so long with them, it's inevitable that we're going to form these attachments. (5)*

On the other hand, facilitating more wild-like behaviors of an animal can result in its own set of positives and negatives. A more wild animal is more likely to be able to maintain its natural behaviors which, while important to its individual wellbeing, can also help in being released back into the wild. However, this can necessarily lead to less trust between trainers and animals, making for more stressful interactions for trainers and animals alike, as well as potentially more dangerous ones especially for the trainers (Figure 3.1).



**Figure 3.1 Managing wild and de-wild in aquariums.** (A) Expresses costs and benefits of moving towards the wild and de-wild ends of the spectrums. (B) Expresses techniques for operationalizing different behaviors across the de-wild to wild spectrum within an aquarium framework for a variety of species (C) Expresses operationalizing different behaviors across the de-wild to wild spectrum for Sea Otters specifically.

This is not to say that the trainers are actively thinking about wilding or de-wilding animals in those terms during their interactions. But it is useful when observing and seeking to understand the interactions to utilize the spectrum framework to conceive of the relationships between trainer and animal. In most cases an animal comes in with a designated status (e.g., releasable, non-releasable) and relationships follow. Throughout it all, trainers are continually striving to maximize the wellbeing of the animal and the trainer and the techniques utilized notably differentiate with the ultimate goal (de-wild or wild) and the animal in question (Figure 3.1). For example, looking at sea otters can provide an example of how different techniques are utilized to move the sea otters at the aquarium along the spectrum of wild to de-wild and how



those ultimately benefit both parties involved (Figure 3.1). While in the wild, humans would not touch sea otters. But in the aquarium, training to allow the trainers to do hands-on examinations with the otters allows for an increased likelihood of identifying health concerns early and relieves the stress of frequent forced immobilizations and veterinary visits. By training for that behavior, the sea otters learn nothing bad will happen to them and they are rewarded for that closeness, while the trainers are able to feel safe with the otters. As one trainer stated,

*Yes, that's one of the reasons we train so we can get close enough to the animal to make sure the animal is ok. So with the sea otters we can check their little paws, because they have pads on their paws so make sure they don't have cuts, ask them to open their mouth and check their teeth. (2)*

The sea otters also are given toys for enrichment purposes, to keep them engaged and active. While sometimes these involve things that mimic natural objects otters would find (e.g., foam-like material that is similar to kelp), other times it is less natural, but stimulating experiences (e.g., watching trainers blow bubbles behind glass). The enrichment stimuli are opportunities for the otters to interact with the trainers, or to engage in stimulating behavior by themselves, similar to how they might explore and learn in the wild.

At the aquarium there are currently six otters and two pools and as such, trainers often mix up groups that are together to promote increased socialization. However, they pay attention to the needs of the animals. For example, if a trainer notes that one otter is feeling a particular mothering instinct toward another at a certain time, they recognize those natural feelings and respect them, allowing them to be together or apart as needed.

The trainers still want the otters to express their natural behaviors. They may, for example, give the otters live prey such as crabs to ensure they are still behaving as wild animals and not becoming overly domesticated. In addition, it serves as a form of enrichment, forcing the

otters to catch and break open the crabs. One trainer emphasized the balance necessary between the two ends of the spectrum,

*So it is very much trying to balance those two things...we want to give you lots of care, lots of attention. But we also want you to do your normal things, we want you, for the otters to groom, and to use the kelp to wrap yourself up in, which they do. We want to see you guys take things and bang them around to try and break things. We want you to try and get stuff out, break things. We want you to do those behaviors, because naturally that's what you do. We don't want them to be pets of any kind, because that takes away from what they should be doing, naturally they may not know those things so it does take time. (4)*

### **3.3.2 Relationships and Trust: “Working with 500 Kilograms”**

Dealing with animals across all ranges of the wild and de-wild spectrum often takes a great deal of mutual trust between animal and trainer and that is built through the bonds that develop between animal and trainer over time. Most interviewees spoke about how trust and the relationships needed to develop it are an essential part of working with the animals at the aquarium. While there is movement across the wild to de-wild spectrum, the animals still have the physical capabilities to cause significant harm to the trainers, especially if they believe the trainers mean harm to them. Many of the trainers emphasized their awareness of these issues and the need to develop relationships based on positivity in order to build trust.

*I guess the relationship is very trust-based for the most part. I think that a lot of what you do, especially when you're just starting out is just building a relationship. I mean I'm working with animals that are 500 kilos, so building a relationship where I know I can trust them not to sit on me or bite my face off and they can trust me that I'm going to come and I'm going to treat them well. I'm always coming bringing something positive, or trying to have that positive relationship. (16)*

*So there's the trust bond, which has to be well established no matter what. Especially when you're going inside the habitat with a very large animal, even the otters, they're not large animals, but still you have to trust that they're ok with you doing that. And that comes with you showing the animal that you aren't going to do anything to them. And we build that relationship over time. (3)*

Trust was a theme that arose across many of the interviews. The trainers stressed the necessity of building a strong trust bond and how, depending on the animal, the formation of that bond was often slow to build. Equally important, trainers discussed how it was essential to maintain that trust bond once it had been formed, citing how difficult regaining trust would be if it were broken. All the trainers always assumed full responsibility for instances of broken trust and were cognizant of the potential for its loss. They would examine their own behavior, consider what went wrong, and what might be done to facilitate a stronger relationship with the animals. One trainer illustrated this by discussing how trust might be broken between animal and trainer and the importance of the relationship in preventing that breakdown.

*Yeah, I think that's where the relationship comes in and being able to read them. Being able to read them is very important because then you know how hard to push them, if you want to push them at all, because ultimately they are wild animals and if they don't appreciate what you're trying to do they will let you know. And usually that's in the form of a bite. And then once they bite you, that actually sets our training program back because then we have to reexamine what did we do wrong? Is there something we could have done better? So we definitely, we want to be careful. They are our kids, but we can't take that for granted. (2)*

Indeed, trainers often spoke about the closeness they felt between themselves and the animals. Some spoke about the joy they felt when they got to interact with animals. Others mentioned even tearing up when they had been gone for a period of time (like a maternity or paternity leave) and then returned and were recognized by the animals that were previously in their care. Interviewees emphasized that although their jobs were predominately filled with chores and lower pay, this ability to interact with and build bonds with animals was the main reason for thriving in their profession, and maintained that they would not want to be anywhere else.

Positives for the animals in the relationships included food (often known as having “a bucket”) and positive vocalizations with upbeat tones of voice. During the study, one researcher witnessed multiple instances of positive feedback between the trainers and animals in the form of vocalizations offered to the animals. There were many “good” or “good girl/boy” during training, but even during training, further conversations were had by the trainers such as “I know that’s your behavior sweetheart,” (7) or “Come on out, come honey,” (1) or “Yes! You’re doing so well!” (16).

Furthermore, when being interviewed near the animals, even when they were not directly working with them, many of the trainers would stop to engage the animals. When the penguins were making noise as they were in a back room waiting for their exhibit to refill after being cleaned, one trainer often spoke with them throughout the interview, saying such things as, “You’re very loud. I know you’ve been cooped up here all morning, it’s filling. 15 more minutes maybe, then you can go out. Sorry buddy.” (2)

At one point one of the walruses was undergoing a procedure to get a silver cap on the end of his tusk to prevent breakage. He had to voluntarily move into an apparatus that would inhibit his movement to allow the vet access to his tusks. One of his trainers, through fish, positive vocalizations, and her presence helped to coax him into the apparatus. It was a procedure that would not have been possible without that trust and relationship between the walrus and trainer. One of the observing trainers illustrated the interaction, saying,

*And she’s the one who works very closely with the walrus. It’s like “Ok, this is a scary thing. I’m coming into the cage, there’s people everywhere, there’s loud noises.” But it’s like “Ok, my person is here, they have a bucket, I know that it’s ok.” (16)*

### 3.3.3 Public Perceptions: “We are Not Just Circus Performers”

The ways in which the trainers interact or do not interact with animals are often on display for the general public. The general public usually sees one of three types of interactions: Close relationships between animals and trainers (e.g., physical contact necessitating mutual trust), general interactions between animals and trainers (e.g., feeding or cleaning exhibits), or no interaction between animal and trainers, but visuals of the animals and education and insights from the trainers and interpretation staff. The first two can certainly coincide, but the trainers differentiate their actions between developing those trust bonds and doing basic maintenance or feeding around the animals. The public may not always see or understand those though, as one trainer put it,

*I guess it's hard sometimes [the public] only see us come out during shows. They don't realize there's other things we're doing with the animals and behind the scenes all the time. So, I don't know, there's kind of those two public perceptions: There's people who think of it like the circus, and we're just doing shows with the animals, and they don't see any sort of relationship. They see us maybe as the big boss telling them what to do. And then there's other people who are like “Oh they're best friends!” And it's not either of those. It's like we're mutually trusting. (16)*

While at times there may be a difference between what the trainers are hoping the public perceives and what is actually perceived, most trainers acknowledged they were hopeful that the public would engage with the environmental and animal welfare messages that viewing the animals might provide. From interviews and observations we synthesized three general ways in which the public might perceive something they witnessed at the aquarium. First, they might perceive the care of the trainer for the animal, noting the actions of the trainer, the trust of the animal, or the positive behavior of the animal. This could be viewed in cases with direct interaction between trainer and animal, but is harder to see in cases where there is only

education, but no direct interactions. One trainer working with one of the Hyacinth macaws emphasized this attraction and perception of the relationship and care,

*That's one of the things, especially working with Ollie. He's definitely the most visually impressive of them. He's huge. They're the largest species of parrot in terms of length. And in terms of weight. So he's a very imposing figure. He's got that big beak that a lot of people find really scary. So there tends to be a bit of an "Ooh, you must have a really good relationship with him." It's a comment I frequently get when I come out after a training session and people are very curious about that. And yeah, how long it takes to cultivate that relationship, which varies depending on the bird. (7)*

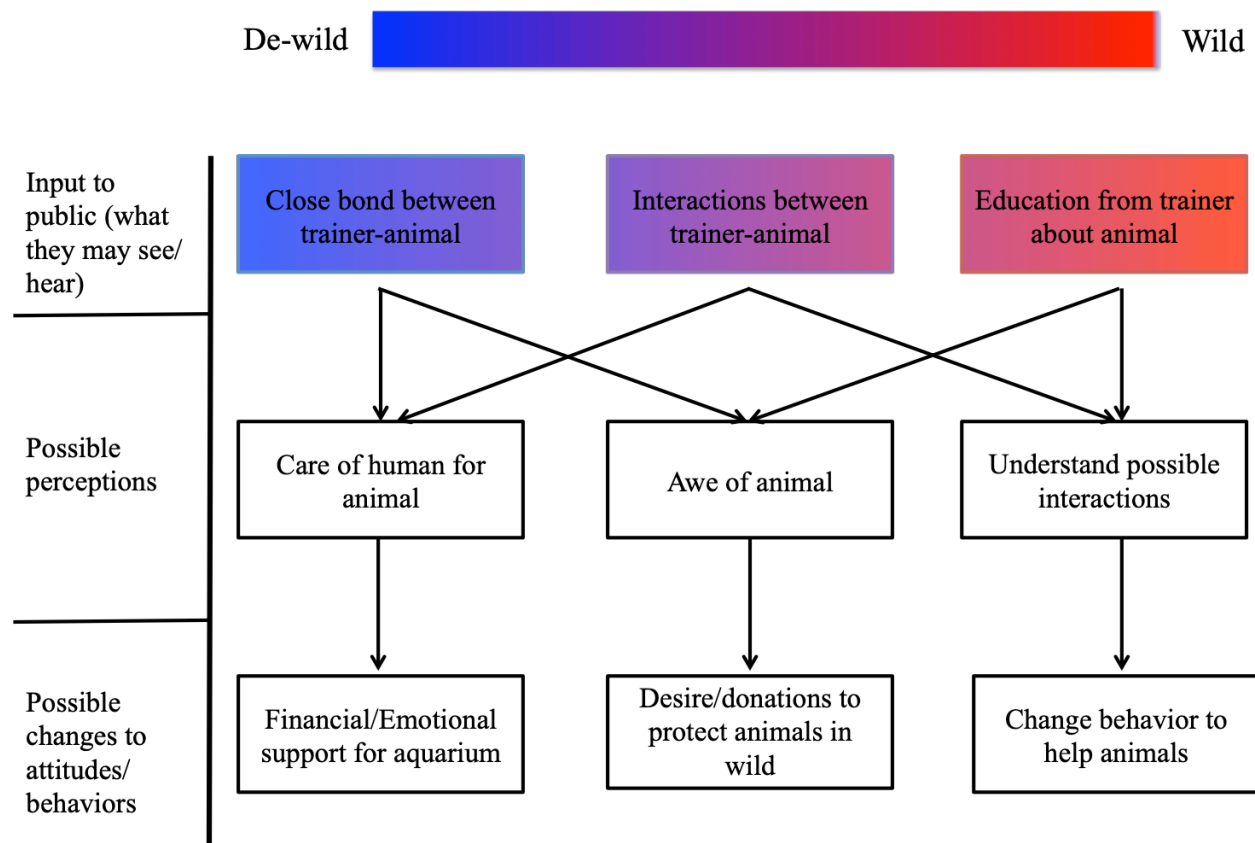
Secondly, the public may feel a sense of awe about a specific animal or group of animals. This may be due to witnessing the close relationship between a trainer and animal. As the quote above states, the fact that Ollie is a visually imposing and impressive figure is compounded and emphasized by the close relationship between the trainer and Ollie, more so than just basic interactions alone. However, awe may also be engendered from education. Learning about an animal, their behavior, history, and influence among others, while being able to view the animal can in itself build that sense of awe about an animal. One trainer who worked with frogs talked about getting to spend time speaking with the public regarding the frogs on display,

*And I think, especially for younger kids that do have a bit more patience and want to find every animal in every enclosure, as soon as they see a frog they're wowed. Because it's one of those things that...frogs are one of the hardest animals to find in the wild. Most people have never seen one in their lives, out and about. So I think it's when they can find a frog they are looking for, that itself builds a connection. (12)*

Finally, the public may learn not just about the animal, but about the interactions that can occur between an animal and humans in general. Basic trainer-animal interactions may lead to an understanding of the physical ways in which humans and animals may interact and coexist, while education often focuses on interactions between humans and animals in the wild and what steps may be taken to improve those interactions. On the other hand, at times, witnessing the close bond between trainer and animal can prove adverse for better understanding relationships

between humans and wild animals. One of Ollie's trainers mentioned how after viewing their relationship, people would ask or simply try to pet Ollie, not understanding that Ollie is still a wild animal, not a pet, and would not react well to anyone who had not spent significant time building trust.

Based on these responses from the trainers, it is clear that witnessing and hearing about different types of trainer-animal interactions may lead to different perceptions within the viewing public. Perceptions may in turn influence attitudes and behavior. While it was not within the scope of this study to examine changes to perceptions, attitudes, and behaviors, it is still possible to speculate on potential changes, and illustrate changes that trainers cited as ones they were hoping to inspire through their work. Each of the previously mentioned perceptions and understandings of animals and of the human-animal relationship potentially may lead to different changes in attitudes or behaviors (see Figure 3.2 for visualization of these possible perceptions and changes).



**Figure 3.2 Potential outcomes of public aquarium visitors witnessing wild and de-wild interactions between animals and trainers.** Inputs to public are from occurrences they may witness and engage with at the aquarium, possible perceptions are potential outcomes from those inputs, and possible changes indicate attitudinal or behavioral changes that may arise from perceptions. Arrows indicate possible one-directional paths.

It is intuitive that increased awareness of and belief in the care of trainers for the animals could lead to financial or emotional support for the aquarium. This may take the form of monetary donations or public outreach and positive promotion. Increased awe and understanding of an animal could lead to an increased desire to protect animals in the wild and may similarly take on a tangible form of monetary donations. Finally, increasing understanding of the positive and negative ways in which humans and wild animals may interact could lead to changes in behavior, such as decreased use of plastics or consuming only sustainable seafood. Though the literature is sparse in regards to whether people move beyond care of animals in zoos and aquariums to direct conservation action, a number of respondents spoke to their desire that the



public walk away from the aquarium with a desire to influence the world and the wild animals around them in more positive ways.

*I think what I care more about is that people [are] taking away why we have them here, what their impact is (and I mean the public), what their impact is on the world around them. And a lot of these animals are here because they have no choice, they could not be anywhere else. And those are the things that I would rather people walk out of here knowing, that what they do affects the world around them, more than anything else. (4)*

Interviewees emphasized their desire for the public to take away positive messages about the animals at the aquarium and hopefully a desire to positively influence animals in the wild as well. Additionally, many trainers did mention they wished the viewing public would understand a bit more about their relationships with the animals in their care. They emphasized the amount of time they spent with the animals, and their dedication to the animals' welfare.

*We are here day to day with these animals. I hope people realize that our number one priority at all times is these animals. And that goes not just for the trainers, that goes all the way, all the way to the top. We will do our best for these animals. We always do the best for the animals. And I hope people realize that that is always is our number one priority. So if we felt they weren't having a good life we're going to do something to fix it. Whatever it takes. (6)*

### **3.4 Discussion**

In previous studies, the dichotomy between wild and de-wilded animals within zoos and aquariums has been mentioned, but the fact that it is a spectrum has not been fully explored. For example, the rise of urban animals and indeed the rapid increase of human-animal interactions due to the decreasing space between humans and animals is leading to animals that cannot be classified as wild or domesticated. It should be noted there are disciplines that recognize far more categorical divisions such as semi-domesticated, native, urbanized, commensal, captive, feral, etc. The spectrum concept noted herein adds to this in two primary ways. First of all, it helps to provide a more understandable framework especially for the lay public who, without the

guidance of scientific classifications, think primarily in terms of either wild or tame. Secondly, the spectrum concept allows for the possibility (and in some cases likelihood) of moving back and forth on the spectrum, depending on the current state of the animal and its surroundings.

This study found that animals within zoos do not exist as either wild or de-wilded animals, but instead occupy spaces within a spectrum between the two. This phenomenon can likewise be seen in so-called urban animals (Nagy & Johnson, 2013). However, in urban populations of animals, human actions that have placed these animals along the spectrum of wild to de-wild are often unintentional, whereas in zoo populations these actions are much more directed in nature. The idea of wildlife thus remains a constantly evolving concept. While there are varying definitions of wild, in the most basic sense it may be taken to be Magle's (2019) definition of a nonhuman, free-living animal. This would assume it does not readily associate with, depend upon, or see humans. Whereas many would classify a wolf in the Arctic as "wild," wolves in the Arctic have been seen to be rooting through and in some part depending upon human trash (Nagy & Johnson, 2013). This further emphasizes the difficulty in classifying wildlife as something that exists fully separate from humans. Trainers at the aquarium acknowledged the wild nature of their charges, but also sought to engage with them in safe environments for the benefit of trainer and animal alike. Previous studies emphasized the necessity for trainers to create safe and effective ways to interact with the animals in their charge (Ward & Melfi, 2015).

The relationships that form between trainers and animals are important as they build trust leading to safer and more positive interactions. Studies have examined how bonds are formed between trainers/keepers and the animals they work with (e.g., Birke et al., 2019; Hosey et al., 2018; Ward & Melfi, 2015), and this study echoes their findings that close relationships are

formed. Furthermore, trainers spoke about these relationships in regard to a wide range of species. Mammals were well represented in the responses, but so too were bird-trainer relationships and to a lesser degree reptile- and amphibian-trainer relationships. Other studies have found that keepers felt that they could communicate better with mammals than other animals (Birke et al., 2019).

Trainers often spoke of the necessity of these bonds in order to promote benefits for the trainers and animals alike. The trainers often evaluated their needs from a safety perspective, though also spoke of an emotional relationship with the animals. Studies have shown benefits for humans when interacting with wildlife. While humans do get pleasure from interacting with wildlife and animals they have also had increases in their physical and mental health as well as improvements in overall wellbeing (Buckley, 2018; Melfi & Hosey, 2018). Similarly for the animals, studies have shown that positive interactions between trainers and animals have lead to decreased indicators of stress in the animals (Baker et al., 2004; Mellen, 1991; Wielebnowski et al., 2002).

This study examined what the trainers hoped the public was perceiving from their interactions and education, as well as hypothesized potential attitudes and behavioral changes that could arise from witnessing those interactions. Preferences, values, and emotions have been shown to influence attitudes and behaviors in regard to biodiversity conservation (Echeverri, Callahan, Chan, Satterfield, & Zhao, 2017; Martín-López et al., 2007) and thus, understanding the ways in which trainers attempt to engage the public and promote those reactions can lead to further understanding of possible conservation behaviors. However, more studies on changes in public perceptions and behaviors after visiting aquariums, while difficult to measure, are certainly needed.

While the study of human-animal relationships represents a growing body of literature, zoos are an under-researched category in this regard (Ward & Sherwen, 2018). Even less work can be found that focuses on human-animal relationships in aquariums. This study found similar responses, such as bonds created between trainers and animals, in an aquarium setting that other studies have shown in a zoo setting. While many would likely assume a similarity between zoos and aquariums, given the occasional presence of marine animals in zoos and terrestrial animals in aquariums, it is important to note that was in fact found through this study.

Finally, studies that focus on human-animal interactions and relationships often focus more on domesticated animals given the availability of those interactions and the difficulties of examining wildlife-human relationships. Most of the studies on humans and wildlife focus on the interactions and, more often than not, conflict between the two (Bhatia et al., 2019). The most commonly studied human-wildlife relationships occur within zoos and, to a much lesser extent, in aquarium environments. Some believe that relationships between humans and animals de-wild the animals no matter where they occur, and certainly there are cases where wild animals have been habituated to or imprinted on humans where their “wildness” is questioned (Chambers & Main, 2014). However, relationships can indeed form between humans and animals in the wild though they are fewer and more random (Smuts, 2001).

As humans and wildlife unavoidably become forced into closer proximity (Soulsbury & White, 2015) it is imperative to examine all facets of the relationship and one such way is looking at the relationships that exist in zoos and aquariums. We found that trainers acknowledge both the wild nature of their animals and the fact that they need to embrace de-wilded tendencies as well for mutual benefit. While not explicitly stated, we found various activities serve to move animals along a wild to de-wild spectrum, but that this is in large part was only possible through

the relationships formed between trainer and animal, and more notably the trust developed through those relationships. Finally, we speculated, through the stated desires of the trainers and the observations through the study, as to the potential effect of those relationships on the public and more notably on their attitudes and behaviors that revolve around conservation. Examining these relationships and their impacts may provide additional information for affecting relationships driven by the increasing interactions between humans and animals in the wild.

## Chapter 4: Into the Animal Mind: Perceptions of Emotive and Cognitive

### Traits in Animals

*“I think it’s important for guests to not only see individuals, but to know that animals are different. Maybe it makes them more relatable...But when you know animals have individuals and personality, you look out for them more.”*  
—Aquarium trainer #4 (2018)

#### 4.1 Introduction

An unprecedented number of species are facing extinction (Diaz et al., 2019), and the conservation of nonhuman animals in the wild has necessarily assumed new urgency. Habitat that used to be utilized primarily by wild species has been increasingly usurped by human needs and incursion. This has pushed animals and humans into smaller and more confined spaces, forcing increased interactions between them (Soulsbury & White, 2015). Additionally, interactions between humans and nonhuman-animals that do exist are often driven by understandings and perceptions of animals that are based on popular assumptions. Yet our empirical knowledge of how wild animals behave, and in particular think, remains nascent at best. Such knowledge is generally referred to as studies of animal mind. Animal mind is the idea that animals have mental states, that they are capable of consciousness, and can think and feel (Knight, Vrij, Cherryman, & Nunkoosing, 2004).

Elucidating public perceptions regarding animal mind may also inform our understanding of human-wildlife interactions (Mascia et al., 2003) and even contribute to knowledge regarding novel conservation interventions. Conservation campaigns, for example, are often supported and funded by members of the public and are aided by the fact that people favor some species over others, seeing them as more charismatic and sympathetic than others (Martín-López et al., 2007). Thus, understanding public perceptions of species in detail might better explain why giraffes are

less popular than elephants, or why we care about some species and ignore others (Lindsey, Alexander, Mills, Romañach, & Woodroffe, 2009).

The idea of animals having minds and being more than Descartes' "mindless machines" is not new. Indeed scientists from Darwin on continue to increase their understanding of multiple levels of mental abilities (e.g., problem solving, emotions, self-awareness) within a variety of species (de Waal, 2016). However, studies of public perception have not kept pace; instead the extent to which people ascribe mental capabilities to animals is varied and poorly understood (Sarter, 2004). Moreover, some studies of these perceptions focus only on examining the idea that animals might have capable minds in broad terms (e.g., questions such as "do you believe animals have minds?") as opposed to more specific questions that evaluate animal capabilities (e.g., "are animals capable of problem solving, emotions, etc.") (Maust-Mohl et al., 2012; Waytz et al., 2010b). While there are studies that focus on specific questions such as perceiving emotions in animals (Morris, Doe, & Godsell, 2007), there is a lack of studies focusing on a multitude of different animal capabilities across a wide range of species.

Furthermore, it is unclear whether or not the results of the emerging sciences that explore the animal mind have reached a wide public audience, despite the growth of research in this field. For example, a recent study found that the degree of self-recognition in animals was not well understood by the lay public (Maust-Mohl et al., 2012). However, there have been multiple studies on the subject regarding species as diverse as chimpanzees (Gallup, 1970) and magpies (Prior, Schwarz, & Guentuerkuen, 2008). This finding may be explained in part by the fact that people often cite personal experiences and media reporting instead of scientific studies to legitimize their belief, or lack of belief, in animal minds (Knight & Barnett, 2015; Maust-Mohl et al., 2012).

In order to examine the extent of emerging understandings of animal cognition and consciousness as well as broader comprehension regarding animal capabilities, more robust and detailed understandings of public perceptions are needed, including those that reference animal mental traits. It is also useful to understand how those are bundled or classified as categories of perception and to which species they are thought to apply. To the extent that research has emerged along those lines in the form of a limited number of studies, they are difficult to analyze as a body of work as there is little consistency in the terminology used across studies. For example, one focus is on what is termed “intelligence,” and asks whether people see animals as having such capacity or not (Nakajima et al., 2002). Other studies focus on whether people have “belief in animal mind” (BAM) (Knight et al., 2004), and still others on whether animals can be said to have general cognitive abilities (Eddy et al., 1993). Studies determining if the public perceives animals as having separate and different mental abilities are sparser and the descriptive terminology varies here as well, depending on the investigation. One study found three categories of capacity and referred to them as: cognition, affect, and sentience (Herzog & Galvin, 1997). Others however have defined capacities in reference to two categories: experience (emotional states such as pleasure and embarrassment) and agency (cognitive states such as memory and planning) (Gray, Gray, & Wegner, 2007), or sensation (such as pleasure and pain) and intellect (such as thinking and imagining) (Bastian, Costello, Loughnan, & Hodson, 2011), or sense and feeling contrasted with planning and action (Waytz et al., 2010b). Despite this lack of consensus in terminology, these pairings do suggest dichotomous constructs, which fit under or could be regrouped as *emotive traits* and *cognitive traits*.

This terminology touches on the concept of anthropomorphism, but is also distinct from it. Since humans only have the frame of reference of their own experiences and feelings, the very



nature of describing animal traits necessarily involves ascribing human characteristics to animals, which is how anthropomorphism is generally defined (Guthrie, 1997). Anthropomorphism is extensively discussed and sometimes narrowly defined (Servais, 2018). Researchers have attempted definitions of subsets of anthropomorphism (Arbilly & Lotem, 2017; Burghardt, 1985; Kennedy, 1992). Additionally, the application of human traits to animals brings into focus the question of what traits are ascribed uniquely to humans and the knowledge that in many cases the animal mind can only be approximated, not definitively determined (Bavidge & Ground, 1994). The terminology of emotive traits, for the purpose of this study, will only approach anthropomorphism in the most general sense and will include characteristics such as emotions, thoughts, and motivations (Davis, 1997). This includes but is not limited to subjective attributions and perceptions (Waytz, Cacioppo, & Epley, 2010a).

Cognition has also emerged as a relatively more popular topic among studies of the animal mind and is described in most studies as a mental state involving information-processing in the brain. Some cognitive processes are said to be conscious and are expressed as intentional behavior that can be modeled and can be replicated in animal-behavioral studies (Shettleworth, 2001; Urquiza-Haas & Kotrschal, 2015). Studies examining cognition in animals include those focusing on planned behavior such as tool use (Bentley-Condit & Smith, 2010), memory recognition (Lind, Enquist, & Ghirlanda, 2015), and skill learning (Brown & Laland, 2003). Across many studies it has been shown that animals that are more similar to humans (i.e., phylogenetically closer) are seen as having higher levels of cognitive abilities (Eddy et al., 1993; Howell et al., 2013), intelligence (Nakajima et al., 2002), mental states (Herzog & Galvin, 1997; Urquiza-Haas & Kotrschal, 2015), and tend to elicit more emotive attributions (Harrison & Hall, 2010).

While emotive and cognitive traits may be perceived in animals, the general use of anthropomorphism in scientific studies has been a point of contention. While many have published on affective states in animals with little to no criticism, others have faced more resistance. By and large, pejorative connotations are associated with anthropomorphism on the assumption that assigning human characteristics to animals will lead to incorrect behavioral motivations or attributions (Wynne, 2004). Postures toward the study of any trait that might be deemed anthropomorphic have thus been at times discouraged, especially those such as emotions and motivations. This is signaled by a heightened focus on studies featuring only objective and observable behavior (Dawkins, 2012; Gallant, 1981; McFarland, 1982; Shettleworth, 2009; Wynne, 2004). Conversely, the general public does not reflect these proscriptions and often anthropomorphizes animals, especially by applying emotions and motivations, or more emotive traits, onto animals (Bruni, Perconti, & Plebe, 2018). Indeed it is reported to be the most common way in which people describe animals and the basis people most often use to inform their understandings of and interactions with animals (Horowitz & Bekoff, 2015).

Given this tendency, it is often assumed that the general public too readily ascribes emotive traits to animals or misunderstands cognitive traits. For example, in one study, “simple thinking” (which included subjective measures such as emotion, play, and imagination) was more likely to be ascribed to animals than “complex thinking” (which included a variety of objective capabilities such as enumeration, sorting, memory, and foresight) (Rasmussen et al., 1993). A further study found that people were more likely to attribute emotions and thoughts to animals as compared to more complex processes (Gallup, Marino, & Eddy, 1997). Lastly, the capability to “experience” such things as pleasure, joy, or embarrassment was ranked higher than were intentional actions associated with “agency,” that is, a capacity for memory, planning, or

recognition (Gray et al., 2007). More recent work found that perceiving an animal as relatively similar to humans led to attributions of “sensation” (e.g., pain, pleasure, happiness) as opposed to “intellect” (e.g., thinking, imagining, planning) (Bastian et al., 2011). One study did, however, find that traits more conventionally associated with intelligence (e.g., belief in the presence of learning and communication in animals) were seen as more likely than those associated with conscious emotive qualities (e.g., behavior motivated by deception, empathy, or awareness of their environment or themselves) (Maust-Mohl et al., 2012).

While public perceptions of animals may influence human-animal interactions (Servais, 2018), the limited data and nonstandard nomenclature make it difficult to utilize the results in future work. Efforts to reclassify traits covering what we here refer to as animal cognition and emotive traits is warranted, particularly as some version of the perceived animal abilities that comprise these traits is evident in work thus far. This necessary work on perceptions enables three researchable questions: (i) Do people distinguish between these two trait classes in animals and if so, based on what ascribed criteria? That is, which animal capabilities define these traits? (ii) Does the perceived capability relate to the overall animal class or is there variation within and between classes (e.g., mammals as opposed to amphibians)? And (iii) Do people over-attribute one trait relative to the other(s) to some animals and not others? We predicted that people would distinguish between cognitive and emotive traits and a wide range of abilities would be present in each trait. We also predicted that individual species and classes of species “closer” to humans (i.e., mammals) would be perceived as having higher trait capability. Based on the aforementioned studies we also anticipated that people would ascribe emotive traits more than cognitive ones.

## **4.2 Methods**

### **4.2.1 Participants**

We conducted online surveys using Qualtrics (Qualtrics, LLC, 2005) to examine the public perceptions of wildlife species. Participants were recruited from Amazon Mechanical Turk (Mturk), a crowdsourcing platform that allows researchers to access a large population of participants. Participants gave informed consent before participating and were compensated US\$0.25 each for their participation. In total, 2342 eligible participants from the United States took part in the survey (1481 female, 847 male, 6 other, and 8 preferred not to answer; mean age of 37.0 (SD=12.3)). To ensure data quality, ineligible participants were removed if they selected the same numerical response for all questions, or took less than two minutes to complete the survey, or responded to the qualitative questions with copied, robotic, or unintelligible responses. This work was given ethical approval by the University of British Columbia (UBC) Behavioral Research Ethics Board (ethics certificate number H16-01907).

### **4.2.2 Survey design & procedure**

The survey included 36 different wildlife species with varying sizes, diets, and colors (see Table 4.1). We tried to ensure that the animals selected represented a range of different geographic locations due to the wide-ranging geographic potential of Mturk. Additionally, we included species with both positive and negative associations. For example, in general people have been shown to have negative attitudes toward snakes (Özel, Prokop, & Uşak, 2009), but have higher positive attitudes towards turtles or even lizards (Batt, 2009; Hartel, Carlton, & Prokopy, 2015). Overall, six different classes were included: amphibians, birds, fish, invertebrates, mammals, and reptiles (Table 4.1). The species were chosen because each had been featured in past studies and had demonstrated a capability for at least one of the items

included in the survey. For example, Nile crocodiles have a “cognitive map” of valued nest areas from years past, indicating long-term memory (Combrink, Warner, & Downs, 2017); the giant moray eel cooperates with the grouper to hunt (Bshary, Hohner, Ait-el-Djoudi, & Fricke, 2006); and the New Caledonian crow can use tools and solve problems that include multiple steps (Taylor, Hunt, Holzhaider, & Gray, 2007).

**Table 4.1 Focal species with their scientific name and class**

Common name	Scientific name	Class
Alpine Newt	<i>Ichthyosaura alpestris</i>	Amphibian
Australian Green Tree Frog	<i>Litoria caerulea</i>	Amphibian
Blue Poison Dart Frog	<i>Dendrobates tinctorius</i> "azureus"	Amphibian
Fire Salamander	<i>Salamandra salamandra</i>	Amphibian
Fire-bellied Toad	<i>Bombina bombina</i>	Amphibian
Tungara Frog	<i>Engystomops pustulosus</i>	Amphibian
African Gray Parrot	<i>Psittacus erithacus</i>	Bird
Burrowing Owl	<i>Athene cunicularia</i>	Bird
Egyptian Vulture	<i>Neophron percnopterus</i>	Bird
Mute Swan	<i>Cygnus olor</i>	Bird
New Caledonian Crow	<i>Corvus moneduloides</i>	Bird
Ruby Throated Hummingbird	<i>Archilochus colubris</i>	Bird
Banded Archerfish	<i>Toxotes jaculatrix</i>	Fish
Coho Salmon	<i>Oncorhynchus kisutch</i>	Fish
Coral Grouper	<i>Epinephelus corallicola</i>	Fish
Giant Manta Ray	<i>Manta birostris</i>	Fish
Giant Moray Eel	<i>Gymnothorax javanicus</i>	Fish
Great White Shark	<i>Carcharodon carcharias</i>	Fish
Common Octopus	<i>Octopus vulgaris</i>	Invertebrate
Earthworm	<i>Lumbricus terrestris</i>	Invertebrate
Fiddler Crab	<i>Uca pugilator</i>	Invertebrate
Leaf-cutter Ant	<i>Atta cephalotes</i>	Invertebrate
Paperwasp	<i>Polistes humilis</i>	Invertebrate
Western Honey Bee	<i>Apis mellifera</i>	Invertebrate
African Elephant	<i>Loxodonta africana</i>	Mammal
Amur Tiger	<i>Panthera tigris altaica</i>	Mammal
Bottlenose Dolphin	<i>Tursiops truncatus</i>	Mammal
Fruit Bat	<i>Pteropus rodricensis</i>	Mammal
Gray Wolf	<i>Canis lupus</i>	Mammal
Meerkat	<i>Suricata suricatta</i>	Mammal
Eastern Fence Lizard	<i>Sceloporus undulatus</i>	Reptile

Green Iguana	<i>Iguana iguana</i>	Reptile
Green Sea Turtle	<i>Chelonia mydas</i>	Reptile
Komodo Dragon	<i>Varanus komodoensis</i>	Reptile
Nile Crocodile	<i>Crocodylus niloticus</i>	Reptile
Plains Garter Snake	<i>Thamnophis radix</i>	Reptile

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The survey started with the presentation of a picture of a randomly selected species on a white background along with its common name (e.g., Gray Wolf). Each participant saw only one randomly assigned species and each of the 36 different species was assigned to 100 participants (though some participants were later removed as ineligible). Participants were asked to rate the capability of the animal on 40 different traits on an 11-point Likert scale ranging from not at all capable (0) to extremely capable (10). The 40 questions were presented in a random order for each participant. The survey closed with a set of demographic questions including participant age, self-reported knowledge, gender, whether or not participants were members of a conservation organization and whether or not they had visited a zoo or aquarium in the last year. The questions were designed to encompass a large range of potential cognitive and emotive abilities (see the full survey in Appendix D). To standardize the terminology, we defined emotive traits as subjective experiential states that an animal may be perceived as having. By this we mean those states in which hedonic valence is involved, not ones that are simply basic sensory experiences. Such traits tend to be emotion-based at their core and replication may be more difficult because different human individuals may ascribe different descriptions based on variations in culture, language, and background. For example, while one observer may ascribe the emotion of jealousy to an animal, other observers may see it as aggression, sadness, or anger. Examples of emotive traits would include grief, guilt, and imagination among others. We defined cognitive traits as intellectual and problem solving behaviors (e.g., opening a jar to retrieve

food), especially that which is inherent in strict scientific protocols. They are less dependent on human interpretations and are designed to probe depths of such characteristics as memory, problem solving, and learning.

The 40 traits were selected based on a literature review regarding animal behavior. Different indicators of mental states in animals were identified as capabilities that had been evaluated in regard to animals and that could fit under the broadest definitions of emotive or cognitive traits. We found some general themes such as emotions, problem solving/decision making, reflection, perceptions of other, communication, and altruism, and created questions that focused on specific aspects of each theme in order to get more nuanced distinctions between potential traits. For example, for problem solving/decision making, we included questions regarding tool use, imparting and receiving knowledge, and problem solving through trial and error and through learning, among others. Similarly, for questions regarding emotion, we included secondary emotions (e.g., guilt, remorse), and generally avoided primary emotions (e.g., fear, anger) (Panksepp, 2005) as primary emotions are believed to exist in all vertebrates (Panksepp & Biven, 2012). Furthermore primary emotions are often linked to instinctual behaviors and are ascribed more often than secondary emotions (Wilkins, McCrae, & McBride, 2015). Examples of questions included: Do you see these animals as capable of experiencing jealousy? Capable of helping other members of their own species? Capable of solving problems through trial and error? (A complete version of the survey is provided in Appendix D). Overall, we wanted to ensure we covered as many capabilities as possible in order to identify distinctions that were perceived among traits, and thus included animal capabilities that were not as commonly found in other studies on human perceptions such as play, communication, and perception of others, among others.

### **4.2.3 Data analysis**

Data analysis began with an exploratory factor analysis, using data pooled per question from all of the different species. This included 40 capability items, measuring degrees of perceived capability based on the aforementioned 11-point Likert scale. This analysis included an examination of the variance of the factors as well as a principal components factor analysis to determine the number of factors. Based on the results we conducted a maximum likelihood factor analysis with orthogonal rotation (varimax) retaining two factors. We used a factor loading threshold of 0.6 when assigning the survey items to the two factors, excluding those items which did not load at or above 0.6 on either factor. We calculated Cronbach's alpha for each factor as a test for internal consistency. All statistical analyses were conducted using the statistical software R, version 3.4.1.

To examine whether there were significant differences among the animal classes in perceived capability for emotive and cognitive traits we ran one-way ANOVAs. We then conducted Tukey HSD post-hoc tests for pairwise comparisons of the classes. Finally, to examine our demographic data, we used a multiple regression predicting emotive traits and cognitive traits from participant age (centered), knowledge (centered), gender (reference group=female), conservation membership (whether participants were members of a conservation organization) (reference group=no), and zoo/aquarium visits (whether or not they had visited a zoo or aquarium in the last year) (reference group=no).

## **4.3 Results**

To examine our first question about whether people distinguish between two trait classes and on what ascribed criteria, we first ran a parallel analysis (Zwick & Velicer, 1986) where the scree plot suggested either two or three factors. To determine the number of factors, we then ran



a maximum likelihood factor analysis with varimax rotation (Costello & Osborne, 2005). The two-factor model explained 53% of the variance, while the three-factor model explained 55% of the variance. However, in the three-factor model the Eigen values leveled off after two factors (the third factor was just over 1). Moreover, there were not enough item loadings on the third factor, leading to difficulty with interpretations. For this reason, we decided to use a two-factor model. The results are depicted below in Table 4.2. We labeled the two factors “Cognitive traits” (eigenvalue = 2.49) and “Emotive traits” (eigenvalue= 19.44). Cognitive traits, as a class of individual capabilities, was characterized by 12 items. These illustrate cognitive capabilities which include such things as problem solving in general and problem solving involving multiple steps, general intelligence (e.g., perceived as intelligent), and social intelligence (e.g., learning by imitating other members of their own species, helping members of their own species, demonstrating problem solving techniques to other animals). The factor labeled emotive traits included 8 capabilities, each of which referenced relatively more subjective qualities about that species or ways in which that species is said to conceive of other species. These included ascribed capabilities such as complex emotions (e.g., shame, remorse), creative or imaginative processes (e.g., appreciating art), and understanding the emotions of other species (e.g., understanding how members of another species feel). Cronbach’s alpha was high for both cognitive and emotive traits (0.91 and 0.94 respectively), which indicates high internal consistency (see again Table 4.2). Overall, items which referred to interactions with and perceptions of other species (separate from the animal’s own species) loaded only onto the emotive traits, whereas items referring to interactions with and perceptions of the same species loaded only onto the cognitive traits. Of the 40 items, half (20 items) did not load onto either factor or provide a basis for any new factor. This was expected given the broad nature of the

selections for the potential animal capabilities and the relatively more limited awareness of the general public about many of those capabilities.

**Table 4.2 Factor loadings of perceived capabilities of animals**

Capability	Factor	
	Emotive Traits	Cognitive Traits
Guilt	<b>0.85</b>	0.2
Shame	<b>0.84</b>	0.2
Embarrassment	<b>0.84</b>	0.17
Remorse	<b>0.81</b>	0.26
Imagination	<b>0.72</b>	0.35
Appreciating Art	<b>0.7</b>	0.15
Understanding how other members of a different species feel	<b>0.69</b>	0.36
Pride	<b>0.68</b>	0.36
Jealousy	<b>0.66</b>	0.38
Concern for the wellbeing of members of a different species	<b>0.64</b>	0.43
Grief	<b>0.62</b>	0.49
Helping members of their own species	0.27	<b>0.71</b>
Intelligence	0.38	<b>0.7</b>
Problem solving through trial and error	0.27	<b>0.7</b>
Solving a problem with multiple stems	0.37	<b>0.68</b>
Solving problems through imitating the same species	0.23	<b>0.68</b>
Cooperating with other individuals	0.28	<b>0.66</b>
Concern for wellbeing of members of their own species	0.44	<b>0.64</b>
Remembering information in the long term	0.35	<b>0.63</b>
Demonstrating problem solving techniques	0.45	<b>0.61</b>
Proportion variance	0.27	0.25
Cumulative variance	0.27	0.53
Cronbach's alpha	0.94	0.91

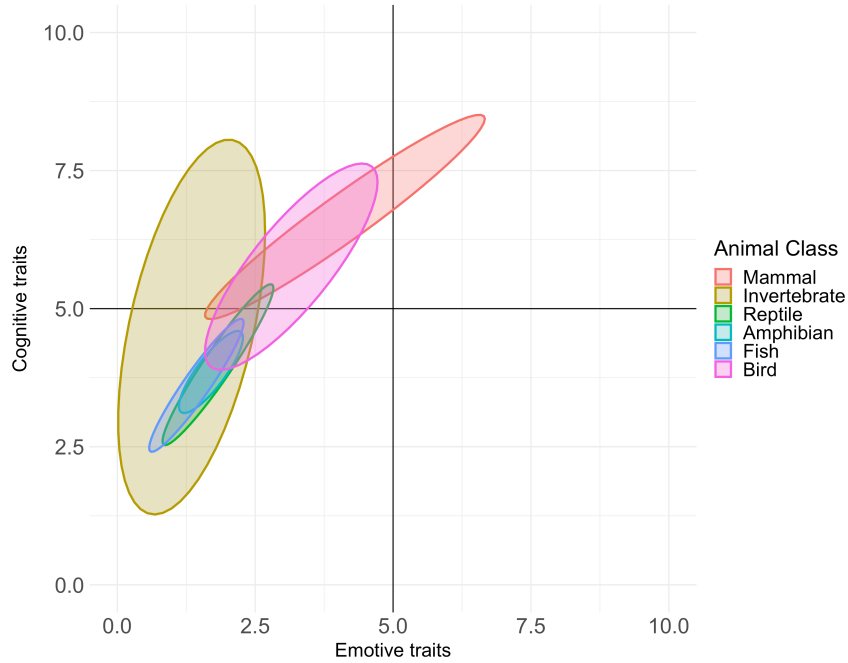
To answer our second question regarding whether perceived capability relates to the overall animal class, we plotted the species on a graph comparing the perceived capability of the emotive traits by the perceived capability of the cognitive traits (Figure 4.1). One-way ANOVAs for cognitive traits showed significant differences by class ( $F(5, 2336)=125.2, p<0.001, \eta_p^2=.21$ ). Tukey HSD tests revealed that mammals ( $M=6.83, SD=2.07$ ) were higher than birds ( $M=5.81, SD=2.27; p<0.001$ ), amphibians ( $M=3.87, SD=2.35; p<0.001$ ), fish ( $M=3.60, SD=2.31; p<0.001$ ), reptiles ( $M=3.93, SD=2.28; p<0.001$ ), and invertebrates ( $M=4.75, SD=2.53; p<0.001$ ). Birds were higher than amphibians ( $p<0.001$ ), fish ( $p<0.001$ ), reptiles ( $p<0.001$ ), and invertebrates ( $p<0.001$ ). Invertebrates were higher than amphibians ( $p<0.001$ ), fish ( $p<0.001$ ), and reptiles ( $p<0.001$ ). Amphibians had the same effect on perceived cognitive capability as fish ( $p=0.55$ ) and reptiles ( $p=0.99$ ). Fish had the same effect as reptiles ( $p=0.33$ ). Table 4.3 indicates these differences.

**Table 4.3 Tukey HSD pairwise comparisons of animal classes for cognitive traits**

	Mean	Mammals	Birds	Invertebrates	Reptiles	Amphibians	Fish
Mammals	6.83 <sup>1</sup>	-	0.001***	0.001***	0.001***	0.001***	0.001***
Birds	5.81 <sup>2</sup>	0.001***	-	0.001***	0.001***	0.001***	0.001***
Invertebrates	4.75 <sup>3</sup>	0.001***	0.001***	-	0.001***	0.001***	0.001***
Reptiles	3.93 <sup>4</sup>	0.001***	0.001***	0.001***	-	0.99	0.33
Amphibians	3.87 <sup>5</sup>	0.001***	0.001***	0.001***	0.99	-	0.55
Fish	3.60 <sup>6</sup>	0.001***	0.001***	0.001***	0.33	0.55	-

<sup>1</sup>SD= 2.07; <sup>2</sup>SD= 2.27; <sup>3</sup>SD= 2.53; <sup>4</sup>SD= 2.28; <sup>5</sup>SD= 2.35; <sup>6</sup>SD=2.31

*Note: Animal classes are listed on the x- and y-axis and p-values are indicated for each comparison of class with asterisks denoting significance. Mean values of each class are included.*



**Figure 4.1 Cognitive and emotive traits by animal class.** Ellipses demonstrating 90% confidence intervals of the species in each animal class where the x-axis values are perceived capability of emotive traits and y-axis values are perceived capability of cognitive traits.

One-way ANOVAs for emotive traits showed significant differences by class ( $F(5, 2336)=138, p<0.001, \eta_p^2=0.23$ ). Tukey HSD tests revealed that mammals ( $M=4.29, SD=2.36$ ) were higher than birds ( $M=3.20, SD=2.24; p<0.001$ ), amphibians ( $M=1.70, SD=1.92; p<0.001$ ), fish ( $M=1.43, SD=1.79; p<0.001$ ), reptiles ( $M=1.79, SD=1.90; p<0.001$ ), and invertebrates ( $M=1.41, SD=1.65; p<0.001$ ). Birds were higher than amphibians ( $p<0.001$ ), fish ( $p<0.001$ ), reptiles ( $p<0.001$ ), and invertebrates ( $p<0.001$ ). Amphibians had the same effect on perceived emotive capability as fish ( $p=0.37$ ), reptiles ( $p=0.99$ ), and invertebrates ( $p=0.33$ ). Fish had the same effect as reptiles ( $p=0.12$ ) and invertebrates ( $p=0.99$ ). Reptiles had the same effect as invertebrates ( $p=0.11$ ). Table 4.4 indicates these differences.

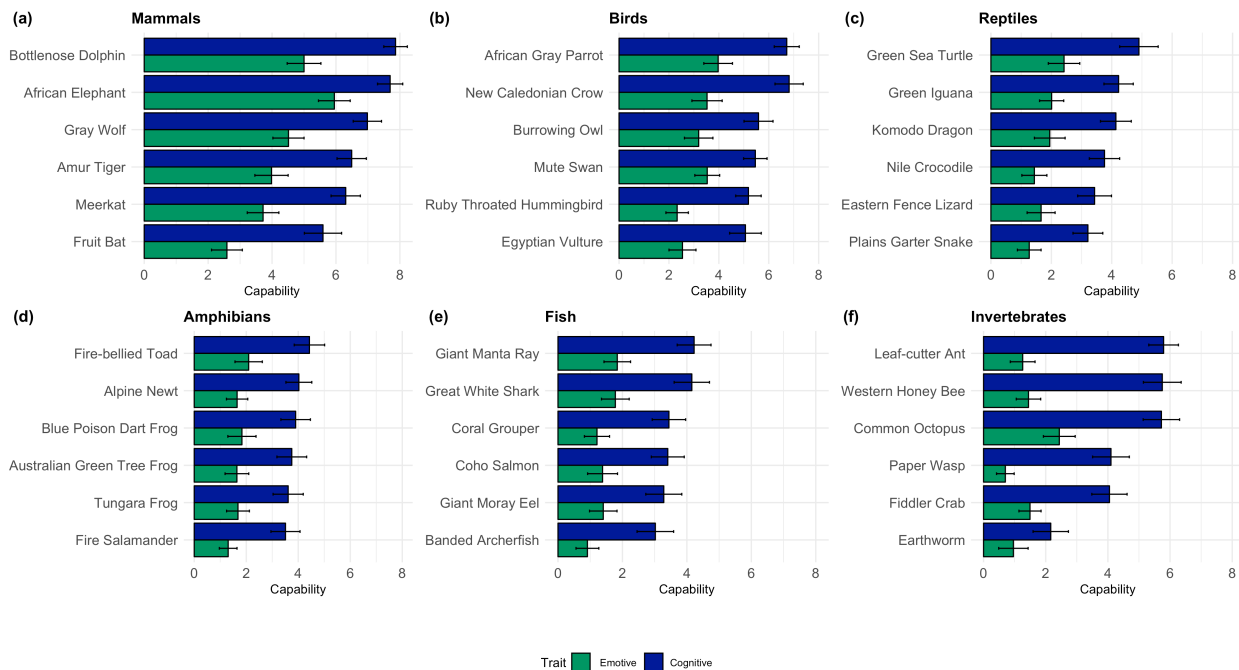
**Table 4.4 Tukey HSD pairwise comparisons of animal classes for emotive traits**

	Mean	Mammals	Birds	Invertebrates	Reptiles	Amphibians	Fish
Mammals	4.29 <sup>1</sup>	-	0.001***	0.001***	0.001***	0.001***	0.001***
Birds	3.20 <sup>2</sup>	0.001***	-	0.001***	0.001***	0.001***	0.001***
Invertebrates	1.41 <sup>3</sup>	0.001***	0.001***	-	0.11	0.33	0.99
Reptiles	1.79 <sup>4</sup>	0.001***	0.001***	0.11	-	0.99	0.12
Amphibians	1.70 <sup>5</sup>	0.001***	0.001***	0.33	0.99	-	0.37
Fish	1.43 <sup>6</sup>	0.001***	0.001***	0.99	0.12	0.37	-

<sup>1</sup>SD= 2.36; <sup>2</sup>SD= 2.24; <sup>3</sup>SD= 1.65; <sup>4</sup>SD= 1.90; <sup>5</sup>SD= 1.92; <sup>6</sup>SD=1.79

*Note: Animal classes are listed on the x- and y-axis and p-values are indicated for each comparison of class with asterisks denoting significance. Mean values of each class are included.*

To answer our third question as to whether or not one trait is over-ascribed in comparison to the others, we grouped the factor scores for each species and ran a paired t-test to determine significant differences between the two factors. We found that counter to our prediction, people perceive that animals have significantly higher levels of cognitive capabilities compared with emotive traits in all species ( $t(35)=22.46, p<0.0001, d=1.86$ ) (Figure 4.2). Tests of individual species also verified that people perceived significantly higher levels of cognitive traits compared to emotive traits in all species ( $p<0.05$ ).



**Figure 4.2 Mean perceived capabilities for different species.** Bar graphs of the mean perceived capability (n=2342) for each species in (a) mammals, (b) birds, (c) reptiles, (d) amphibians, (e) fish, and (f) invertebrates. Emotive traits are in green and cognitive traits are in blue with 95% Confidence intervals shown.

We also examined how demographic variables of our participants predicted these traits, including gender, age, self-reported knowledge (measured by a 7-point Likert scale from not at all knowledgeable about wildlife (0) to very knowledgeable (7)), conservation organization membership, and zoo and aquarium visits within the last year (Table 4.5). Variables that negatively predicted cognitive traits were age ( $p=0.003$ ) and male gender ( $p<0.001$ ). Given that age was centered, this means that after the mean age (37.0), ascription of cognitive traits decreased 0.01 per year of age and before the mean age ascription of cognitive traits increased 0.01 per year of age. Additionally, males scored cognitive traits in animals -0.57 lower than females. Surprisingly zoo and aquarium visits also negatively predicted cognitive traits ( $p=0.02$ ). Variables that positively predicted cognitive traits were knowledge ( $p<0.001$ ) and conservation organization membership ( $p=0.001$ ).

**Table 4.5 Multilevel regression models of demographic data using cognitive traits and emotive traits as the dependent variables.**

	Cognitive Traits				Emotive Traits			
	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Gender	-0.57	0.11	-5.12	<0.001	-0.2	0.1	-2.09	0.04
Age	-0.01	0.004	-2.93	0.003	-0.02	0.004	-5.9	<0.001
Knowledge	0.25	0.04	5.86	<0.001	0.18	0.04	4.78	<0.001
Zoo/Aquarium	-0.26	0.11	-2.39	0.017	-0.06	0.1	-0.71	0.48
Membership	0.43	0.13	3.36	<0.001	0.32	0.11	2.85	<0.001
Multiple R <sup>2</sup>	0.039				0.034			
Adjusted R <sup>2</sup>	0.036				0.032			

*Note.* Zoo/Aquarium=Zoo/Aquarium visits in the last year. Membership=Conservation organization membership.

The variables that negatively predicted emotive traits were age ( $p<0.001$ ) and male gender ( $p=0.03$ ). Variables that positively predicted emotive traits were self-reported knowledge of wildlife ( $p<0.001$ ) and conservation organization membership ( $p=0.006$ ). Zoo and aquarium visits ( $p=0.43$ ) were not a significant predictor (see Table 4.5, also Figure A.1.).

#### 4.4 Discussion

While studies of people's perceptions of animals often focus on understanding perceptions of animal mind as a whole (Maust-Mohl et al., 2012; Waytz et al., 2010b), we found that people do distinguish between general emotive and cognitive traits, and that such distinctions are multi-faceted and internally consistent. One explanation for this distinction may relate to the fact that many humans have long believed there exists separate dimensions within their own brains that, given their distinct natures, are often in opposition to one another. These are loosely referred to as cognition and emotion (Dolan, 2002). Despite this perception, psychological science is increasingly demonstrating the interrelatedness of these two seemingly disparate processes and how they are much more closely linked than previously thought (Dolcos, Jordan, & Dolcos, 2011; Schwarz, 2000).

The classification was also consistent with the re-categorization we predicted into emotive traits and cognitive traits. Interestingly, however, cognitive traits tended to be ascribed only to same-species interactions and relationships, whereas emotive traits included those ascribed to inter-species relations as well. This may be due to the fact that people are more likely to witness interactions between two members of the same species as compared with different species, especially in wild animals. Thus, participants may have felt it possible to more conclusively identify communication and care between two members of the same species as opposed to members of a different species. Additional study into this finding would be beneficial.

Our evaluation as to which specific animal capabilities were ascribed to each of the two traits revealed active use of 20 of our 40 capabilities loaded onto the two constructs. This may be explained by the fact that we included a broad range of capabilities that various scientific studies have attributed to animals such as object permanence, self-awareness, and communication. However, the public may not as readily see such entities as part of animal capabilities. Previously, many of these capabilities had been included under cognition, as studies have been able to demonstrate and replicate facets of them, such as with the mirror-test indicating self-awareness (Gallup, 1970; Prior et al., 2008) and search tests indicating awareness of object permanence, an understanding that objects remain in place even when they cannot be seen (Mendes & Huber, 2004). However, the public may not be as aware that these capabilities have been seen in animals. Indeed one study showed people did not believe self-awareness had been tested in animals (Maust-Mohl et al., 2012).

We did find a general relationship between the “closeness” of species to humans and the perceived capability. Mammals ranked the highest in both emotive and cognitive capabilities,



followed by birds. Then reptiles, amphibians, and fish followed, though with little difference between them. This order generally echoes findings from previous studies regarding preferences of species (Batt, 2009; Driscoll, 1995; Moss & Esson, 2010; Tisdell et al., 2006). Thus, there does appear to be a link between preference and perception of traits. People generally prefer and view as more capable those animals which have a phylogenetic similarity to humans (Eddy et al., 1993; Nakajima et al., 2002), and this was echoed in our results.

It is important to note that this particular public perception does not always correlate with actual findings of capabilities of animals. Indeed, studies of parrots and corvids have found that they have the same cognitive skills as primates across a variety of different tests (Güntürkün & Bugnyar, 2016). While not as much work has been done with reptiles and amphibians, there are calls for increased study of those classes as they have been shown to engage in behaviors and mental processes previously thought to be found only in humans and later only in mammals (Burghardt, 2013).

While we did find differences between classes with a large effect size, it should also be noted that there was a high error variance. Animal class alone was thus not the only driver of people's perceptions about the animal, but instead many factors influence perception. For example, it is also useful to note that the "proximity to humans" effect is less predictable in other ways. Notably, mammals, birds, reptiles, amphibians, and fish followed a more predictable pattern, yet a wide range of perceived capabilities was visible in the class invertebrates. In general, cognitive traits were ranked higher in relation to emotive traits than in other classes, indeed invertebrates ranked higher in cognitive capability than all but mammals and birds. This could be due in part to the diversity within our group of tested "invertebrates." While we sought diversity in every class, invertebrates encompass vastly more species than any of the other

classes. There are an estimated 1.2 million species worldwide that have been identified, and likely many more that have not been and the vast majority (around 98%) of these are invertebrates (Mora, Tittensor, Adl, Simpson, & Worm, 2011). For comparison, there are thought to be less than 6,500 extant mammal species (Burgin, Colella, Kahn, & Upham, 2018) and only around 18,000 bird species (Barrowclough, Cracraft, Klicka, & Zink, 2016).

Additionally, it is likely that increased awareness may have played a role in the higher ascription of the capability of traits to some invertebrates. In the case of the common octopus (*Octopus vulgaris*) for example, octopus intelligence and affect are increasingly being explored and disseminated in forms more accessible to a general public audience, such as newspaper articles and popular non-fiction books (e.g., Godfrey-Smith, 2016; Montgomery, 2015).

Our finding that women ascribe higher cognitive and emotive capability to animals was also found in previous studies which have shown women generally are more empathetic towards animals and more willing to ascribe traits to animals overall (Herzog & Galvin, 1997; Hills, 2015). Our finding that conservation organization membership positively predicted cognitive and emotive capability was echoed in prior studies as people who are members of conservation organizations generally have more positive attitudes and concern towards animals than those who are not members (Falk & Adelman, 2003; Williams et al., 2002). Similarly, it has been shown that young age influences higher belief in animal mind (Kupsala et al., 2016) and our findings echoed this with age negatively predicting cognitive and emotive capabilities. Lastly, higher education levels are correlated with higher beliefs in animal mind (Maust-Mohl et al., 2012); somewhat consistently we found that self-reported knowledge positively predicted cognitive and emotive capabilities. Interestingly, zoo and aquarium visits did not predict emotive capability, and such visitors also expressed a comparatively negative or lesser ascription of

cognitive capability. One study did find that zoo visitors perceived zoo animals as “passive” or “tame” while wild animals were seen as “free” and “active” (Finlay, James, & Maple, 1988). If participants perceived the animals in a zoo environment as passive and tame, then they might subsequently perceive these animals as less cognitively capable. Additionally, other studies have noted that the zoo exhibits can alter visitors’ perceptions of zoo animals (Godinez & Fernandez, 2019). This may also influence people’s perceptions of the cognitive abilities of these animals. For example, if animals are routinely seen in cages, that image may elicit the perception that they are dominated by or inferior to their human counterparts.

A particularly surprising finding and counter to our hypothesis was that across all species surveyed, people were significantly more likely to ascribe cognitive traits to animals than emotive traits. Previous studies indicated that people tended to more readily ascribe emotions to animals (Gallup et al., 1997; Rasmussen et al., 1993) and this had led to claims that anthropomorphism especially as it pertained to assigning animals feelings and emotions, should not be used in scientific study in part because it is over-applied (Wynne, 2004). This study shows that traits such as feelings and emotions are not ascribed by the general public more than cognitive traits. Thus, the current findings are important as they give us a more complete understanding of the perceptions of the animal mind. While anthropomorphism may remain a pejorative attribution in the sciences, such positions have been found to positively influence people’s relationships with animals. Specifically, increasing anthropomorphism increases the recognition of animal mind (Bastian et al., 2011). Given this, the awareness of emotional and cognitive capabilities in animals can also be used effectively in conservation campaigns (Chan, 2012; Root-Bernstein, Douglas, Smith, & Veríssimo, 2013).

In addition, this finding that people are more willing to ascribe cognitive traits than emotive may counter justifications that are offered for focusing on evidence for cognition in animals, specifically that there is a lack of public belief in animal cognition. Rather, the assumption that people over-ascribe emotive traits to animals as compared to cognitive traits appears over-stated. This may relate to a desire for people to believe those traits are instead “reserved” or “restricted” to humans. Indeed, most people still maintain a belief that there is a difference between human and animal minds (Penn, Holyoak, & Povinelli, 2008). Throughout history, some humans have considered themselves to be apart from animals and they consciously or unconsciously sought ways to remain differentiated from animals. This is not to say this is the only way in which humans have viewed themselves, indeed there has been debate ranging from Descartes to Voltaire to Kant that have continued into the current era (Fraser, 2013; Harwood, 1928). Many of these distinctions between humans and animals have since been refuted to the extent that the scientific community recognizes that humans are not the only species to be able to use tools (Bentley-Condit & Smith, 2010), possess language (Kako, 1999), or display emotions such as grief (King, 2013).

Given our strong finding regarding the willingness to ascribe cognitive traits to animals, it may be useful to further explore the effectiveness of utilizing cognitive traits in conservation campaigns. Instead of focusing on promoting “cute and cuddly” animals (Small, 2012), or attempting to create an emotional response with the animal (Kollmuss & Agyeman, 2010) as is often done, it might be equally or more effective to focus on ways in which the animals exhibit cognitive abilities. Our finding of people’s affinity for and willingness to ascribe cognitive capabilities may open new avenues of understanding between humans and non-human animals.

Inexorable pressure placed on wildlife habitat by increasing human populations and activity has vastly changed the need to understand interactions between humans and wildlife in general and thus might aid conservation. We found that people not only perceive mental states in animals, but perceive differences between those states. Specifically, we found that the public recognizes the cognitive capabilities of wildlife more strongly than the emotive capabilities. This was contrary to our initial prediction and in part refutes the presumption that the ascription of emotive traits such as feelings and emotions is widespread and problematic. This new finding suggests that much can still be learned about public perception and that there is room for fresh and imaginative approaches to conservation-based pursuits. As humans and wildlife increasingly share space and resources, conservation-based research must have a clear idea of perceptual factors that may inform conservation donations, policy decisions and perhaps ultimately, and longer-term, lay the groundwork for new schools of thought on human-animal interaction and offer commensurate guidance for the benefit of both groups.

## Chapter 5: Using the Phylo Card Game to Advance Biodiversity Conservation in an Era of Pokémon

*“I just hope they walk away with an increased appreciation for all life. Whether it’s jellies or larval fish. Walk away with a new appreciation or a new love for it. Because people can’t help or conserve what they don’t know or love.”*

—Aquarium trainer #10 (2018)

### 5.1 Introduction

Current and ongoing news and research regarding biodiversity loss, local extirpations, and extinctions of wildlife species and populations have indicated that we now live amid an Anthropocene defaunation (Dirzo et al., 2014). Human actions involving land-use and climate change effects are reshaping biodiversity and causing homogenization of biological communities (Brodie, 2016; Frishkoff et al., 2014; Karp et al., 2018). Indeed, recent reports indicate that species extinction rates are dramatically increasing, and ecosystems are suffering due to human activities (IPBES, 2019). As serious as these problems are however, humans can also be part of the solution (Clayton et al., 2013). This is underscored by the significant attention now paid to engagement and education that contrasts with more pessimistic narratives which can lead to feelings of hopelessness (McKinley, 2008). Conservationists are consistently seeking new tools with which to motivate public knowledge and action, including media-driven games and movies, which can convey powerful messages and inspire action (Silk et al., 2017).

Another primary explanation for the current ecological crisis is incomplete knowledge and inadequate awareness of environmental problems, as a function of disconnection from local biodiversity (Kollmuss & Agyeman, 2010). Affiliation with nature has been shown to be associated with improved mood, increased physical health, and enhanced cognitive performance in humans (Barton, Bragg, Wood, & Pretty, 2016; Bratman, Hamilton, & Daily, 2012; Hull &

Michael, 1995). However, despite this demonstrated vital connection, people, and notably children, are spending less time in nature and instead are occupied by other, more indoor-based pursuits (Louv, 2008). Soga and Gaston (2016) refer to this phenomenon as the “extinction of experience.” It is postulated that urbanization has led to an increased alienation from and a decreased focus on natural ecosystems and biodiversity (Turner, Nakamura, & Dinetti, 2004). This decreasing awareness of nature is starkly evident in a study of schoolchildren in the United Kingdom which found that children could name significantly more Pokémon characters than they could local species (Balmford, Clegg, Coulson, & Taylor, 2002).

In response, one key avenue linked to behavior change is education, or what is known as “ecoliteracy,” improved understanding of natural systems (Fletcher, 2017). Ecoliteracy has led to an increased desire for sustainability and motivation to solve current environmental issues (McBride et al., 2013), including beneficial actions regarding biodiversity conservation.

Hubs of innovation for this purpose have included visual arts (Curtis et al., 2014), television (Dingwall & Aldridge, 2016), movies (Balmford et al., 2004), apps (Verma et al., 2015), as well as games (Fletcher, 2017). The argument, following Curtis et al. (2014), is that different forms of arts can influence environmental behavior through communicating information, creating empathy for the environment, and engaging in ecologically sustainable development. Millions of viewers see wildlife programs, for example, on television and in movies (Dingwall & Aldridge, 2016). Visual depictions of species increases interest and concern for those species (Smith & Sutton, 2008) and movies have the potential to influence people’s perceptions towards endangered species (e.g., Spix’s Macaw with the movie *Rio*) (Silk et al., 2017). Similarly, social media may be useful for understanding conservation behavior (Hausmann et al., 2017) and influencing knowledge about conservation (Papworth et al., 2015).

However, the rich visual information that media offers is still a passive form of communication and while it is consuming, it is not engaging. Little is known about more active forms such as games, that may promote biodiversity conservation or change people's perceptions of biodiversity. Research does indicate promise in that studies have suggested that people prefer games over other forms of education (Garris, Ahlers, & Driskell, 2016) and that games utilize experiential learning, an often more effective pedagogical tool than traditional didactic learning (Sandbrook, Adams, & Monteferri, 2014). It is notable however that while most studies have focused on digital games (Fletcher, 2017), many do acknowledge the large quantity of players invested in collectable trading card games and their potential for ecological knowledge acquisition (Turkay et al., 2012; Fletcher, 2017).

One such trading card entity, the Phylo Trading Card Game (referred to as the Phylo game in this paper) has potential for investigating influence on knowledge and perceptions. It was designed in reaction to the aforementioned popularity of Pokémon, utilizes various cards featuring flora and fauna, and is a competitive two-player game focused on building ecosystems from a deck of cards (Ng, 2015). Since it is open platform in design, decks and cards are easily available (e.g., as free print-your-own formats and non-revenue generating purchasable decks) and many have been subsequently created including species from various geographical locations (e.g., Colombian Andean ecosystem, British Columbian Bryophyte, Danish Ice Age). Decks have been hosted by organizations such as museums and academic institutions focused on biodiversity and other STEM concepts (e.g., the Women in Science and Engineering deck) (Jones, 2018). A continual stream of new decks continues to be produced worldwide (<http://phylogame.org>) and thus provides a unique opportunity to explore an educational tool that has unlimited and global potential for raising awareness of biodiversity.



Given this potential, our objective here was to investigate whether the Phylo game is effective, and whether it positively impacts people's knowledge of species and ecosystems, as well as their attitudes and behaviors toward ecosystem or species conservation. Five research questions guided our work: (i) Does Phylo change people's dispositions (e.g., negative or positive) toward species, ecological perceptions (e.g., species' relationships to other ecosystem components), or economic perceptions (e.g., relative value of species)?, (ii) Does Phylo increase ecological knowledge about species (e.g. their diet or habitat)?, (iii) Do participants experience more positive affect (related to personal emotions) when playing Phylo vs. when learning information via a more traditional way (e.g., lecture-style slideshow)?, (iv) Does Phylo impact conservation donation behavior?, and (v) Does Phylo increase people's recall or memory retention of species over and above those listed in a pre- and post-intervention survey? We predicted that Phylo had the potential to increase positive ecological perceptions of and positive dispositions for species, ecological knowledge of species, donation behavior toward endangered species and negative environmental events, positive affect, and memory of species.

## **5.2 Methods**

We used a before-and-after-control-impact design in a laboratory setting between March and November 2017 to examine how people's perceptions and knowledge of species and their subsequent donation behavior changed after playing the Phylo game. To do so, we designed an experiment with three conditions: *Phylo*, *Slideshow*, and *Projects* to which participants were assigned randomly. The *Phylo* condition referred to those participants who played the Phylo game in pairs. The *Slideshow* condition was designed to be an information control and referred to a more traditional form of learning, in the form of a PowerPoint lecture. The other control was

the *Projects* condition and was used as a game control where paired participants actively played a similar game, but one that did not focus on biodiversity conservation.

### 5.2.1 Participants

To determine the sample size, we conducted an *a priori* power analysis using Power and Sample Size (<http://powerandsamplesize.com>). Our power analysis was calculated with the following parameters: probability of a no event-event ( $P_{01}$ )=0.4, probability of event-not event ( $P_{10}$ )=0.6, alpha=0.05, power=0.8, three between-subject groups, and two within-subject groups. According to the power analysis we needed a minimum of 194 participants in total to detect differences across conditions and determined that a sample size of at least 68 participants per condition would be sufficient. Based on this number we designed our experiment.

Overall we recruited 209 participants, both graduate and undergraduate students from the University of British Columbia (UBC) (123 female, 83 male, 2 other, 1 preferred not to answer; mean age(SD)=21.6(4.8)). The students were predominantly recruited through the Human Subject Pool (HSP) in the Department of Psychology and completed the study in exchange for course credit. Additional students were recruited through other departmental listservs (e.g. Zoology, Earth and Ocean Sciences, Forestry).

Participants were run in pairs by a researcher and each pair was randomly assigned to one of three conditions prior to their arrival to the lab: the Phylo condition (n=70 people, n=35 pairs), where participants played the Phylo game using the Beaty Biodiversity Museum Deck, the Slideshow condition (n=71) where participants viewed a PowerPoint slideshow using the Phylo cards on a computer, and the Projects condition (n=68 people, n=34 pairs) where participants played a separate card game using a deck created by the Genetic Society of America. If a participant failed to show up for the Phylo or Projects condition, the researcher would run the

other person singly in the Slideshow condition. It should be noted that as most participants were run in pairs, single participants were thus not randomly assigned (as the only applicable condition was the Slideshow condition).

### **5.2.2 Justification for a student sample**

Sampling students is a widely accepted practice in psychology. We acknowledge that using only a student sample has its limitations, however we felt this was an applicable population for a number of reasons. The game is marketed for ages 8+ and indeed is sold on campus at the Beaty Biodiversity Museum, thus making students possible purchasers and users of the game. In addition, the general age of the students sampled place them in the category of the population who experienced the height of the Pokémon popularity phase, and thus their interactions with trading card games may be of interest, along with species identifications. Finally, college-age individuals are often of interest to conservation organizations due to their ability to be influenced as they seek to understand their own self-identities (Arnett, 2012).

### **5.2.3 Stimuli and Procedure**

#### **5.2.3.1 Pre-survey**

Participants in all three conditions completed the same pre survey on the computer using Qualtrics (Qualtrics LLC, 2005). The pre survey contained questions on perceptions and knowledge about four focal species, affect, and intended donations. Participants were first asked questions regarding their dispositions towards and ecological and economical perceptions of the species, as well as questions about their knowledge of those species. Ecological perceptions were measured as the understanding of species and their relation to their respective ecosystems. Economic perceptions related to participants' views on the importance of a species as a resource for human economic needs. What we refer to here as dispositions is a measure of participants'

preference for and liking of different species. We asked two questions regarding participants' knowledge of species, one pertaining to the species' diet (carnivore, autotroph, etc.) and one pertaining to the environments in which the species could be found (forests, grasslands, etc.). Additionally, participants were asked qualitative open-ended questions broadly focused on each species (e.g. "What comes to mind when you think of Clark's Nutcrackers?"). All information could be found on the Phylo cards. Open-ended questions have been credited with revealing additional information and emotive reactions that the Likert scale items do not capture, thus they provide complementary data to quantitative methods (Slovic, Finucane, Peters, & MacGregor, 2004). (See Appendix E for a copy of the survey).

The four focal species in the survey were: Clark's Nutcracker (*Nucifraga columbiana*), three-spined stickleback (*Gasterosteus aculeatus*), earthworm (*Lumbricus terrestris*), and giant kelp (*Macrocystis pyrifera*) (Figure 5.1). The four focal species were selected because they are all found in the Phylo Beaty Biodiversity Museum starter deck, they represent a range of different trophic levels, diets, and environments, and are not generally considered overly iconic or charismatic, which can induce ceiling effects (Echeverri et al., 2017).



**Figure 5.1 Pictures of Phylo cards from the Beaty Biodiversity Deck.** Featuring the four different species used in the pre and post survey (a) giant kelp (*Macrocystis pyrifera*), (b) three-spined stickleback (*Gasterosteus aculeatus*), (c) earthworm (*Lumbricus terrestris*), and (d) Clark's Nutcracker (*Nucifraga columbiana*). This figure is covered by the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. Card artwork seen in figure by Lindsey Chetek, Alexandria Neonakis, and Kyu Hwang.

Additional questions in the pre survey included the Positive and Negative Affect Schedule (PANAS scale) (Watson, Clark, & Tellegen, 1988), and questions to measure intended

donations to either conserve one of the four species, conserve an environment (grassland, ocean, or forest), prevent/clean up after an event (climate change, wildfire, oil spill), or keep the money for oneself.

#### **5.2.3.2 Experimental conditions**

When both participants finished the pre survey, they continued the experiment in their respective condition. Those in the Phylo condition were taught the Phylo card game with the Beaty Biodiversity Museum starter deck that focuses on native British Columbian species and environments. They then played the card game against one another. The researcher only reiterated the rules or answered questions about what was permissible. They did not comment on strategy or otherwise engage with the game. When the game finished, the points were tallied and the winner was given a “toonie” (CAD\$2), and the loser a “loonie” (CAD\$1).

Those in the Projects condition were taught a different Phylo card game, created by the Genetic Society of America that focused on accumulating resources to complete scientific “projects.” This condition served as a control for the act of playing a game since it was a two-person competitive card game in the same vein as Phylo but was not based on building ecosystems and did not feature any of the species from the Phylo game. As with the Phylo condition, those in the Projects condition played the game against one another with the researcher only providing rule-based information. At the conclusion of the game the winner was given CAD\$2 and the loser CAD\$1.

Those in the Slideshow condition were given access to a slideshow on a computer that they could advance at their own pace. The slideshow used images of the Phylo cards to explain different trophic levels, different ecosystems, and different environmental events. All the cards available in the deck were shown in the slideshow. Afterwards, participants were given a chance

to look through the deck but did not play the Phylo game and did not interact with their partner. All single participants were placed in the Slideshow condition. After the pair completed the slideshow and looked through the deck one participant was randomly given CAD\$2 and the other CAD\$1. Single participants were also randomly assigned either CAD\$2 or CAD\$1.

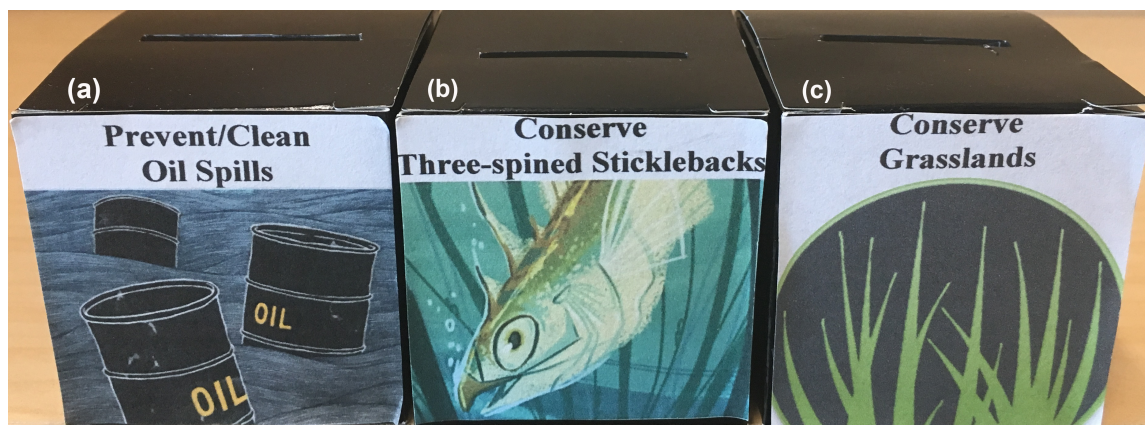
#### **5.2.3.3 Post-survey**

At the end of the game or slideshow, participants in all three conditions completed the post survey on the computer using Qualtrics. The post survey contained the same questions as in the pre survey, except there was no question regarding donation intention. In addition, a range of demographic questions and some qualitative questions regarding memories of the game and specific species were included at the end of the post survey. Specifically, we asked: “Which one species do you most remember from the Phylo game (or the Slideshow)?” The survey was the same across the three conditions, except participants in the Projects condition were not asked which species they recalled, as the card game used in the Projects condition did not contain the species found in the Phylo or Slideshow conditions.

#### **5.2.3.4 Donation**

After completing the post-survey, one participant at a time was taken out of the testing room and debriefed by the researcher about the purpose and design of the study. (Although information on the future tasks such as donation was not revealed at that time). Afterwards, participants were asked if they would like to donate their earnings from the game (a CAD\$1 or CAD\$2 coin) to conserving one of the four focal species, one of three ecosystems, or preventing one of three negative environmental events by placing the coin in an opaque sealed box (see Figure 5.2, Figure A.2.). The order of the boxes was randomized for each pair of participants, though the same 10 boxes were displayed each time. We placed four coins in each box *a priori*,

so that participants would not be biased toward empty or more full boxes. Participants were accurately told that a donation would be made at the end of the study depending on which species, ecosystem, or event had received the most money, but were also explicitly told that the coin was theirs and they were free to do with it what they wished, including keeping it for their own use. All boxes were checked after each study and coins removed to ensure each box had an equal number of coins when participants were donating. For the analysis, we sorted the donation possibilities into four categories: Ecosystems (conserve grassland, conserve forest, conserve ocean), Events (prevent/clean oil spills, prevent/fight wildfires, prevent climate change), Species (conserve three-spined stickleback, conserve earthworm, conserve Clark's Nutcracker, conserve giant kelp), and No Donation.



**Figure 5.2** Example of the boxes used for collecting donations from participants. The boxes were a set of issues: event-focused such as (a) Prevent/Clean Oil Spills; species-focused such as (b) Conserve Three-spined Sticklebacks; and ecosystem-focused such as (c) Conserve Grasslands.

#### 5.2.3.5 Follow-up survey

One month after they had completed the in-person part of the study, participants were emailed a follow-up survey using Qualtrics. They had been apprised that this would be occurring during the debrief and were asked to fill out the follow-up survey. The follow-up survey was



identical to the post survey, but without the additional demographic questions. The total number of survey responses were low: Phylo (n=23), Projects (n=21), and Slideshow (n=17).

## **5.2.4 Data analysis**

### **5.2.4.1 Quantitative analysis**

A confirmatory factor analysis was used to test that our questions were indeed measuring three separate constructs: ecological perceptions, economic perceptions, and dispositions towards species. Upon confirmation of the three factors, we then pooled all response scores into each of the three categories and summed the scores. We used these summed scores as response variables in subsequent analyses. All statistical analyses were conducted in the statistical software R version 3.4.1 and Excel.

To examine our first question, (whether Phylo impacted people's perceptions of species), we first ran three-way mixed-design ANOVAs (Species x Condition x Time). Species refers to the four focal species and is a within-subjects factor. Condition refers to the three experimental conditions and is a between-subjects factor. Time refers to pre vs. post comparison and is a within-subjects factor. We then conducted post-hoc t-tests to detect significant differences between individual conditions. We applied Bonferroni corrections to all  $p$  values with scores  $<0.05$  to minimize type I errors. We also calculated partial eta squared ( $\eta_p^2$ ) and Cohen's  $d$  as measures of effect size. Additionally, we calculated the difference between pre and post scores on ecological and economic perceptions, and dispositions and conducted one-way ANOVAs to assess the impact of condition on such differences. Then, we used Tukey HSD post-hoc tests for pairwise comparisons.

To examine our second question, (whether Phylo increased ecological knowledge about species), we first calculated knowledge scores for each of the two knowledge questions.

Participants were scored either 1 (correct) or 0 (incorrect) on questions regarding the diet of species (e.g., autotroph, herbivore) for both the pre and post survey. For questions regarding the environment of the species, the participants' scores were a proportion of correct responses over the total possible correct responses, thus participants were scored between 0 (no correct responses) and 1 (all correct responses selected), and we evaluated participants' total accuracy. We then conducted three-way mixed-design ANOVAs (Species x Condition x Time), post-hoc t-tests, and calculated Cohen's d.

To examine our third question, (whether participants experienced positive affect when playing Phylo), we conducted a two-way ANOVA (Condition x Time) on scores from the Positive and Negative Affect Schedule (PANAS scale), a measure of personal positive and negative emotional states (Watson et al., 1988). The scale was split into positive and negative affect. We also conducted post-hoc t-tests, and calculated partial eta squared ( $\eta_p^2$ ) and Cohen's d. We also calculated a one-way ANOVA to test the effect of condition on the difference in affect scores for the post and the pre surveys, and used Tukey HSD as post-hoc tests.

Lastly, to examine our fourth question and test whether there was a difference in donation across the three conditions we ran two chi-squared tests on the donation intentions in the pre survey and the actual donations after the game or slideshow.

#### **5.2.4.2 Qualitative analysis**

Responses to open-ended questions were analyzed using non-hierarchical axial coding for each species and condition. Codes were derived from the participants' responses and identified using 7 categories presented in Table A.1. (e.g., ecological importance, species' attributes, species' environment). We assigned each response or part of a response to a category and performed two rounds of coding to ensure accuracy. We then counted the frequency of

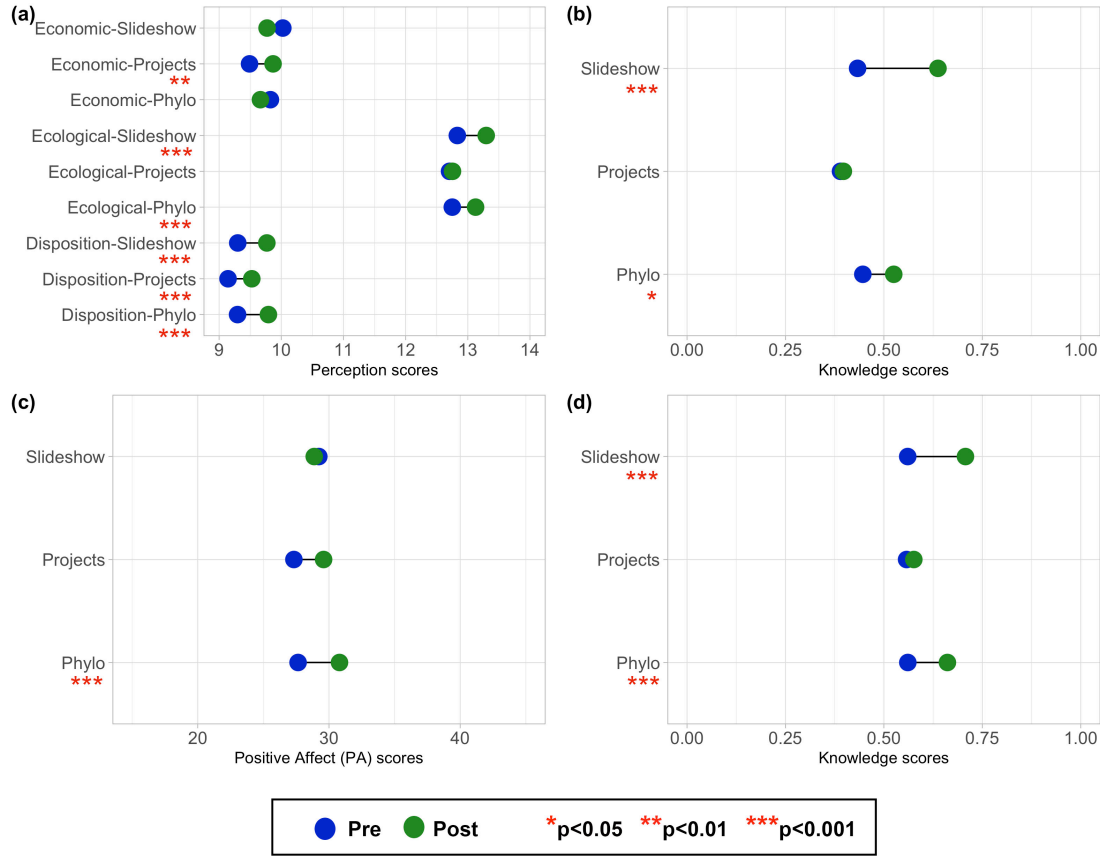
occurrence for each category. For each condition (Phylo and controls) we conducted chi-squared tests to evaluate the statistical differences between the pre and post counts. We also analyzed answers from the final survey question “Any other comments?” as well as comments stated verbally to researchers throughout the experiment to determine general positive attitudes across the conditions (i.e., statements of fun/enjoyment/liking).

To examine our fifth question, (whether Phylo increased people’s recall or memory retention of species), we counted the frequency of different species mentioned in the final question of the post survey (“which one species do you most remember from the Phylo game/slideshow?”) and performed a chi-squared test to evaluate the effect of condition on species recall. Lastly, we calculated the percentage of species that were mentioned in the survey.

### **5.3 Results**

#### **5.3.1 Perceptions**

Regarding ecological perceptions of species (i.e., the perceived relationship of species to their ecosystems), we found a significant main effect of condition (Phylo, Projects, or Slideshow condition) on responses ( $F(2, 206)=3.54, p<0.05, \eta_p^2=0.03$ ). The post-hoc t-tests with Bonferroni corrections revealed that both the Phylo and Slideshow conditions significantly increased ecological perceptions from pre to post survey (Phylo:  $t(279)=-3.90, p_{adj}<0.001, d=-0.21$  and Slideshow:  $t(283)=-4.57, p_{adj}<0.0001, d=-0.03$ ) (Figure 5.3). Results from the one-way ANOVA indicated that condition had an effect on changing ecological perceptions (i.e., difference in scores of post – pre) ( $F(2,833)=5.49, p<0.05$ ). Tukey HSD tests revealed that Phylo and Slideshow had the same effect on ecological perceptions ( $p_{adj}=0.77$ ). Projects was different than Phylo ( $p_{adj}=0.04$ ) and Slideshow ( $p_{adj}=0.004$ ) as both had a stronger impact on increasing ecological perceptions than Projects.



**Figure 5.3 Changes in perceptions, knowledge, and positive affect scores.** Lollipop graphs showing the results of (a) changes in economic perceptions, ecological perceptions, and dispositions across conditions, (b) changes in participants' knowledge of species environments across conditions, (c) changes in participants' positive affect across conditions, (d) changes in participants' knowledge of species diets across conditions. The blue circles represent the mean value of the pre survey and the green circles represent the mean value of the post survey. Significance level is indicated by the red asterisks underneath the name of each condition on the left of the graphs in the following order of significance \* $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$ . Three conditions are represented: Phylo ( $n=70$ ), Projects ( $n=68$ ), and Slideshow ( $n=71$ ).

For the economic perceptions (i.e. the relative importance of species to economies) we also found that there was a significant main effect of conditions ( $F(2, 206)=7.67, p<0.001, \eta_p^2=0.07$ ). The post-hoc t-tests revealed that the Projects condition significantly increased economic perceptions from pre to post ( $t(271)=-3.78, p_{adj}<0.01, d=-0.14$ ), while they were not different for the Slideshow or Phylo Conditions ( $p_{adj}>0.05$ ) (Figure 5.3). One-way ANOVA results indicated a significant effect of condition on the difference between post-pre scores

( $F(2,833)=10.37, p<0.0001$ ). Tukey HSD tests revealed that Phylo and Slideshow had the same effect on economic perceptions ( $p_{\text{adj}}=0.81$ ). Projects was different than Phylo ( $p_{\text{adj}}<0.001$ ) and Slideshow ( $p_{\text{adj}}<0.0001$ ) as both decreased economic perceptions in the post condition.

Lastly, regarding dispositions toward species, there was no main effect of conditions ( $F(2, 206)=0.65, p=0.52, \eta_p^2=0.01$ ). However, we found a significant main effect of time (increasing from pre to post) in all three experimental conditions ( $F(1, 206)=49.29, p<0.0001, \eta_p^2=0.19$ ) (Figure 5.3). One-way ANOVA results indicated no significant effect of condition on the difference between post-pre scores ( $F(2,833)=0.39, p=0.68$ ).

### 5.3.2 Knowledge

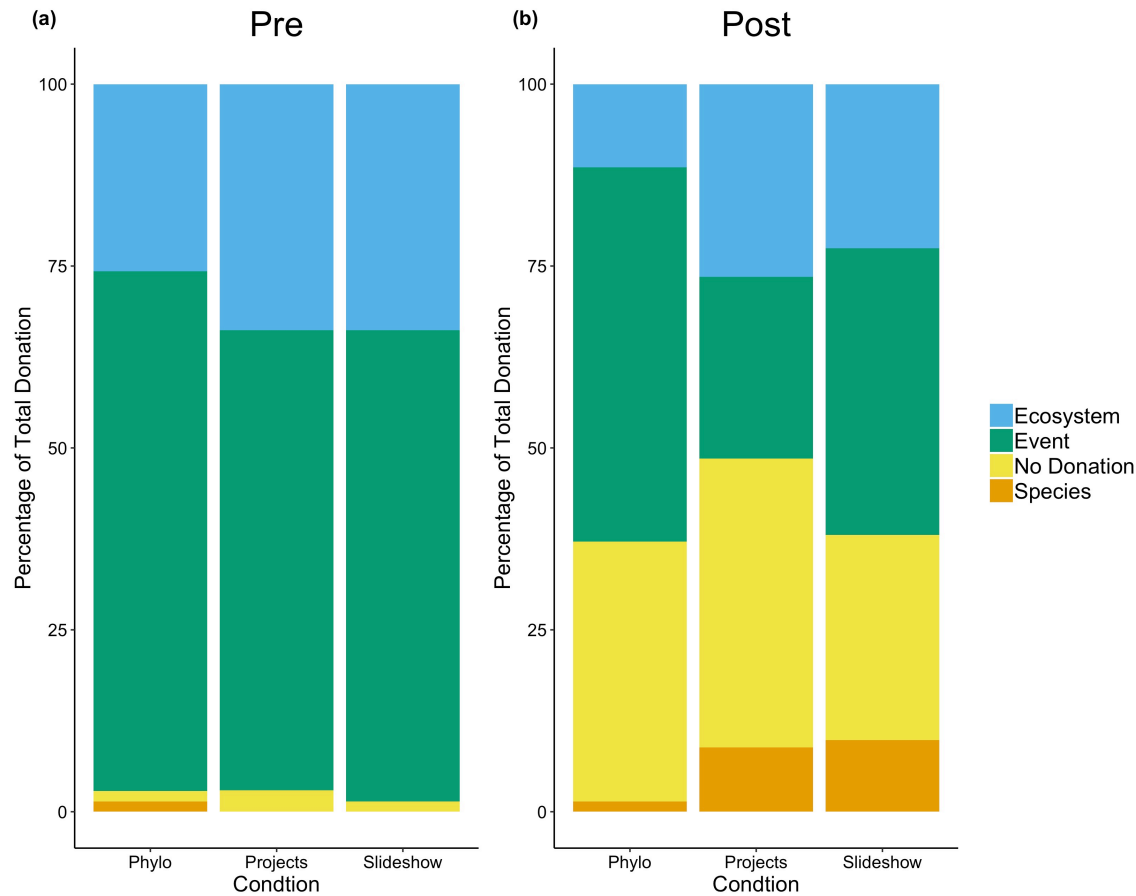
We found a significant difference in the three conditions regarding knowledge of species diet ( $F(2, 206)=10.10, p<0.001, \eta_p^2=0.08$ ). The post-hoc t-tests showed that both the Phylo and Slideshow conditions significantly increased people's knowledge on diets from pre to post (Phylo:  $t(279)=-2.48, p_{\text{adj}}<0.05, d=-0.16$ ; Slideshow:  $t(283)=-5.97, p_{\text{adj}}<0.0001, d=-0.02$ ), whereas the Projects condition had no significant change (Projects:  $t(271), p_{\text{adj}}>0.05, d=0.01$ ). A similar result was found regarding knowledge on the species' environments where there was a significant difference in the three conditions ( $F(2, 206)=4.57, p<0.05, \eta_p^2=0.07$ ). The Phylo and Slideshow conditions significantly increased from pre to post (Phylo:  $t(279)=-5.19, p_{\text{adj}}<0.001, d=-0.32$ ; Slideshow:  $t(283)=-7.30, p_{\text{adj}}<0.001, d=-0.06$ ) (Figure 5.3). We also found that participants in the Slideshow condition exhibited higher accuracy, which is the number of correct answers, in their responses of ecological knowledge of species (71.73% of correct responses about diet vs. 66.13% for Phylo vs. 55.95% for Projects and 64.64% of correct responses about environment vs. 52.50% for Phylo vs. 38.57% for Projects).

### 5.3.3 Affect

There was a significant main effect of condition for positive affect ( $F(2, 206)=4.69$ ,  $p<0.05$ ,  $\eta_p^2=0.04$ ) (Figure 5.3), but not for negative affect ( $F(2,206)=0.065$ ,  $p>0.05$ ,  $\eta_p^2<0.001$ ) (Figure A.3). Specifically, post-hoc t-tests showed that the Phylo condition significantly increased positive affect from pre to post ( $t(69)=-3.72$ ,  $p_{\text{adj}}<0.001$ ,  $d=-0.40$ ) and Projects was marginally significant ( $t(67)=-2.28$ ,  $p_{\text{adj}}=0.07$ ,  $d=-0.28$ ), while the Slideshow condition did not have a significant impact on positive affect ( $t(69)=0.51$ ,  $p_{\text{adj}}>0.05$ ,  $d=0.05$ ) (Figure 5.3). One-way ANOVA results indicated that condition had an effect on the difference of positive affect scores (i.e., difference between post and pre) ( $F(2,206)=4.68$ ,  $p<0.05$ ). Tukey HSD tests revealed that Phylo and Projects had the same effect on positive affect ( $p_{\text{adj}}=0.74$ ). Slideshow was different than Phylo ( $p_{\text{adj}}=0.01$ ) and Projects ( $p_{\text{adj}}=0.08$ ) as both had a stronger impact on positive affect than Slideshow. One-way ANOVA results indicated no significant differences on the effect of condition on the difference of negative affect between post and pre conditions ( $F(2,206)=0.065$ ,  $p=0.94$ ).

### 5.3.4 Donation behavior

Chi-squared results indicated that for the pre survey, there were no associations between conditions and donation categories ( $\chi^2(6)=3.9$ ,  $p=0.68$ ). However, after playing the game or seeing the slideshow, chi-squared results revealed a significant association between conditions and donation categories ( $\chi^2(6)=16.2$ ,  $p=0.01$ ). Specifically, we found that in the Projects condition, participants donated significantly less to events than expected by chance. We also found that in the Phylo condition, participants donated significantly less to ecosystems and species, and significantly more to events than expected by chance. Additionally, no donation increased in all three conditions in the post data (Figure 5.4).



**Figure 5.4 Donations in pre and post periods.** Bar graphs showing the percentage of total donation to each of the four donation categories (i.e., conserve ecosystem, prevent negative environmental event, no donation, conserve species) for each experimental condition (i.e., Phylo, Projects, Slideshow) in the (a) pre and (b) post periods.

### 5.3.5 Qualitative data

We found significant differences between the pre and post survey responses regarding the category: “Ecological” label ( $\chi^2(2)=19.67, p<0.0001$ ). Slideshow participants at the post-survey stage had more ecological responses than expected by chance, and Projects participants had less than expected by chance. Phylo did not have a significant change from pre to post ( $p>0.05$ ), but it trended upwards (more ecological responses post than pre) (Tables A.1 and A.2). After analyzing the “Any other comments?” and the verbal statements to the researchers, we found that

participants in the Phylo and Projects conditions expressed more fun and enjoyment than those in the Slideshow condition (Table A.3).

### **5.3.6 Species recall**

Species recall in the Phylo condition included 76% of the total number of species featured in the game (19 different species remembered of 25 total in the Phylo game). In the Slideshow condition participants remembered 56% of the total number of species in the Phylo game (14 species remembered). The difference between Phylo and Slideshow was not significant ( $\chi^2(1)=0.67, p=0.41$ ), given the small sample size of total species.

We also examined how frequently any of the four focal species, featured in the pre and post surveys, were mentioned as compared to species not featured in the surveys. The majority of species remembered (83.58%) by Phylo participants were not featured in the survey. In the Slideshow condition only 29.85% of the species remembered were ones not found in the survey (Figure 5.5). The difference between the experimental condition (Phylo) and Slideshow regarding species remembered and featured in the survey versus not featured in the survey was significant ( $\chi^2(1)=37.24, p<0.001$ ).





Enhanced ecological perceptions indicate participants' increased beliefs that the species are important to the ecosystem in which they live. This result supports the idea that different conservation-based tools (such as games) have the potential for increasing ecoliteracy and aiding conservation education (Brewer, 2003). Furthermore, the fact that the Phylo game had similar results to the slideshow in some categories (e.g., ecological perceptions, knowledge of species' diets and environments), which is arguably a more traditional form of imparting information, suggests that the Phylo game could be used as a potential substitution for didactic learning as well. One important caveat is that Slideshow participants still had higher knowledge accuracy scores. This could be due to the fact that current university students are taught primarily via lectures often with the use of slideshow presentations (Laurillard, 2013), so the familiarity with this format may have facilitated learning.

The monetary value of species (what we here call economic perceptions), was comparatively higher in the Projects condition; participants rated species as significantly higher in terms of their relative importance to economies in the post survey. Similar trends were not exhibited by participants in the Slideshow or Phylo conditions. This finding may be explained by the fact that the species cards in the slideshow and the Phylo card game did not emphasize any kind of economic value of the species. However, in the card game used in the Projects condition, species cards (i.e. zebrafish, and frog) were used as resources to complete projects. In addition, the game features cards such as "Grant approved" or "Lose funding" that serve to place greater emphasis on economic concerns (Swanson, 1994). Together these may explain why Project participants ranked the economic value of species as higher after playing the game.

Dispositions toward species were not impacted by the experimental condition, but rather by time (pre vs. post). This was evidenced by the fact that affinity for species was significantly

higher in all of the post responses than the pre survey responses, indicating a greater affinity for species after each condition. This may be a result of increasing familiarity with the species, given that participants saw the same species multiple times across the different conditions and surveys. Familiarity of species has been shown to increase liking for the species (Amiot & Bastian, 2015; Echeverri et al., 2017).

The Phylo game significantly increased participants' positive affect overall, a finding also marginally significant for Projects participants. In addition, participants in both games expressed higher levels of fun and enjoyment than those in the Slideshow condition. Participants verbally stated this to the researchers as well as writing comments in the survey (e.g., "The game was quite fun to play," "I like the game! Wish we could play a few more rounds"). These are notable results due to the fact that more enjoyable pursuits increase motivation to engage further with them, which has been noted as the first step toward learning (Paras & Bizzocchi, 2005). Indeed, a game that is deemed "fun" is more likely to be played and thus more likely to have an effect than the opposite (Sweetser, Johnson, Ozdowska, & Wyeth, 2012).

Assessing participants' actions after the game, such as donation behavior, was used to determine any additional positive result of the game. We found all conditions increased in No Donation in the post data, though this may be due to our sample being comprised mostly by students who have no extra money to spare. These results might differ if other populations are sampled. Nonetheless, we found that in the Phylo condition, the amount donated to prevent environmental events such as climate change, wildfires, and oil spills was significantly higher than would be expected by chance. However, donations to species and ecosystems were less than expected by chance. These results may be due to the effect such cards have in the game. Event cards often cause the destruction of entire ecosystems (when played on low trophic level cards)

or the extinction of iconic species and are usually the main cards that lead to either winning (if played on the opponent) or losing the game (if one receives the card). In the game, by stopping a single event, participants were often able to save ecosystems and species. Thus, the game potentially taught our participants that preventing events may lead to better conservation outputs and this may help explain why in the post condition participants donated less to species and ecosystems and more to events.

This result also makes the Phylo game of interest to conservation organizations as a potentially useful tool for promoting donation toward the prevention of environmental threats. Our results also indicate that dystopian content is not necessarily at odds with utopian scenarios. The game not only highlighted both dystopic threats (e.g., climate change) and their magnitude as they concern biodiversity (Slovic et al., 2004), but also engaged people in ways that were fun. Such motivational contexts (as opposed to content) about ecosystems and biodiversity issues may then still contribute to hopeful rather than hopeless feelings about these topics (McKinley, 2008).

The high rate of species remembered that were not in the survey indicates that those playing the Phylo game were recalling species from playing the game itself. The follow-up surveys, despite their low return rate, echo this finding. Indeed, the responses for the Phylo condition participants in the follow-up surveys included responses of “Himalayan Blackberry” and “Western Honey Bee” as opposed to just “blackberry” or “bee,” suggesting their retention was not necessarily due to its familiarity, but due to the game itself. This finding emphasizes the ability of the game to encourage memory retention of species akin to the Pokémon game, where detailed characters are common. This also verified the primary expectation behind creating the game itself as its intent was to create a tool that would promote ecoliteracy (Ng, 2015).

Balmford's (2002) observation that children had greater recognition of, and therefore a presumed predilection for, Pokémon characters rather than local flora and fauna is sobering. Indeed a recent study that evaluated the benefits of Pokémon Go echoed the results from Balmford (2002), stating that conservation continues to lag behind Pokémon (Dorward, Mittermeier, Sandbrook, & Spooner, 2017). As interactions with wilderness are replaced by more virtual interactions, those concerned about the so-called extinction of experience, (Louv, 2008) may yet find hope in such under-explored options as putting gaming potential to good use. The utilization of a "Pokémonesque" trading card system, like the Phylo game, may hold real value in increasing ecoliteracy in a relatable and enjoyable fashion. The Phylo game, as demonstrated here, has potential for increasing ecoliteracy regarding local biodiversity, for raising awareness of environmental issues, and for motivating people to donate to the mitigation of environmental threats. Phylo is also an open-source and creative commons game that can be easily adapted to other geographical contexts and thus is widely available for environmental knowledge enhancement and communication.

We also consider the Phylo game as a complementary strategy to other emerging initiatives such as citizen science projects (e.g. iNaturalist, eMammal, eBird, Project BudBurst) for raising awareness on biodiversity and hopefully reversing the extinction of experience (Dickinson et al., 2012, Schuttler et al., 2018). But some citizen science projects are likely more useful for certain situations and for people with access to and interest in technology. On the other hand, the Phylo game might be welcomed and used to engage other audiences, such as those limited by nonexistent or incomplete access to or familiarity with screen-based media. Future research could replicate our study with any of the other decks that have been designed, to test for the generalizability of our results within other populations. Moreover, a study comparing various

methods, such as the aforementioned games, movies, and citizen science apps designed to increase ecoliteracy would also be important to consider for future research.

At a time when conservationists need to engage more broadly with the public and motivate engagement with global threats to biodiversity (Butchart et al., 2010), we suggest the importance of bringing more attention to enjoyable and educational games. They can serve as novel and effective tools to help advance the achievement of common conservation goals. We acknowledge that games alone are not a “panacea,” but they may provide an important adjunct to other efforts to increase ecoliteracy, motivate environmental citizenship, and contribute to more affinity with the natural world and ecosystems undergoing rapid anthropogenic change.

## Chapter 6: Conclusion

*“I am an animal lover, that is why I have this job, it’s not because I want to take them out of the ocean and take them away from the natural environment, it’s that I want people to care about that stuff more. So that’s what my focus of my job is here, to engage people to actually care about it enough to want to do something to help in the bigger picture.”*

—Aquarium trainer #14 (2018)

The essential nature and lives of humans and animals have been intertwined since long before the dawn of recorded history. Relationships have, at times, revolved around the provision of a number of tangible and intangible ecosystem services, human-animal connections, and mutual dependencies. From the food we eat and the clothes we wear to the guardians, real and metaphorical, that we enlist, animals are everywhere. We write stories, songs, fables, and poetry about animals. Our relationships are fraught with conflict and love, fear and respect. No matter where in the world a human is, there are always animals, both large and microscopic, somewhere nearby. From working in the fields, visiting a zoo, even feeding ducks at a pond, humans encounter animals daily.

Animals often have both profound and detrimental influences on human lives, however the reverse is indisputably true as well. With increasing human populations and human-produced environmental consequences, wild animal populations are being forced into increasingly smaller habitats and extinction levels are quickly rising (Díaz et al., 2019). It is safe to say our continual interactions and our relationships with animals are very complex. Despite this interconnectedness, we still know little (beyond a long tradition in zoology) about animals themselves and the deeper influences that underlie our relationships. It is only recently that we have even begun to examine the cognition and emotions behind animal behavior, seeing them as

agentive beings instead of mindless machines, and have begun to question our relationships accordingly.

In this era of species extinction and increasingly varied ways of interacting with animals, it is essential to continue to explore the relationships that exist between us and the animal worlds that surround us, or with which we engage. While many have looked at the relationships that exist between humans and domesticated animals, this dissertation explores the crucial but often less visible relationships between humans and wild animals. Its purpose is to understand what classificatory logics, empirical findings, and field-based observations tell us about how we as humans and scholars are coming to characterize the human-wildlife relationship. For this reason, I examine human-wildlife interactions, the qualities people assign or perceptions they hold about different taxa and species of wildlife, and I also ask how we might identify ways to alter perceptions and knowledge so that conservation improvements might follow. In this conclusion I reflect upon the contributions of this dissertation to those overall goals, as well as the limitations of this work, future potential studies, and steps that may follow.

## **6.1 Original Contributions to Characterizing Human-wildlife Relationships**

### **6.1.1 Wild and Relationships**

Examining relationships that exist between humans and wild animals can present challenges not found in studies on domesticated animals, such as consistent access to wild populations. This is not to say that relationships with domesticated animals are secondary or not worthy of investigation. Indeed, factory farming, for example, constitutes a grave situation given the growing needs for agricultural feed, animal suffering, and the contribution of meat-centric diets to climate change. However, I chose to focus on wild animal relationships because the literature on human-animal relationships with regard to wild animals is still in its infancy



however much these relationships affect our world profoundly. Given the uncertain definition of what is in fact, “wild,” I began by examining current studies of human-wild animal interactions in Chapter 2 and found that, though sparse in number, many interesting discussions of what constitutes a wild animal are evident. For example, in the case of urban birds, swiftlets in Malaysia are disregarded largely as a result of their abundance (Connolly, 2016), while urban hawks in New York invoke awe and are still viewed as “wild” (Hunold, 2017). Yet as evidenced by these varying definitions of what constitutes wild, it would seem there are more questions than answers. This uncertainty in what constitutes wild clearly points to the need for terminology beyond the simple “tame” and “wild” designations. Such an either/or system fails to include many animals that inhabit the “in-between” categories: feral animals, residents of zoos, aquaria, and wildlife preserves, as well as those creatures that have successfully adapted to urban life or intermittent reliance on human aid. Thus, a contribution of my work includes Chapter 3, where I illustrated the importance of a wild to tame (or de-wild) spectrum to encompass all categorizations of animals by highlighting the relationships that exist between trainers and animals in aquariums and how trainers must respect the wild nature of their charges, while still engaging with them in safe and effective ways. The spectrum concept can better encompass the shifts that can take place in a de-wilding sense, when an animal moves progressively away from the wild end and closer to the de-wild end such as with animals that are unable to be released and must necessarily become further involved with and reliant on human interaction. As well, the spectrum can help illustrate the opposite, namely shifts that occur in a re-wilding sense with an animal that has experienced a great deal of human involvement and must then be encouraged to become “re-wilded,” as is the case with animals that are abandoned when young, or rehabilitated due to injuries and subsequently need to be released back into their natural habitats.

Additionally, in Chapter 3, I explored this spectrum and the relationships that exist between humans and wildlife in an aquarium. Given that very little research has been completed on aquarium-based human-wildlife relationships, this was a contribution to the overall literature regarding relationships in more controlled environments. I note that since human-wildlife interactions in the field are usually limited, examining relationships in a setting where the animal resides in relatively closed conditions can facilitate study.

I was also able to observe and discuss relationships with the individuals who were responsible for day-to-day interactions of care, treatment, and training that occurred between trainers and animals. This, I believe, was a strength of my work as I was able to give voice to those who spent countless hours building and managing these crucial relationships. They were able to articulate the creative and caring steps that were needed when building the trust and cooperation that defined their relationships. These were evident in the progressive training steps many trainers referenced in regard to their interactions with six otters. New trainers were often paired with more accommodating individual otters so that both could succeed during training and begin to build mutually positive and trusting relationships.

These findings may help move the field beyond the simple terms of “wild” and “tame” and further the premise (and its implications) that since animals inhabit many positions and expressions of wildness within our lives, they cannot and should not be so simply defined. In addition, even though humans struggle with understanding and accepting their own categories, realizing that animals have such variations may strike a chord and serve to make animals more relatable, as well as removing the justification of “they’re wild animals” when disregarding certain species.

### **6.1.2 Perceptions of wildlife**

At this writing, we know very little and have yet to delineate how an animal thinks or feels. While we might never completely know, there are some avenues of promising research. The development of research tools such as functional MRIs, and quantitative and qualitative testing procedures (e.g., blood levels of hormones, testing experiments looking at problem solving) are increasingly being used to obtain information on states of stress, pleasure, biophysical health, and others. While such scientific tools are tantalizing as their use in research increases, the research is also laden with assumptions and at times near obsessive preoccupation with empirical legitimacy. Thus, we then also fail to make full sense of why humans perceive wildlife the way they do, or how this might vary across social groups or given different animal beings. We know, for example, that public understanding of animal traits lag behind science's push to explore them (Maust-Mohl et al., 2012). Our perceptions are thought to inform decisions and subsequent actions, and yet we know comparatively little about what these might be and need to examine them more fully. While many studies focus on general perceptions regarding the "animal mind," work that comprises this dissertation—particularly that in Chapter 4—indicates that people not only perceived mental states of animals, but distinguish wild animals as possessing both thinking, or particular cognitive states, and feeling, or emotive states. Given the emphasis on anthropomorphism in popular culture if not in people in general (e.g., books and movies that tend to equate human characteristics with human ones (Manfredo, 2009)), it seemed more likely that people would be willing to ascribe the capability for feeling and emotions to animals more so than the capability of thinking and cognition. However, an interesting contribution of this dissertation is the finding that people were more likely to ascribe cognitive ability to animals than emotive ability. As much as previous thinking by the scientific

community might have defaulted assumptions that people attributed human characteristics, especially emotional ones, to animals, Chapter 4 suggests the reverse might be so. That is, people do appear to be attributing human characteristics, but they may reflect emerging forms of 'anthropomorphism' as cognitively focused. This could have impacts on conservation and educational messaging, as current messaging often focuses on projecting animal emotions. But as there is already a propensity to see the cognitive ability of animals, building upon those abilities could lead to further appreciation of the intellectual prowess of animals and perhaps extend to better care and respect of animals. This propensity—towards cognitive attributes—might also be an implicit index of the added respect assigned to wild species as we become more aware of their presence and decline given the urgency of biodiversity loss globally.

### **6.1.3 Altering perceptions and knowledge**

When looking beyond the definition and understanding of perceptions, it follows that it may be possible to examine whether there are ways to influence those perceptions and the knowledge linked to these, and thus even potentially affect conservation support. In Chapter 5, I showed that the Phylo card game had the ability to positively impact ecological perceptions, species-specific knowledge, and even affect donations for major environmental threats. This contribution illustrates the potential for novel tools to advance ecoliteracy and even affect conservation efforts, and indeed confirms an early piece in *Science* that inspired this possibility (Balmford et al., 2002). While my study focused on a low-tech card game, increasingly there are new physical and virtual tools being developed that attempt to influence our perceptions and knowledge of animal worlds. This study provided evidence of the usefulness of the Phylo card game where previously there had only existed anecdotal reports. Although the study was limited to this particular tool, it may facilitate additional study and even spur the creation of other tools.

It was also important that one of the control conditions was a slideshow, as this is a common current tool for imparting knowledge. By showing that the Phylo game had the added benefit of increasing positive affect and being an enjoyable learning method, this study showed that there are ways to impart important messages while positively engaging the public. In an era where our attention is constantly being sought, especially from various virtual devices, it is important to highlight and test educational and communicative methods that participants will find enjoyable and will thus continue to use.

## **6.2 Considering Multi-disciplinary**

In Chapter 2, I highlighted the multi-disciplinary nature of the field of human-animal studies. This still somewhat broad set of efforts necessarily complicates any study of the field as the aims, methodology, and results may vary across disciplines and sub-disciplines. In a sense, the only consistency that exists resides in the fact that there is inconsistency in the field as a whole. However, the many disciplines also allow for a diversity of ideas and approaches and indicate a great deal of inquiry and interest. Indeed, some people reference an emotional undercurrent of attentiveness and appeal that runs through all the disciplines exploring animals and our relationships with them (Hurn, 2012).

Given this, I believe that the fact that my thesis is interdisciplinary in nature is one of its strengths. By this I mean that I was able to use different disciplines in the exploration of my goals to facilitate an examination of human-animal relationships from a number of different angles and using a variety of methods. I wasn't constrained by a single literature or methodology that might be linked to a particular discipline, but was instead able to allow the questions to drive the approach. In this sense I was able to apply the best theory and method for each of my goals and questions. Creating an opportunity to interview and observe trainers in an aquarium in

Chapter 3 allowed me to learn more about their relationships and the variation of those relationships in reference to the fundamental nature of “wild” than I would have been able to using, for example, a survey. Many of the results I enumerated in that study were less a response to my initially devised questions, but instead grew out of open-ended discussion that followed after observing a particular interaction. On the other hand, when it came to categorizing perceptions in Chapter 4, given the academic literature on animal capabilities, it proved more effective to devise a survey to gauge people’s responses to and understandings of those capabilities. Had I simply asked about people’s perceptions I likely would not have been able to find as nuanced information or discover the over attribution of cognitive capabilities compared to emotive ones.

In addition, the ability to utilize methods from a number of different disciplines, in effect synthesizing the different methodology into a hybrid model, worked well for my analysis. For example, Chapter 5 was predominantly an experimental design of the kind favored by cognitive psychologists to test the Phylo game. While it was necessary to apply a rigid format in order to accurately examine the efficacy of the game, one of the more interesting results came when I included more general questions asking about which species people most remembered from the game or slideshow and why. My finding that people who played the game remembered a much more diverse range of species, and indeed often focused on the smaller species at the base of ecosystems as opposed to the traditional charismatic megafauna was an important conclusion and one I would not have encountered if I had kept to a strict, multiple choice survey. Additionally the notes my research assistants and I kept regarding our interactions with the participants and the participants’ interactions with one another also provided additional information. While this is a small example, it shows the benefits of including a diversity of approaches, best tailored to

research needs, to examine particular questions. Being able to do so on a larger scale across my dissertation helped unearth essential and novel findings about the human-animal relationship.

### **6.3 Limitations**

As my dissertation is an attempt at characterizing human-wildlife relationships and human attributions of animal qualities, it is necessarily varied and relies on multiple approaches. This strength is also a weakness however, or at least introduces some limitations. Choosing the theories and methods that supported an investigation of each of the questions was based on synthesizing the knowledge I had alongside help from collaborators—each of whom have scientific backgrounds in different areas and are driven by those specific backgrounds. We thus tended towards studies and methods in areas driven by environmental social science, anthropology, psychology and/or ethics, and so I may well have missed methods and theories that were even better suited. Additionally, this illustrates the “double-edged sword” of any interdisciplinary approach—at the very least because my initial literature review and the variety of backgrounds involved helped enhance the discussion, but also required that things like terminology and the research process itself had to be blended into workable products.

An additional limitation was the context in which my studies took place. The research was mostly conducted in North America and featured populations predominantly located in those areas. Human-wildlife relationships are built upon a variety of factors and can vary in nature given the location and sociocultural values of the human participants, thus the applicability of my findings to other locales is limited at best. Additional studies could examine these topics across other locations and populations to see whether or not my findings can be extrapolated to other arenas.

In addition to location, my research sample in two of these studies may be a limiting factor. There have been questions regarding the applicability of Amazon Mechanical Turk (Mturk) responders as well as student samples, which I used in Chapters 4 and 5 respectively. Amazon Mturk respondents may not be a fully representative sample of the general population, however I was not able to confirm this one way or the other. Using a paid online panel could be of use for future studies to ensure this is not an issue. Using a student sample is a widely accepted practice in psychology, and we felt it was justified given the geographical location and age requirements for the game. However, looking at other populations, such as younger children who are still forming some of their initial perceptions about environmental concerns, could be beneficial. Finally, in Chapter 3, I interviewed 19 participants, which is a small sample size. This was simply due to the limited number of available trainers within the aquarium, but I would have liked to increase the size, whether by interviewing additional members of the staff, or exploring additional aquariums since larger sample sizes will, of course, lead to more robust findings and may have elucidated additional information. Future studies could examine more locations and thereby reveal any inconsistencies across locations, as well as identify similarities in experiences of care. That said, we also know that variation in interview content begins to level off at about 20 participants and stabilizes quite fully at about 30 (Morgan, 2002).

An additional limitation is the species covered in my work. “Wild animals” is a category comprised of millions of different species. While I tried to explore a range of different classes throughout all of my studies, there is always the need for additional research into under-represented classes and species. Chapter 3 was similarly limited by the species at the aquarium and favored the reports of those who worked with the larger marine mammals, simply given the number of trainers assigned to the mammals as opposed to the single trainer working with the



amphibians or reptiles. In Chapter 4, I selected animals across six classes, but as I mentioned in that chapter, the invertebrate category was too varied given that around 98% of identified species are invertebrates compared to the significantly smaller classes of mammals and birds (Barrowclough et al., 2016; Burgin et al., 2018; Mora et al., 2011). Finally, given the location of our study in Chapter 5, we utilized a card deck that featured species found in British Columbia. While that was applicable to our study location, it will be helpful to present alternative decks utilizing alternative species to definitively see whether the findings can be expanded to other populations and their locales.

#### **6.4 Future Studies**

The field of human-animal studies is rapidly expanding and human-wildlife relationships are being examined from many different angles and viewpoints. While my work provides additional information and characterization for understanding these relationships, there are still many questions that remain. I have alluded to some of these questions and further studies above, but I further explore potential future avenues of study here.

Examining interactions between humans and wildlife is understandably difficult due to the often ephemeral interactions that occur between the two, and the inability to bring wild animals into an in-lab setting as is quite possible with companion animals. I argue in Chapter 3 for the effectiveness of study in particular areas of where humans and wild animals (in all definitions of wild) come into more regular and sustained contact such as zoos, aquariums, wildlife parks, rehabilitation facilities. While there have been studies looking at human-keeper relationships in zoos (e.g., Birke et al., 2019; Hosey & Melfi, 2010), aquariums are under-researched and additional study across aquariums could add valuable information. This is especially true as aquariums often house a wider variety of animals than zoos who tend towards

the larger, more visually impressive animals. Additionally, there is little research examining bonds and relationships in wildlife parks and sanctuaries and these offer a unique view at how humans and more free-roaming animals might interact and relate. While not quite the same as free-roaming animals in the natural world, the insights from these types of interactions and relationships could provide valuable insight into ways to shape and improve all types of human-wildlife relationships.

The perceptions and attitudes that humans develop towards animals drive many of our relationships with animals and although I considered perceptions in my work, this remains an area in need of continual exploration. In my study I utilized a broad range of species, but tailoring additional studies to specific local species could better elucidate perceptions since people may have or could conceivably come into contact with such animals. Asking someone in North America about their perceptions regarding tigers elicits responses that are influenced by media and zoo visits, whereas perhaps asking about coyotes or crows may elicit responses based on more personal experiences and opinions.

Additionally, while I utilized a survey to identify perceptions, there are additional methods that may prove very effective in determining underlying perceptions and attitudes towards animals. For example, the Implicit Association Test (IAT), which helps to identify implicit human biases to different human groups, has been used to uncover and study implicit attitudes regarding human variations that are may not be consciously or explicitly identified. Developing and utilizing a form of this test to look at human perceptions regarding various animal species could provide further data regarding human attitudes towards wildlife. As the IAT has explored innate attitudes towards racism, perhaps a further exploration of “speciesism” could further illuminate attitudes towards wildlife.

Another area of future work relates to informing and examining messaging with regards to animals and their conservation. My work on perceptions shows areas in which dispersion of current knowledge could have positive effects on people's understandings and perceptions of species. For example, while studies have shown that Nile crocodiles have the capacity for long-term memory (Combrink et al., 2017), the public perceptions of crocodile abilities in my study did not echo those findings. As research into animal cognition increases, additional studies such as these can help ensure that currently discrete fields (e.g., crocodile zoology or animal behavior and the psychology of perceptions) are in communication with each other and/or are communicated effectively to the public.

Finally, I examined one potential tool for impacting perceptions and conservation support, however there are many other tools that may be of use for exploring and improving relationships that could be considered. Increasingly, technology is becoming the way in which humans are interacting with animals. Nature documentaries and webcams allow humans to view wildlife in a more natural state and potentially can thus influence opinion as to the appropriateness of management strategies and offer an alternative to anthropocentric interpretations of animal existence. One question that may pertain to this is: how do digital or stream-accessible animal representation and the information-heavy digital world in general influence attitudes towards wildlife? While videos of animals may elicit short-term feelings of positivity towards animals and the environment (Ulrich, 1995), their long-term value in terms of affecting attitudes or behavior has not been studied. Additionally given that videos of animals have been shown to be more therapeutic and calming to humans than videos of humans or videos with no animals or humans (Wells, 2005), this may open up new areas for inquiry into animal-assisted therapies as well as how such video tools might influence people's knowledge and

perceptions about animals. In the quickly changing digital age, this and other similar studies would be very important to investigate.

These are but a few ways to continue to examine the various facets of the human-wildlife relationship. However many of them preferentially examine *human* perceptions and behaviors. While humans have the ability to enact substantial change in animals' lives, both positively and negatively, it is also essential to continue to evaluate the welfare, contributions, and state of the animal participant as well. I believe there must be an expansion in the ways we understand animals as well as humans' relationships with them. The human reliance on spoken communication and the fact that many animals experience the world through senses that are relatively underdeveloped in humans should not completely block the path of such understanding. While human understanding of animals is limited, as discussed in Thomas Nagel's famous essay, *What is it like to be a bat?* (Nagel, 1974), many scholars have referred to the validity and value of at least developing understanding to the best of our own abilities and based on our own experiences. Indeed, there is already a model that could be utilized in this situation. If the humanities (literature, philosophy, religion, etc.) are understood as the way in which the human experience and cultural variation is expressed, perhaps a parallel field—a type of “animalities”—is not too far reaching. Such an effort may well develop into a deeper understanding of the animal experience on its own terms. Whether or not this is feasible, it underscores the essential core idea that must be carried forward: human-animal relationships exist between two individuals or groups and each must be considered accordingly in order to promote the ultimate welfare of both.

## 6.5 Final Thoughts

I have always been fascinated with the relationships we build with animals. I was able to experience these relationships with all of the animals that have lived with me throughout the years, but I've also briefly viewed it with wild animals. Whether it was the crow that remembered who had fed him or her and showed up each day at the same place and time, or the coyote that ran through the neighborhood eliciting both fear and awe, or the whale that might be momentarily glimpsed while out on the water. All of these relationships have inspired me and made me question the deeper connections that might be built between animals and ourselves.

When turning to my studies, I knew these relationships could not be examined through a simple framework and I was able to approach it through many different lenses. This facilitated the diversity of results I was able to produce and I think aided in the overall conclusions I reached. I was provided the support and instruction to do so by my various co-authors and collaborators and I remain forever grateful for their patience, compassion, and mentorship. I know there is no one way to characterize the human-wildlife relationship and as much as I wish there were simple answers to improving these relationships, I know this is sadly not the case. Human wants are often contrasted with animal needs and with lack of understanding and ways to communicate compromise, instances of conflict will inevitably occur. But in my work, I wanted to focus, not so much on these instances of conflict, but instead on beneficial relationships, ways to understand more about the underlying factors in relationships, and finally, ways to improve those relationships. I thus choose to see this work as an expression of optimism and hope for the future and for coexistence.

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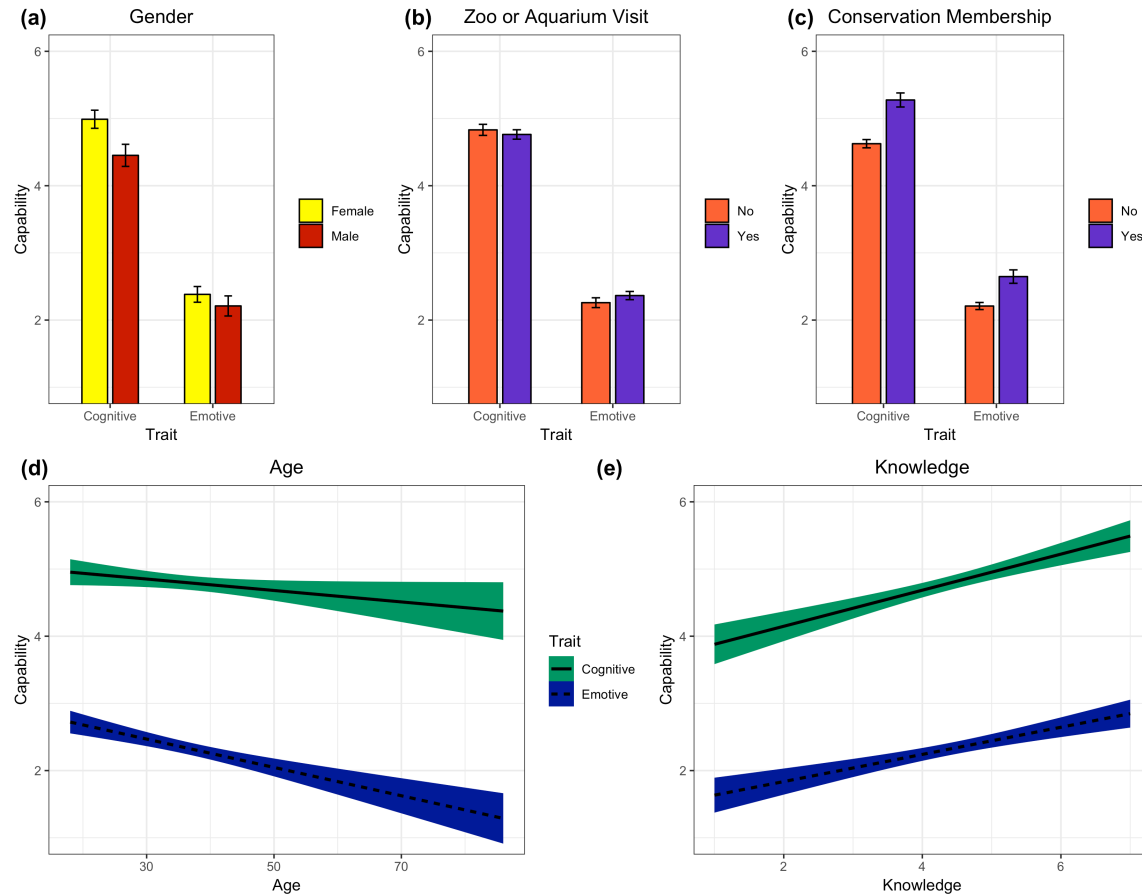
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## Appendices

### Appendix A Supplementary Tables and Figures

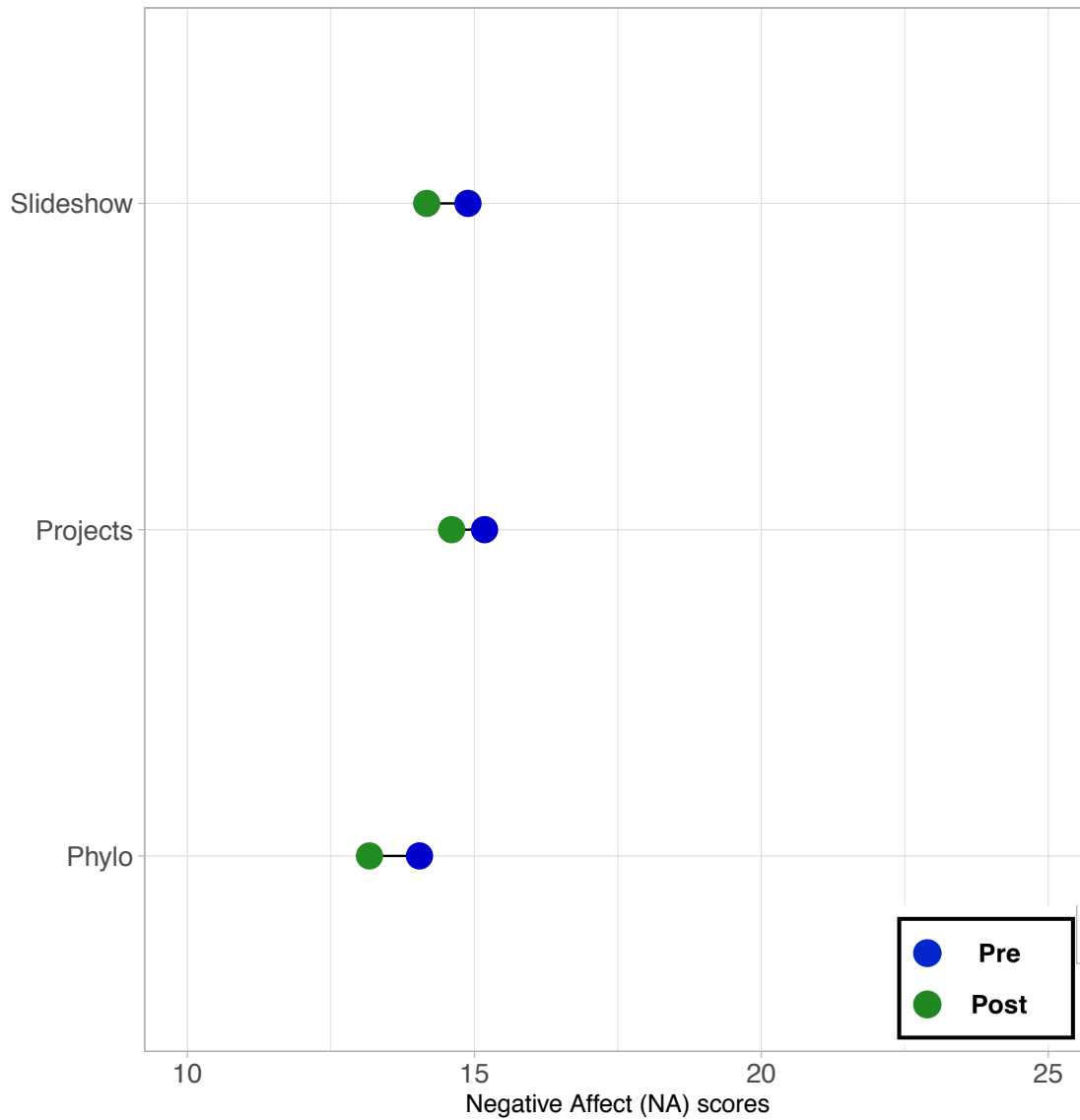


**Figure A.1. Bar graphs of demographic data.** Graphs show the demographic data (n=2342) for the perceived capability of both emotive and cognitive traits for all species for (a) gender, (b) zoo or aquarium visits in the last year and (c) membership in a conservation organization, and linear models for (d) age and (e) knowledge.



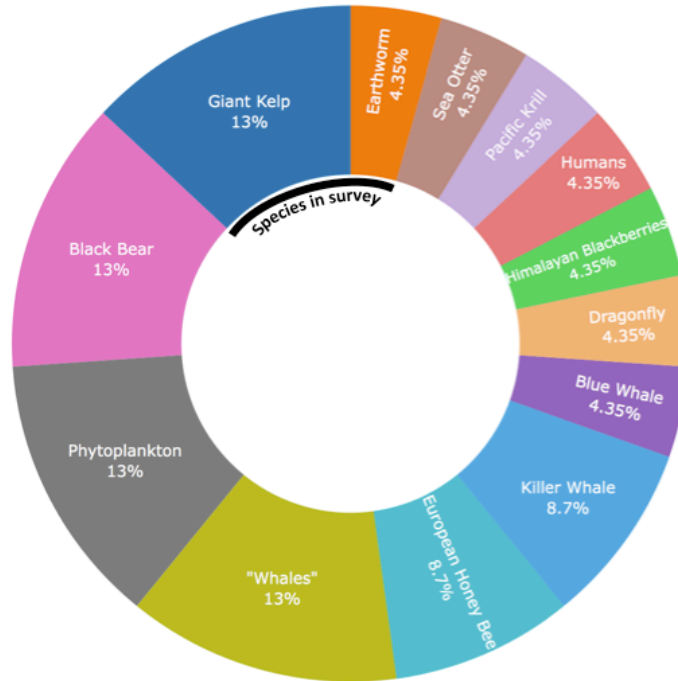
**Figure A.2. Layout of boxes used for collecting donations from participants.** There were 10 boxes total, four species: Conserve three-spined stickleback, Conserve Clark's Nutcracker, Conserve earthworm, and Conserve giant Kelp; three events: Prevent climate change, Prevent/fight wildfires, and Prevent/Clean oil spills; and three ecosystems: Conserve oceans, Conserve grasslands, and Conserve forests. Box orders were always randomized between participant pairs.



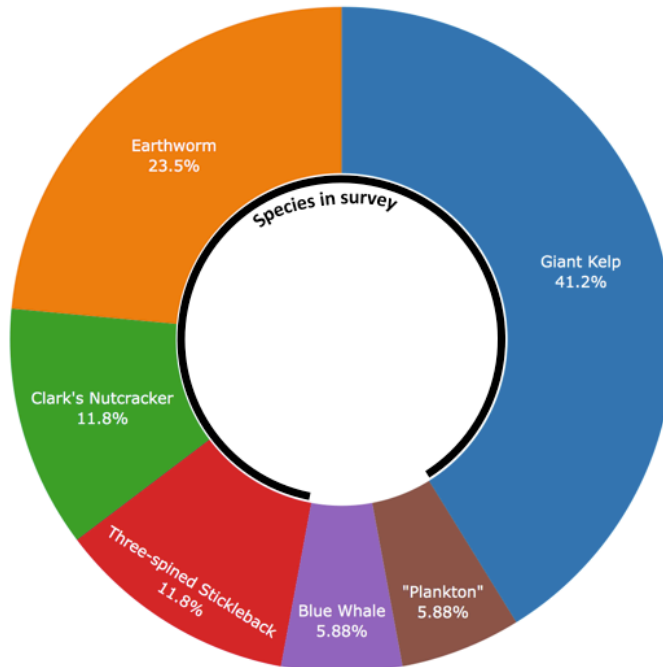


**Figure A.3. Lollipop graph showing the results of changes in mean scores for pre and post negative affect scores across conditions.** The blue circles represent the mean value of the pre survey and the green surveys represent the mean value of the post survey.

(a)



(b)



**Figure A.4. Donut graphs showing the species participants most recalled from the Phylo game or the slideshow.** Species were recalled at the end of the follow up survey, one month after participating in the experiment. The number of mentions of different species were from (a) among Phylo participants (n=23) and (b) among Slideshow participants (n=17). Black lines in the center of the graphs indicate species that were featured in the surveys.

**Table A.1. Labels used in the coding analysis of the qualitative questions**

<b>Label</b>	<b>Meaning</b>	<b>Examples</b>
<b>Ecological importance</b>	Words and phrases used to describe the beneficial relationship the animal has to the natural world.	“I think of an animal that is important to the ecosystem,” “...its extinction would be bad for creatures around it.”
<b>Economic impact</b>	Words and phrases that refer to the economic potential or human benefit of the animal or any of its parts.	“Its feathers may be a point of harvest for some people,” “...a fish that can be farmed for food.”
<b>Animal attributes</b>	Words and phrases used to describe the essence or main appearance of an animal.	“Lots of spines,” “Small,” “Agile.”
<b>Animal actions</b>	Words and phrases used to describe common actions that the animal may take including eating and diet.	“Feeds on insects and seeds/nuts,” “Flying,”
<b>Environment</b>	Words and phrases that describe the environment the animal may live in, including other animals present in that environment.	“Lives in forest and grassland environments,” “Tall trees,” “Other local species (e.g., seagulls).”
<b>Culture/Experience</b>	Words and phrases that relate the animal to elements of human culture or draw from the participants’ personal experiences.	“Home remedies for skin care,” “Playing at the beach,” “Birdwatching.”
<b>Unknown</b>	Words and phrases that indicate a lack of knowledge about the animal or a lack of familiarity with the animal	“I had not heard about this species prior to this study,” “No idea,” “I’m not too familiar with plants.”

**Table A.2. Number of mentions of each coded label in the pre and post survey across conditions**

Coded Categories	Phylo		Projects		Slideshow	
	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>
Ecological importance	84	117	86	84	60	150
Economic impact	55	35	38	44	41	28
Animal attributes	89	101	102	115	108	134
Animal actions	62	47	57	53	56	59
Environment	164	157	168	174	178	175
Culture/Experience	51	23	59	43	46	20
Unknown	45	17	25	16	47	13

**Table A.3. Number of mentions of “Fun” “Enjoyable” and “Like.”** Instances were recorded from written comments in the survey and verbal comments to the researchers across conditions

	Phylo	Projects	Slideshow
Written comment in survey	24	25	1
Verbal statement to researcher (and not stated in written comments)	2	3	0
Total	26	28	1
Percent of total participants in condition	37.14%	41.18%	1.41%

## Appendix B Human-wildlife literature review articles

Article	Year	Journal
'A place for everything': moral landscapes of 'swiftlet farming' in George Town, Malaysia	2016	Geoforum
'Of place' or 'of people': exploring the animal spaces and beastly places of feral cats in southern Ontario	2017	Social & Cultural Geography
'A pig is a person' or 'you can love a fox and hunt it'; innovation and tradition in the discursive representation of animals	2015	Discourse & Society
'I feel in love with Carlos the Meerkat': engagement and detachment in human-animal relations	2010	American Ethnologist
"Buddhist compassion" and "animal abuse" in Thailand's Tiger Temple	2013	Society and Animals
"The time of the most polar bears": a co-management conflict in Nunavut	2008	Arctic
"He's so fluffy I'm gonna die!" cute responses by hikers to autonomous animals on the Appalachian Trail	2019	Anthrozoös
"You can't really hug a tiger": zookeepers and their bonds with animals	2019	Anthrozoös
A citizen science survey: perceptions and attitudes of urban residents towards vervet monkeys	2017	Urban Ecosystems
A comparative approach to the study of keeper-animal relationships in the zoo	2009	Zoo Biology
A comparison between human-carnivore conflicts and local community attitudes toward carnivores in westgate community conservancy, Samburu, Kenya	2019	Human Dimensions of Wildlife
A comparison of attitudes towards animals between the German- and French-speaking part of Switzerland	2010	Schweizer Archiv fur Tierheilkunde
A multi-enclosure study investigating the behavioural response of meerkats to zoo visitors	2014	Applied Animal Behavioral Science
A tale of two species: human and peafowl interactions in human-dominated landscapes influence each other's behaviour	2020	Current Science
A walk on the wild side: how interactions with non-companion animals might help reduce human stress	2020	People and Nature
African penguin tolerance to humans depends on historical exposure at colony level	2016	Bird Conservation International

An anthropological analysis about primatology - reports of a particular human-animal relationship with Capuchin monkeys	2019	Anais da Academia Brasileira de Ciências
An experimental test of community-based strategies for mitigating human–wildlife conflict around protected areas.	2020	Conservation Letters
Animal images database: validation of 120 images for human-animal studies	2019	Animals
Animal personhood in Mi'kmaq perspective	2014	Societies
Animal-assisted interventions as an adjunct to therapy for youth: clinician perspectives	2020	Child and Adolescent Social Work Journal
Animal-related activities and appreciation of animals among children and adolescents	2001	Anthrozoös
Animals and pastoral groups in the mountainous Ömerli district of southeast Anatolia	2020	Anthrozoös
Annual intake trends of a large urban animal rehabilitation centre in South Africa: a case study	2010	Animal Welfare
Approaches to studying behavior in captive sloth bears through animal keeper feedback	2018	Zoo Biology
Aquatic animals and their threats to public health at human-animal-ecosystem interface: a review	2015	International Journal of the Bioflux Society
Artisanal fishers' perceptions of the ecosystem services derived from a dolphin-human cooperative fishing interaction in southern brazil	2019	Ocean & Coastal Management
Attitudes toward and acceptability of management strategies for a population of hooded crows ( <i>Corvus cornix</i> ) in Slovenia	2016	Anthrozoös
Attitudes toward animals among German children and adolescents	2013	Anthrozoös
Attitudes toward jaguars and pumas and the acceptability of killing big cats in the Brazilian Atlantic forest: An application of the potential for conflict	2017	Ambio
Attitudes towards returning wolves ( <i>Canis lupus</i> ) in Germany: Exposure, information sources and trust matter	2019	Biological Conservation
Attitudes, knowledge, and behavior toward wildlife among the industrial superpowers: United States, Japan, and Germany	1993	Journal of Social Issues
Behavioral adaptations of a large carnivore to human activity in an extremely arid landscape	2018	Animal Conservation

Behavioral ecology of captive species: using bibliographic information to assess pet suitability of mammal species	2016	Frontiers in Veterinary Science
Between "wild" and "tame": placing encounters with Sirocco the Kakapo Parrot in Aotearoa/New Zealand	2014	Society and Animals
Beyond neutrality: the human–primate interface during the habituation process	2018	International Journal of Primatology
Beyond the numbers: human attitudes and conflict with lions ( <i>Panthera leo</i> ) in and around Gambella National Park, Ethiopia	2018	PLoS One
Bicho bandido: wild boars, biological invasions and landscape transformations on the Brazilian-Uruguayan border (Pampas region)	2020	Social Anthropology
Biological and cultural anthropology of a changing tropical forest: a fruitful collaboration across subfields	2006	American Anthropologist
Biosocial conservation: integrating biological and ethnographic methods to study human-primate interactions	2017	International Journal of Primatology
Can training zoo-housed primates compromise their conservation? A case study using Abyssinian colobus monkeys ( <i>Colobus guereza</i> )	2005	Anthrozoös
Captive bears in human-animal welfare conflict: a case study of bile extraction on Asia's bear farms	2012	Journal of Agricultural and Environmental Ethics
Changing perceptions of protected area benefits and problems around Kibale National Park, Uganda	2017	Journal of Environmental Management
Characteristics of free-roaming cats and their caretakers	2002	Journal of American Veterinary Medical Association
Children's perception of wolverine in the North Slave Region of the Northwest Territories, Canada	2019	Arctic
Citizen science reveals widespread supplementary feeding of African woolly-necked storks in suburban areas of KwaZulu-natal, South Africa	2018	Urban Ecosystems
Coexistence and conflict between the Island Flying fox ( <i>Pteropus hypomelanus</i> ) and humans on Tioman Island, Peninsular Malaysia	2017	Human Ecology
Coexistence between humans and capuchins ( <i>Sapajus libidinosus</i> ): comparing observational data with farmers' perceptions of crop losses	2017	International Journal of Primatology

Coexistence with bears in Romania: a local community perspective	2019	Sustainability
Coloring and size influence preferences for imaginary animals, and can predict actual donations to species-specific conservation charities	2020	Conservation Letters
Common sensing: human-black bear cohabitation practices in Colorado	2016	Geoforum
Community participation in ecotourism and its effect on local perceptions of snow leopard ( <i>Panthera uncia</i> ) conservation	2019	Human Dimensions of Wildlife
Community perceptions of the human-wildlife conflict: a case study of old Oyo National Park, Nigeria	2019	Biodiversity
Community power over conservation regimes: techniques for neutralizing the illegal killing of large carnivores in Finland	2017	Crime, Law and Social Change
Conflict to coexistence: human - leopard interactions in a plantation landscape in Anamalai Hills, India	2017	Conservation & Society
Controlled exposure reduces fear of brown bears	2019	Human Dimensions of Wildlife
Costs of coexistence: understanding the drivers of tolerance towards Asian elephants ( <i>Elephas maximus</i> ) rural Bangladesh	2020	Oryx
Coyotes living near cities are bolder: implications for dog evolution and human-wildlife conflict	2020	Behaviour
Designing laboratory marmoset housing: What can we learn from urban marmosets?	2012	Applied Animal Behavioral Science
Distribution of Asiatic black bear and its interaction with humans in Jigme Singye Wangchuck National Park, Bhutan	2020	Nature Conservation Research
Does enrichment improve well being in animals under human care? A case study of two harbor seals ( <i>Phoca vitulina</i> )	2019	Journal of Applied Animal Welfare Science
Dolphins and human flourishing: a novel application of the PERMA model	2019	Ecopsychology
Dynamic mutual adaptation: human-animal interaction in reindeer herding pastoralism	2010	Human Ecology
Eco-psychiatry and environmental conservation: study from Sundarban Delta, India	2008	Environmental Health Insights
Ecopsychosocial aspects of human-tiger conflict: an ethnographic study of tiger widows of Sundarban Delta, India	2016	Environmental Health Insights



Ecotourists' beliefs and knowledge about dolphins and the development of cetacean ecotourism	1996	Aquatic Mammals
Effects of developmental history on the behavioural responses of European starlings ( <i>Sturnus vulgaris</i> ) to laboratory husbandry	2013	Animal Welfare
Effects of human settlement and roads on diel activity patterns of elephants ( <i>Loxodonta africana</i> )	2018	African Journal of Ecology
Effects of roads on the behaviour of the largest South American artiodactyl ( <i>Lama guanicoe</i> ) in an Argentine reserve	2017	Animal Behavior
Effects of touristic development on Mediterranean island wildlife	2019	Landscape Ecology
Effects of visual contact with zoo visitors on black-capped capuchin welfare	2015	Applied Animal Behavioral Science
Emotional coping among communities affected by wildlife-caused damage in north-east India: Opportunities for building tolerance and improving conservation outcomes.	2018	Oryx
Ethnoprimateology without conservation: the political ecology of farmer–Green Monkey ( <i>Chlorocebus sabaeus</i> ) relations in St. Kitts, West Indies	2018	International Journal of Primatology
Exploratory investigation of infrared thermography for measuring gorilla emotional responses to interactions with familiar humans	2019	Animals
Exploring local perceptions of and attitudes toward endangered Francois' Langurs ( <i>Trachypithecus francoisi</i> ) in a human-modified habitat	2019	International Journal of Primatology
Extensive human presence at an early age of ostriches improves the docility of birds at a later stage of life	2013	Applied Animal Behavioral Science
Fatalities due to indigenous and exotic species in Florida	2014	Journal of Forensic Science
Fear, economic consequences, hunting competition, and distrust of authorities determine preferences for illegal lethal actions against gray wolves ( <i>Canis lupus</i> ): a choice experiment among landowners in Jutland, Denmark	2017	Crime, Law and Social Change
Finding our bearings: understanding public attitudes toward growing black bear populations in Alabama	2018	Human Dimensions of Wildlife
Flight-initiation response reflects short- and long-term human visits to remote islets.	2020	Ibis
Fortified bomas and vigilant herding are perceived to reduce livestock depredation by large carnivores in the Tarangire-Simanjoro ecosystem, Tanzania	2017	Human Ecology

Four types of activities that affect animals: implications for animal welfare science and animal ethics philosophy	2011	Animal Welfare
Franco-Japanese and other collaborative contributions to understanding chimpanzee culture at Bossou and the Nimba Mountains	2020	Anthrozoös
Fur seals and fisheries in Tasmania: An integrated case study of human-wildlife conflict and coexistence.	2019	Biological Conservation
Good neighbours: distribution of black-tufted marmoset ( <i>Callithrix penicillata</i> ) in an urban environment	2016	Wildlife Research
Guarding crops from monkey troops: farmer-monkey interaction near a nature reserve in Guangxi, China	2020	Environmental Sociology
Hematological differences between stingrays at tourist and non-visited sites suggest physiological costs of wildlife tourism	2009	Biological Conservation
Heterogeneity in beliefs about feeding stray animals: the complexity of human–animal interaction	2020	Human Dimensions of Wildlife
How do human-animal emotional relationships influence public perceptions of animal use?	2016	Journal of Animal Ethics
How urban identity, affect, and knowledge predict perceptions about coyotes and their management.	2020	Anthrozoös
Human conflict over wildlife: Exploring social constructions of African wild dogs ( <i>Lycaon pictus</i> ) in Botswana	2018	Human Dimensions of Wildlife
Human peak experience triggered by encounters with cetaceans	2000	Anthrozoös
Human-leopard ( <i>Panthera pardus fusca</i> ) co-existence in Jhalana Forest Reserve, India	2019	Sustainability
Human-nonhuman animal relationships in Australia: An overview of results from the first national survey and follow-up case studies 2000-2004	2007	Society and Animals
Human-wildlife coexistence: attitudes and behavioural intentions towards predators in the Maasai Mara, Kenya	2020	Oryx
Human–dolphin interactions: relationships, connections, and the reinforcement of an ongoing nature relationship	2018	Anthrozoös
Human–wildlife interactions and attitudes towards wildlife and wildlife reserves in Rajasthan, India	2019	Oryx

Improved wellbeing for both caretakers and users from a zoo-related nature based intervention—a study at Nordens Ark Zoo, Sweden	2019	International journal of Environmental Research and Public Health
Influence of early experience on processing 2D threatening pictures by European starlings ( <i>Sturnus vulgaris</i> )	2018	Animal Cognition
Inside the yellow rectangle: an analysis of nonhuman animal representations on National Geographic Kids Magazine covers	2020	Anthrozoös
Interactions between humans and capuchin monkeys ( <i>Cebus libidinosus</i> ) in the Parque Nacional de Brasilia, Brazil	2006	Applied Animal Behavioral Science
Interactions with humans impose time constraints on urban-dwelling rhesus macaques ( <i>Macaca mulatta</i> ).	2019	Behaviour
Keeper-animal interactions: differences between the behaviour of zoo animals affect stockmanship	2015	PLoS One
Keepers as social companions: tactile communication and social enrichment for captive apes	2019	Sign Systems Studies
Linking human destruction of nature to COVID-19 increases support for wildlife conservation policies	2020	Environmental and Resource Economies
Little penguins, <i>Eudyptula minor</i> , show increased avoidance, aggression and vigilance in response to zoo visitors	2015	Applied Animal Behavioral Science
Living at the interface human-chimpanzee competition, coexistence and conflict in Africa	2009	Interaction Studies
Living with wildlife: conflict or co-existence	2016	Acta Ecologica Sinica
Local perception of public goods: recent assessments of willingness-to-pay for endangered species	2005	Contemporary Economic Policy
Local responses to marginalisation: human-wildlife conflict in Ethiopia's wetlands	2009	Geography
Local tolerance of hyena attacks in east Hararge Region, Ethiopia	2013	Anthrozoös
Longitudinal study on human-related behaviour in horses—can horses ( <i>Equus caballus</i> ) be de-domesticated?	2017	Applied Animal Behavioral Science
Maasai relationships with and perceptions of dogs in northern Tanzania	2020	Society and Animals
Mass-culling of a threatened island flying fox species failed to increase fruit growers' profits and revealed gaps to be addressed for effective conservation.	2019	Journal for Nature Conservation

Monkey business: human–animal conflicts in urban Singapore	2010	Social & Cultural Geography
Nonlinear liminality: human-animal relations on preserving the world's most famous tigress	2017	Geoforum
Once I found out: awareness of and attitudes toward coyote hunting policies in Massachusetts	2018	Human Dimensions of Wildlife
Participation of women and children in hunting activities in Sierra Leone and implications for control of zoonotic infections	2017	PLoS One Neglected Tropical Diseases
People and jaguars: new insights into the role of social factors in an old conflict	2020	Oryx
People and seals at Siberia's Lake Baikal	2013	Journal of Ethnobiology
Perception of visitors regarding the wildlife inhabiting an archaeological site	2019	Human Dimensions of Wildlife
Perceptions and attitudes of urucum settlement residents about local wildlife	2019	Anthrozoös
Perceptions and satisfaction of human-animal encounters in protected areas		Worldwide Hospitality and Tourism Themes
Preserving Preuss's red colobus ( <i>Piliocolobus preussi</i> ): an ethnographic analysis of hunting, conservation, and changing perceptions of primates in Ikenge-Bakoko, Cameroon	2018	International Journal of Primatology
Prevalence and determinants of stereotypic behaviours and physiological stress among tigers and leopards in Indian zoos	2017	PLoS One
Primates on the farm – spatial patterns of human–wildlife conflict in forest-agricultural landscape mosaic in Taita Hills, Kenya	2020	Applied Geography
Protecting life on land and below water: using storytelling to promote undergraduate students' attitudes toward animals	2018	Sustainability
Public acceptability of measures to prevent from predation on commercial fish by the endangered Eurasian otter ( <i>Lutra lutra</i> ) in Natura 2000	2018	Journal for Nature Conservation
Public attitudes in India and Australia toward elephants in zoos	2015	Anthrozoös
Putting animals back together, taking commodities apart	2014	Annals of the Association of American Geographers

Rating harms to wildlife: a survey showing convergence between conservation and animal welfare views	2013	Animal Welfare
Resisting extinction: purple martins, death, and the future	2019	Conservation & Society
Retaining change in attitudes and emotions toward coyotes using experiential education	2019	Wildlife Research
Rural and urban students' perceptions of and attitudes toward brown bears in Turkey	2016	Anthrozoös
Saltwater crocodile and human conflict around Bhitarkanika National Park, India: a raising concern for determining conservation limits.	2019	Ocean & Coastal Management
Secondary phorate poisoning of large carnivores in India	2011	European Journal of Wildlife Research
Short- and long-term changes in the intensity of responses of pinnipeds to tourist approaches in Cabo Polonio, Uruguay	2018	Applied Animal Behavioral Science
Slovenian students' knowledge and opinions about wild boar ( <i>Sus scrofa</i> L.)	2018	Anthrozoös
Social media contexts moderate perceptions of animals	2020	Animals
Solidarity with animals: assessing a relevant dimension of social identification with animals	2017	PLoS One
Sorcery and nature conservation	2018	Environmental Conservation
Spatial assessment of attitudes toward tigers in Nepal	2014	Ambio
Strengthening animal-human relationships as a doorway to indigenous holistic wellness	2019	Ecopsychology
Student perceptions of, and attitudes toward, bats in Barak Valley, Assam, India	2018	Anthrozoös
Survey-based assessment of the frequency and potential impacts of recreation on polar bears	2018	Biological Conservation
Surveying attitudes toward reptiles on roads: questionnaire responses do not directly translate to behavioral action	2019	Anthrozoös
Temporal patterns of human-fox interactions as revealed from internet searches	2020	Human Dimensions of Wildlife
Testing the roles of intergroup anxiety and inclusion of animals in the self as mechanisms that underpin the "pets as ambassadors" effect	2019	Anthrozoös
The 'nature dispositions' of visitors to animal encounter sites in Australia and New Zealand	1999	Journal of Sociology

The ability of artisanal fishers to recognize the dolphins they cooperate with	2020	Journal of Ethnobiology and Ethnomedicine
The Asian elephants-driver partnership - the drivers perspective	1994	Applied Animal Behavioral Science
The educational benefits of a ten-week home-based wild bird feeding program for children	2001	Anthrozoös
The effect of behind-the-scenes encounters and interactive presentations on the welfare of captive servals ( <i>Leptailurus serval</i> )	2020	Animals
The effect of investigator disturbance on egg laying, chick survival and fledging mass of short-tailed shearwaters ( <i>Puffinus tenuirostris</i> ) and little penguins ( <i>Eudyptula minor</i> )	2012	Animal Welfare
The effect of rapid social changes during post-communist transition on perceptions of the human - wolf relationships in Macedonia and Kyrgyzstan.	2013	Pastoralism
The effects of environmental and visitor variables on the behavior of free-ranging ring-tailed lemurs ( <i>Lemur catta</i> ) in captivity	2017	Zoo Biology
The effects of zoo visitors on Quokka ( <i>Setonix brachyurus</i> ) avoidance behavior in a walk-through exhibit	2018	Zoo Biology
The emergence of tolerance of human disturbance in Neotropical birds	2020	Journal of Tropical Ecology
The fascination of fur and feathers: managing human-animal interactions in wildlife tourism settings	2006	Australian Zoologist
The gift in the animal: the ontology of hunting and human-animal sociality	2007	American Ethnologist
The good, the bad and the ugly: perceptions of wildlife in Tombali (Guinea-Bissau, West Africa)	2013	Journal of Primatology
The impact of 'selfie' tourism on the behaviour and welfare of brown-throated three-toed sloths	2018	Animals
The impact of wildlife-related benefits on the conservation attitudes of local people around the Selous Game Reserve, Tanzania	1999	Environmental Conservation
The importance of first impression judgments in interspecies interactions	2020	Scientific Reports
The insolent fox: human–animal relations with protected predators in central-southern Chile	2020	Anthrozoös

The leopard that learnt from the cat and other narratives of carnivore–human coexistence in northern India	2019	People and Nature
The monkey is not always a god: attitudinal differences toward crop-raiding macaques and why it matters for conflict mitigation.	2018	Ambio
The reintroduction of the white-tailed sea eagle to Ireland: people and wildlife	2014	Land Use Policy
The relationship between bonding with nonhuman animals and students' attitudes toward science	2008	Society and Animals
The tragedy of becoming common: landscape change and perceptions of wildlife	2010	Society & Natural Resources
Theories of nomadic movement: a new theoretical approach for understanding the movement decisions of Nenets and Komi reindeer herders	2008	Human Ecology
There goes the neighborhood: urban coyotes and the politics of wildlife	2019	journal of Urban Affairs
Tooth breakage and dental disease as causes of carnivore-human conflicts	2003	Journal of Mammalogy
Tourist impact on Tibetan macaques	2006	Anthrozoös
Toward sustainable conservation and management of human-wildlife interactions in the Mmadinare region of Botswana: villagers' perceptions on challenges and prospects	2018	Human-Wildlife Interactions
Training reduces stress in human-socialised wolves to the same degree as in dogs	2016	PLoS One
Transgressive little pests: hiker descriptions of "shelter mice" on the Appalachian Trail	2019	Anthrozoös
Troublemaking carnivores: conflicts with humans in a diverse assemblage of large carnivores	2017	Ecology and Society
Uncertain encounters with wild elephants in Assam, northeast India	2017	Journal of Religious and Political Practice
Understanding carnivore killing behaviour: exploring the motivations for tiger killing in the Sundarbans, Bangladesh	2014	Biological Conservation
Understanding complex drivers of wildlife crime to design effective conservation interventions	2019	Conservation Biology
Understanding foraging flexibility in urban vervet monkeys, <i>Chlorocebus pygerythrus</i> , for the benefit of human-wildlife coexistence	2020	Urban Ecosystems

Understanding human attitudes towards sharks to promote sustainable coexistence	2018	Marine Policy
Understanding human-animal relations in the context of primate conservation: a multispecies ethnographic approach in North Morocco	2018	Folia Primatologica
Understanding people's responses toward predators in the Indian Himalaya	2020	Animal Conservation
Urban sloths: public knowledge, opinions, and interactions	2018	Animals
Using a social science approach to study interactions between ski tourers and wildlife in mountain protected areas	2018	Mountain Research and Development
Variability and change in Maasai views of wildlife and the implications for conservation.	2019	Human Ecology
Visitor perceptions of captive, endangered Barbary macaques ( <i>Macaca sylvanus</i> ) used as photo props in Jemaa El Fna Square, Marrakech, Morocco	2018	Anthrozoös
Vultures attacking livestock: a problem of vulture behavioural change or farmers' perception?	2019	Bird Conservation International
Who hunts lemurs and why they hunt them	2016	Biological Conservation
Why not the city?; urban hawk watching and the end of nature	2017	Nature and Culture
Wildlife responses to recreation and associated visitor perceptions	2003	Ecological Applications
Wildlife-vehicle collisions in Spain	2015	European Journal of Wildlife Research
Working for the forest: the ambivalent intimacies of human–elephant collaboration in South Indian Wildlife Conservation	2016	Ethnos
Youth experiences with wildlife during a period of significant cultural change in Laikipia, Kenya	2015	Human Dimensions of Wildlife
Zoo experiences: conversations, connections, and concern for animals	2009	Zoo Biology



## **Appendix C Aquarium staff interview consent form and script**

### **Consent Form**

Understanding Human-Animal Relationships of Care at the Vancouver Aquarium

#### **Principal Investigator:**

Dr. Theresa Satterfield, Institute for Resources, Environment and Sustainability. University of British Columbia. Vancouver, B.C., Canada. XX.

#### **Co-Investigator:**

Megan (Meggie) Callahan, Institute for Resources, Environment and Sustainability. Contact: XX (US Cell), XX (Canada Cell), or XX.

You are being asked to participate in a research study conducted by Meggie Callahan and Dr. Terre Satterfield from the Institute for Resources, Environment and Sustainability at the University of British Columbia. The study is being conducted as part of a graduate student dissertation.

#### **Sponsor:**

Funding is provided by the Institute for Resources, Environment and Sustainability.

#### **Purpose:**

You have been asked to participate in this research study because you are a staff member or volunteer at the Vancouver Aquarium. The purpose of this research is to discuss the relationships between your role as staff at the Aquarium and the variety of different animals with which you interact. Furthermore this research seeks to identify your insights and perceptions of the general public's assumptions about the nature of your relationship with the animals at the Aquarium.

#### **Study Procedures:**

This work will be accomplished with one-to-one interviews. Questions regarding relationships between staff and animals as well as those regarding your perceptions of the public will be asked. There are no costs to you for participating. The interview should take around one hour, but can be completed across various time periods. The interview will be audiotaped and then transcribed. You will receive a copy of the transcription to comment upon and review. The results will also help inform a future survey of the visiting public.

#### **Risks:**

There are no known risks should you chose to participate in this study, except perhaps for your personal reflections that may arise from interviews about your relationships with the animals. You may withdraw from the interview at any point.

**Confidentiality:**

Unless you wish to be cited by name, your name will be known only to the two researchers listed. Your identity will be protected by utilizing an individual study number instead of your name. No one else will have access to any of your interview answers. All documents will be identified only by code number and kept in a secure password protected computer. Should the data be published, no individual information will be disclosed.

Despite these precautions it is conceivable that the participant may be identified by the information provided. However, in the compiled report no names or positions will be used unless otherwise desired by you.

Should you instead wish to be cited by name and position, we will of course do so.

I wish to be identified by name:      Yes ☐      No ☐

I wish to be identified by position:      Yes ☐      No ☐

**Compensation:**

No payment will be offered as part of participating in this research study. A single donation of \$500.00 will be given to the Aquarium.

**Contact:**

If you have any questions or desire further information with respect to this study you may contact Terre Satterfield or Meggie Callahan.

If you have any concerns about your treatment or rights as a research participant, you may telephone the Research Subject Information Line in the UBC Office of Research Services at the University of British Columbia, at XX or if long distance email XX or call toll free XX.

**Consent:**

You may choose whether or not to participate in this study. If you chose to be involved in this study you may withdraw at any time without any consequences of any kind. You may remove your data from the study at any time. You may also refuse to answer any questions and still remain in the study.

Signed consent forms will be collected prior to beginning the interview.

Your signature below indicates that you have received a copy of this consent form for your own records.

Your signature indicates that you consent to participate in this study.

---

Participant Signature

Date

---

Printed Name

### **Aquarium Interview Script**

I am interested in exploring the relationship between the staff and volunteers at the Vancouver Aquarium and the animals in their care.

What is your role at the Aquarium?

How long have you been at the Aquarium?

What animals do you interact with most frequently at the Aquarium?

I'd like to talk a bit about your relationship with those animals...

#### **Relationship:**

Can you describe a normal day of work for you?

What type of interactions do you have with the [animals named]?

Can you give me some specific examples?

What types of care do you provide the animals? (Physical, emotional, physiological, psychological, etc)?

#### **Understanding of Animals:**

What do you think of think of the animals in your care?

Have your thoughts changed over time?

Are there any events that have occurred at the Aquarium that have changed your relationship or perception of the animal?

Do you think the animals think? If yes, how so? If no, why not?

Do you think the animals feel?

#### **Experiences:**

Do you have any memorable experiences that come to mind when thinking about who the animal is and whether you see that interaction/behavior as specific to the animal or the specific to the species?

Have you found your relationships with [named animal] have changed while you've worked at the Aquarium?

Do you communicate with the animals? If yes, how so?

Do you interact differently with animals that you know or hope will be returned to the wild versus those who are more likely to be permanent residents at the Aquarium? If it is easier, we can talk first about maintaining “wildness” then “domestication”?

**Public:**

Can you describe your primary audiences or your ‘public’?

How do you think the public relates to the animals at the Aquarium?

What do you think visitors know about the relationships between staff and animals?

What do you wish visitors knew about the relationship between staff and animals?

What do you want visitors to get out of their experiences at the Aquarium?

How would you like the public to relate with animals at the Aquarium?

Is there anything you don’t believe the public understands that you would like them to?

Is there anything else you would like to mention or discuss that I haven’t yet enabled?

Note: I will frequently provide necessary pauses after questions as well as additional prompts as needed to provide chances for additional answers. The wording will be along the lines of “is there anything else that comes to mind or that you would like to add?”

## **Appendix D Copy of one online survey of animal capabilities**

### **Who is conducting this survey?**

Principal investigators: Dr. Terre Satterfield, Institute for Resources, Environment & Sustainability, University of British Columbia (XX) and Dr. Jiaying Zhao, Institute for Resources, Environment & Sustainability, University of British Columbia (XX). Co-Investigator: Megan Callahan, PhD Candidate, Institute for Resources, Environment & Sustainability, University of British Columbia (XX).

### **Study Purpose:**

Our purpose is to understand how you perceive different animals.

### **Study Description:**

Your task is to answer questions about the following animal. The name and a picture of the animal are provided before each set of questions. The picture is provided as a representative reminder of the appearance of the animal. Please do not base your answers on the specific picture provided, but instead base your answers on your own perceptions of the animal group. You will be asked a series of questions about 1 animal.

Results from this survey will be reported in M. Callahan's graduate thesis and may also be published in journal articles and books.

**Time:** This survey takes approximately 10 minutes, but the HIT will be open for 35 minutes.

### **Risks and Benefits:**

There seems to be no major or direct negative impacts for individuals who participate in this survey. However, if you are uncomfortable viewing a picture of a certain animal, you may leave the study at any point. As per Mturk protocols you will be compensated for your participation. Results of the study may assist with conservation goals.

### **Privacy:**

You will remain anonymous. No names or contact information will be collected. All survey responses will remain strictly confidential. Survey data is stored in Canadian data centers.

### **Contact Information:**

If you have questions or concerns, please contact the principal investigators or the co-investigator. Principal investigators: Dr. Terre Satterfield, Institute for Resources, Environment & Sustainability, University of British Columbia (XX) and Dr. Jiaying Zhao, Institute for Resources, Environment & Sustainability, University of British Columbia (XX). Co-Investigator: Megan Callahan, PhD Candidate, Institute for Resources, Environment & Sustainability, University of British Columbia (XX).

### **Contact for concerns about the rights of research participants:**

If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at XX or if long distance e-mail XX or call toll free XX.

**Participant Consent:**

Participation in this study is optional. You may leave the study at any time. **By completing the questionnaire, you are consenting to participate in this research.**

Your task is to answer questions about the following animal.

The name and a picture of the animal are provided before the questions. The picture is provided as a representative reminder of the appearance of the animal.

Please do not base your answers on the specific picture provided, but instead base your answer on your own perceptions of the animal group.

## **New Caledonian Crow**



**Do you see these animals as...**

	Not at all Capable					Extremely Capable					
	0	1	2	3	4	5	6	7	8	9	10
Capable of surviving through instinct alone?											
Capable of experiencing joy?											
Capable of experiencing remorse?											
Capable of experiencing greed?											
Capable of experiencing pride?											
Capable of experiencing shame?											
Capable of experiencing jealousy?											
Capable of experiencing guilt?											
Capable of experiencing embarrassment?											
Capable of experiencing grief?											
Capable of using tools in response to a need? (Where a tool is defined as an item the animals use as an extension of their own bodies)											
Capable of making a tool in order to solve a problem?											
Capable of saving a tool in the anticipation of a future need?											

Capable of solving a problem that requires multiple steps in a specific order?

Capable of understanding that even when an object is not visible it is still in existence?

Capable of solving problems through trial and error?

Capable of solving problems by imitating other members of the same species?

Capable of solving problems by imitating other members of a different species?

Capable of demonstrating problem solving techniques to others?

Capable of anticipating the outcome of their own actions before those actions are taken?

Capable of understanding what they know?

Capable of remembering information in the long-term?

Capable of understanding how other members of their own species feel?

Capable of understanding how other members of a different species feel?

Capable of distinguishing between members of a different species?

Capable of having imagination?

Capable of being creative?

Capable of appreciating art?

Capable of verbally communicating to other members of their own species?



Capable of verbally communicating to members of a different species?

Capable of nonverbally communicating to members of a different species?

Capable of cooperating with other individuals in order to reach a common goal?

Capable of experiencing concern for the well-being of other members of their own species?

Capable of experiencing concern of the well-being of other members of a different species?

Capable of playing (a behavior that is performed for enjoyment and not for any immediate survival needs)?

Capable of helping other members of their own species?

Capable of helping other members of a different species?

Capable of intelligence?

Capable of experiencing consciousness?

Capable of having agency?

We have a few more questions to ask you. We'd like to know about some of your wildlife-related and nature-related experiences or activities in which you may have been involved.

What do you think influences your views about wildlife?

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Please indicate Yes or No for the following questions

	Yes	No
Have you ever been a member of a conservation, animal welfare, or other environmental organization?	<input type="radio"/>	<input type="radio"/>
Do you currently have any pets?	<input type="radio"/>	<input type="radio"/>
Have you ever had pets?	<input type="radio"/>	<input type="radio"/>
Have you visited a zoo in the last year?	<input type="radio"/>	<input type="radio"/>
Have you visited an aquarium in the last year?	<input type="radio"/>	<input type="radio"/>

How many times have you watched films, documentaries, or read about wildlife in the past 2 years?

- ☐ Never
- ☐ 1-2 times
- ☐ 2-5 times
- ☐ More than 5 times

How knowledgeable are you about wildlife?

	1	2	3	4	5	6	7	
Not at all knowledgeable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very knowledgeable

In this last section of the survey, we would like to learn more about your background and your current household characteristics. You can be assured that all your answers will be kept confidential. This information will only be used to report results among groups of people. We will never identify individuals or households with these responses.

Age (in years)

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Gender

- ☐ Female
- ☐ Male
- ☐ Other
- ☐ Prefer not to answer

Where do you consider home? (City, Country)

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What is the highest level of education you have completed?

- ☐ High school or equivalent
- ☐ Vocational/Technical school
- ☐ College
- ☐ Bachelor's Degree
- ☐ Professional degree (MD, JD, etc)
- ☐ Master's degree
- ☐ Doctoral degree
- ☐ Other

What races or ethnic background do you consider yourself to be? (Please check all that apply).

- ☐ White or Caucasian
- ☐ Black or African-American
- ☐ Hispanic or Latino (includes Mexican, Central American and South American)
- ☐ Korean
- ☐ Japanese
- ☐ Chinese
- ☐ Filipino
- ☐ Pacific Islander
- ☐ Middle Eastern
- ☐ African (NOT African-American)
- ☐ South Asian (from India, Bangladesh, Pakistan, etc.)
- ☐ Other

What is your religious affiliation?

- ☐ Mormon
- ☐ Muslim
- ☐ an Orthodox Church such as Greek or Russian Orthodox Church
- ☐ Buddhist
- ☐ Catholic
- ☐ Protestant
- ☐ Jewish
- ☐ Jehovah's Witness
- ☐ Hindu
- ☐ Atheist
- ☐ Agnostic
- ☐ Other

Thank you for participating in this survey!

## **Appendix E Pre and Post surveys for Phylo Game participants**

### **Phylo Pre-Survey**

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#### **Consent Form**

Understanding Perceptions of Species and the Phylo game

#### **Principal Investigators:**

Dr. Jiaying Zhao, Institute for Resources, Environment and Sustainability, University of British Columbia. Contact: XX.

Dr. David Ng, Advanced Molecular Biology Laboratory, University of British Columbia. Contact: XX.

#### **Co-Investigators:**

Dr. Terre Satterfield, Institute for Resources, Environment and Sustainability, University of British Columbia. Contact: XX.

Megan Callahan, Institute for Resources, Environment and Sustainability, University of British Columbia. Contact: XX.

Alejandra Echeverri Institute for Resources, Environment and Sustainability, University of British Columbia. Contact: XX.

Dr. Kai Chan, Institute for Resources, Environment and Sustainability, University of British Columbia Contact: XX

#### **Research Assistants:**

Amit Chhina Department of Psychology, University of British Columbia. Contact: XX.

Katie Edge Department of Psychology, University of British Columbia. Contact: XX.

You are being asked to participate in a research study conducted by Dr. Jiaying Zhao, Megan Callahan, Alejandra Echeverri, Dr. Terre Satterfield, and Dr. Kai Chan from the Institute for Resources, Environment and Sustainability and Dr. David Ng from the Advanced Molecular Biology Laboratory at the University of British Columbia. The study is being conducted as part of a graduate student thesis.

#### **Sponsor:**

The funding for this study is provided from the operating grant of the Advanced Molecular Biology Laboratories within UBC's Michael Smith Laboratories. The study has not received funding from an internal or external funding competition or award.

#### **Purpose:**

The purpose of this research is to understand people's knowledge and perceptions about different species and to examine the Phylo game. You have been asked to participate in this research study because you are a student at the University of British Columbia and have a good understanding of spoken and written English in order to follow instructions.

**Study Procedures:**

All research will be conducted in room XX in the Aquatic Ecosystems Research Lab, XXX UBC Vancouver campus.

You will be engaging in the research in pairs. You will take an online survey and then either play a game or view a slideshow. You will then take another online survey. You will be contacted by email 1 month later and asked to participate in an online survey.

The entire research session will take approximately 2 hours.

**Risks:**

There are no known risks should you chose to participate in this study. However if you are uncomfortable answering a question about any species or at any other point during the study you may leave the study at any time.

**Confidentiality:**

Any information resulting from this research study will be kept confidential. All data will be encrypted and be kept in a secure password protected computer. Should the data be published, no individual information will be disclosed, all information will be in aggregate form. Only the principal investigators, co-investigators, and their research assistants will have access to the data. The data will be used for publication purposes only and will be maintained for a minimum of five years. All raw data will be destroyed after 5 years.

**Compensation:**

You will receive 2 HSP credit for your participation. In addition, at the end of the study you will recieve a coin that you may keep or use to donate to a particular species or event of your choice.

**Contact:**

If you have any questions or desire further information with respect to this study please contact Megan Callahan (XX), Alejandra Echeverri (XX), or Dr. Jiaying Zhao (XX).

If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at XX or if long distance email XX or call toll free XX.

**Consent:**

You may choose whether or not to participate in this study. If you chose to be involved in this study you may withdraw at any time without any consequences of any kind. You may remove your data from the study at any time for up to a month after you have completed the study.

Your signature below indicates that you have been offered a copy of this consent form for your own records.

Your signature indicates that you consent to participate in this study.

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Please print your name

\_\_\_\_\_

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Please write the date

\_\_\_\_\_

In this question there are a number of words that describe different feelings and emotions. Read each item and then select a number from the scale below. **Indicate to what extent you feel this way right now, that is, at the present moment.**

1	2	3	4	5
Very Slightly or Not at All	A little	Moderately	Quite a Bit	Extremely

	1	2	3	4	5
Interested	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Distressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Excited	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Strong	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Guilty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scared	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	1	2	3	4	5
Hostile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enthusiastic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Proud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alert	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ashamed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inspired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nervous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Determined	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attentive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jittery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Active	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Afraid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



## Clark's Nutcracker



Clark's nutcrackers are...

- ☐ Autotroph
- ☐ Carnivore
- ☐ Herbivore
- ☐ Omnivore
- ☐ Other

Clark's nutcrackers live in which environment(s) (Select all that apply)

- ☐ Desert
- ☐ Forest
- ☐ Freshwater
- ☐ Grassland
- ☐ Ocean
- ☐ Tundra
- ☐ Urban

## Three-spined Stickleback



Three-spined sticklebacks are...

- ☐ Autotroph
- ☐ Carnivore
- ☐ Herbivore
- ☐ Omnivore
- ☐ Other

Three-spined sticklebacks live in which environment(s) (Select all that apply)

- ☐ Desert
- ☐ Forest
- ☐ Freshwater
- ☐ Grassland
- ☐ Ocean
- ☐ Tundra
- ☐ Urban

## Earthworm



Earthworms are...

- ☐ Autotroph
- ☐ Carnivore
- ☐ Herbivore
- ☐ Omnivore
- ☐ Other

Earthworms live in which environment(s) (Select all that apply)

- ☐ Desert
- ☐ Forest
- ☐ Freshwater
- ☐ Grassland
- ☐ Ocean
- ☐ Tundra
- ☐ Urban

# Giant Kelp



Giant kelp is a(n)...

- ☐ Autotroph
- ☐ Carnivore
- ☐ Herbivore
- ☐ Omnivore
- ☐ Other

Giant Kelp lives in which environment(s) (Select all that apply)

- ☐ Desert
- ☐ Forest
- ☐ Freshwater
- ☐ Grassland
- ☐ Ocean
- ☐ Tundra
- ☐ Urban

Please answer the following questions about **Clark's Nutcrackers**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
This species provides raw materials for human use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The harvesting of this species provides employment opportunities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The sale of this species provides income for humans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species is important to its ecosystem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It would not matter if this species went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other species rely on this species for their survival.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species provides a source of tourism and recreational interest.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would miss this species if it went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like this species.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you see **Clark's Nutcrackers** as...

	Not at all capable					Extremely capable					
	0	1	2	3	4	5	6	7	8	9	10
Capable of experiencing emotions?											
Capable of solving a problem that requires multiple steps in a specific order?											
Capable of understanding how other members of their own species feel?											
Capable of surviving through instinct alone?											
Capable of intelligence											
Capable of experiencing consciousness											

Have you heard of **Clark's Nutcrackers**

☐ Yes (4)

☐ No (5)

What comes to mind when you think of **Clark's Nutcrackers**? (List or write out anything that comes to mind).

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Please answer the following questions about **Three-spined Sticklebacks**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
This species provides raw materials for human use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The harvesting of this species provides employment opportunities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The sale of this species provides income for humans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species is important to its ecosystem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It would not matter if this species went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other species rely on this species for their survival.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species provides a source of tourism and recreational interest.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would miss this species if it went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like this species.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you see **Three-spined Sticklebacks** as...

	Not at all capable					Extremely capable					
	0	1	2	3	4	5	6	7	8	9	10
Capable of experiencing emotions?											
Capable of solving a problem that requires multiple steps in a specific order?											
Capable of understanding how other members of their own species feel?											
Capable of surviving through instinct alone?											
Capable of intelligence											

Capable of experiencing consciousness

Have you heard of **Three-spined Sticklebacks**?

☐ Yes

☐ No

What comes to mind when you think of **Three-spined Sticklebacks**? (List or write out anything that comes to mind).

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Please answer the following questions about **Earthworms**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
This species provides raw materials for human use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The harvesting of this species provides employment opportunities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The sale of this species provides income for humans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species is important to its ecosystem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It would not matter if this species went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other species rely on this species for their survival.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species provides a source of tourism and recreational interest.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would miss this species if it went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like this species.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you see **Earthworms** as...

	Not at all capable					Extremely capable					
	0	1	2	3	4	5	6	7	8	9	10
Capable of experiencing emotions?											
Capable of solving a problem that requires multiple steps in a specific order?											
Capable of understanding how other members of their own species feel?											
Capable of surviving through instinct alone?											
Capable of intelligence											

Have you heard of **Earthworms**?

☐ Yes

☐ No

What comes to mind when you think of **Earthworms**? (List or write out anything that comes to mind).

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Please answer the following questions about **Giant Kelp**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
This species provides raw materials for human use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The harvesting of this species provides employment opportunities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The sale of this species provides income for humans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species is important to its ecosystem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It would not matter if this species went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other species rely on this species for their survival.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species provides a source of tourism and recreational interest.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would miss this species if it went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like this species.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you see **Giant Kelp** as...

	Not at all capable					Extremely capable					
	0	1	2	3	4	5	6	7	8	9	10
Capable of experiencing emotions?											
Capable of solving a problem that requires multiple steps in a specific order?											
Capable of understanding how other members of their own species feel?											
Capable of surviving through instinct alone?											
Capable of intelligence											

What comes to mind when you think of **Giant Kelp**? (List or write out anything that comes to mind).

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What comes to mind when you think of **Oceans** (List or write out anything that comes to mind).

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What comes to mind when you think of **Forests**? (List or write out anything that comes to mind).

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Q40 What comes to mind when you think of **Grasslands**? (List or write out anything that comes to mind).

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Please answer the following questions...

	Strongly disagree	Disagree a little	Neither agree nor disagree	Agree a little	Strongly agree
My ideal vacation spot would be a remote, wilderness area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I always think about how my actions affect the environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My connection to nature and the environment is a part of my spirituality.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I take notice of wildlife wherever I am.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My relationship to nature is an important part of who I am.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel very connected to all living things and the earth.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you could donate to conserve a species or environment or prevent a threat to species, which one of the following would you choose?

- ☐ Conserve Clark's Nutcracker
- ☐ Conserve Grasslands
- ☐ Conserve Forests
- ☐ Conserve Earthworm
- ☐ Conserve Oceans
- ☐ Conserve Three-spined Stickleback
- ☐ Conserve Giant Kelp
- ☐ Prevent Climate Change
- ☐ Prevent/Clean Oil Spills
- ☐ Prevent/Fight Wildfires
- ☐ I would prefer to keep my money

Why did you choose that option?

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## Phylo Post-Survey

In this question there are a number of words that describe different feelings and emotions. Read each item and then select a number from the scale below. **Indicate to what extent you feel this way right now, that is, at the present moment.**

1	2	3	4	5
Very Slightly or Not at All	A little	Moderately	Quite a Bit	Extremely

	1	2	3	4	5
Interested	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Distressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Excited	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Strong	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Guilty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scared	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hostile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enthusiastic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Proud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	1	2	3	4	5
Alert	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ashamed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inspired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nervous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Determined	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attentive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jittery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Active	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Afraid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Clark's Nutcracker



Clark's nutcrackers are...

- ☐ Autotroph
- ☐ Carnivore
- ☐ Herbivore
- ☐ Omnivore
- ☐ Other

Clark's nutcrackers live in which environment(s) (Select all that apply)

- ☐ Desert
- ☐ Forest
- ☐ Freshwater
- ☐ Grassland
- ☐ Ocean
- ☐ Tundra
- ☐ Urban

## Three-spined Stickleback



Three-spined sticklebacks are...

- ☐ Autotroph
- ☐ Carnivore
- ☐ Herbivore
- ☐ Omnivore
- ☐ Other



Three-spined sticklebacks live in which environment(s) (Select all that apply)

- ☐ Desert
- ☐ Forest
- ☐ Freshwater
- ☐ Grassland
- ☐ Ocean
- ☐ Tundra
- ☐ Urban

## Earthworm



Earthworms are...

- ☐ Autotroph
- ☐ Carnivore
- ☐ Herbivore
- ☐ Omnivore
- ☐ Other

Earthworms live in which environment(s) (Select all that apply)

- ☐ Desert
- ☐ Forest
- ☐ Freshwater
- ☐ Grassland
- ☐ Ocean
- ☐ Tundra
- ☐ Urban

# Giant Kelp



Giant kelp is a(n)...

- ☐ Autotroph
- ☐ Carnivore
- ☐ Herbivore
- ☐ Omnivore
- ☐ Other

Giant Kelp lives in which environment(s) (Select all that apply)

- ☐ Desert
- ☐ Forest
- ☐ Freshwater
- ☐ Grassland
- ☐ Ocean
- ☐ Tundra
- ☐ Urban

Please answer the following questions about **Clark's Nutcrackers**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
This species provides raw materials for human use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The harvesting of this species provides employment opportunities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The sale of this species provides income for humans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species is important to its ecosystem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It would not matter if this species went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other species rely on this species for their survival.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species provides a source of tourism and recreational interest.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would miss this species if it went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like this species.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you see **Clark's Nutcrackers** as...

	Not at all capable					Extremely capable					
	0	1	2	3	4	5	6	7	8	9	10
Capable of experiencing emotions?											
Capable of solving a problem that requires multiple steps in a specific order?											
Capable of understanding how other members of their own species feel?											
Capable of surviving through instinct alone?											
Capable of intelligence											
Capable of experiencing consciousness											

Have you heard of **Clark's Nutcrackers**

☐ Yes (4)

☐ No (5)

What comes to mind when you think of **Clark's Nutcrackers**? (List or write out anything that comes to mind).

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Please answer the following questions about **Three-spined Sticklebacks**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
This species provides raw materials for human use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The harvesting of this species provides employment opportunities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The sale of this species provides income for humans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species is important to its ecosystem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It would not matter if this species went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other species rely on this species for their survival.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species provides a source of tourism and recreational interest.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would miss this species if it went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like this species.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you see **Three-spined Sticklebacks** as...

	Not at all capable					Extremely capable					
	0	1	2	3	4	5	6	7	8	9	10
Capable of experiencing emotions?											
Capable of solving a problem that requires multiple steps in a specific order?											
Capable of understanding how other members of their own species feel?											
Capable of surviving through instinct alone?											
Capable of intelligence											

Capable of experiencing consciousness

Have you heard of **Three-spined Sticklebacks**?

☐ Yes

☐ No

What comes to mind when you think of **Three-spined Sticklebacks**? (List or write out anything that comes to mind).

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Please answer the following questions about **Earthworms**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
This species provides raw materials for human use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The harvesting of this species provides employment opportunities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The sale of this species provides income for humans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species is important to its ecosystem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It would not matter if this species went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other species rely on this species for their survival.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species provides a source of tourism and recreational interest.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would miss this species if it went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like this species.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you see **Earthworms** as...

	Not at all capable					Extremely capable					
	0	1	2	3	4	5	6	7	8	9	10
Capable of experiencing emotions?											
Capable of solving a problem that requires multiple steps in a specific order?											
Capable of understanding how other members of their own species feel?											
Capable of surviving through instinct alone?											
Capable of intelligence											

Have you heard of **Earthworms**?

☐ Yes

☐ No

What comes to mind when you think of **Earthworms**? (List or write out anything that comes to mind).

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Please answer the following questions about **Giant Kelp**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
This species provides raw materials for human use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The harvesting of this species provides employment opportunities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The sale of this species provides income for humans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species is important to its ecosystem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It would not matter if this species went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other species rely on this species for their survival.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This species provides a source of tourism and recreational interest.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would miss this species if it went extinct.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like this species.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you see **Giant Kelp** as...

	Not at all capable					Extremely capable					
	0	1	2	3	4	5	6	7	8	9	10
Capable of experiencing emotions?											
Capable of solving a problem that requires multiple steps in a specific order?											
Capable of understanding how other members of their own species feel?											
Capable of surviving through instinct alone?											
Capable of intelligence											

What comes to mind when you think of **Giant Kelp**? (List or write out anything that comes to mind).

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What comes to mind when you think of **Oceans** (List or write out anything that comes to mind).

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What comes to mind when you think of **Forests**? (List or write out anything that comes to mind).

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Q40 What comes to mind when you think of **Grasslands**? (List or write out anything that comes to mind).

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Please answer the following questions...

	Strongly disagree	Disagree a little	Neither agree nor disagree	Agree a little	Strongly agree
My ideal vacation spot would be a remote, wilderness area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I always think about how my actions affect the environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My connection to nature and the environment is a part of my spirituality.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I take notice of wildlife wherever I am.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My relationship to nature is an important part of who I am.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel very connected to all living things and the earth.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Now that you have played the Phylo game, what are the three most memorable things to you about the Phylo game?

- ☐ 1. \_\_\_\_\_
- ☐ 2. \_\_\_\_\_
- ☐ 3. \_\_\_\_\_

Which one species do you most remember from the Phylo game?

\_\_\_\_\_

Why?

\_\_\_\_\_

\_\_\_\_\_

Any other comments?

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In this last section of the survey, we would like to learn more about your background. You can be assured that all your answers will be kept confidential. This information will only be used to report results among groups of people. We will never identify individuals or households with these responses.

Please indicate Yes or No for the following questions

	Yes	No
Have you ever been a member of a conservation, animal welfare, or other environmental organization?	<input type="radio"/>	<input type="radio"/>
Do you currently have pets?	<input type="radio"/>	<input type="radio"/>
Have you ever had pets?	<input type="radio"/>	<input type="radio"/>
Have you visited a zoo in the last year?	<input type="radio"/>	<input type="radio"/>
Have you visited an aquarium in the last year?	<input type="radio"/>	<input type="radio"/>

How knowledgeable are you about wildlife?

	1	2	3	4	5	6	7	
Not at all knowledgeable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely knowledgeable

Q60 Age (in years)

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Gender

- ☐ Male
- ☐ Female
- ☐ Other
- ☐ Prefer not to answer

Where do you consider home?

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What races or ethnic background do you consider yourself to be? Please check all that apply

- ☐ White or Caucasian
- ☐ Black or African-American
- ☐ Hispanic or Latino (includes Mexican, Central American and South American)
- ☐ Korean
- ☐ Japanese
- ☐ Chinese
- ☐ Filipino
- ☐ Pacific Islander
- ☐ Middle Eastern
- ☐ African (NOT African-American)
- ☐ South Asian (from India, Bangladesh, Pakistan, etc)
- ☐ Other

**Thank you for taking our survey!**