Wildlife Policy and Conservation: An Interdisciplinary Historical Perspective

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UNIVERSITY OF MIAMI

WILDLIFE POLICY AND CONSERVATION: AN INTERDISCIPLINARY
HISTORICAL PERSPECTIVE

By
Catherine C. Macdonald

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WILDLIFE POLICY AND CONSERVATION: AN INTERDISCIPLINARY
HISTORICAL PERSPECTIVE

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It is widely recognized that historical data about human interactions with the natural world is critical to understanding anthropogenic environmental change over time (McNeill, 2001). However, the potential contribution of interdisciplinary historical perspectives to wildlife conservation problems remains largely unexplored. Human-wildlife interactions are informed by a variety of factors, including the scientific and ecological literacy of human populations, human values, the availability of habitat and resources for human and animal populations, and the types of resource conflicts taking place (or likely to take place) (Treves et al., 2006). The role of historical interactions in shaping present attitudes and conflicts can be significant, but often not recognized or fully understood (Rangarajan, 2013). Similarly, more work is needed to contextualize modern conservation science within the larger history of long-term human-wildlife relationships. In spite of growing recognition that natural and social systems are inextricably intertwined, the contribution historians and social scientists can make to conservation-associated academic disciplines is only beginning to be realized (Jacobson & Duff, 1998; Saunders, 2003; Mascia et al., 2003; Campbell, 2005).
This dissertation uses a case study approach to demonstrate the potential contribution of historical perspectives, data, and context to understanding present and future human-wildlife interactions. Many of these relationships are seen as being in the process of being reshaped and renegotiated. The sudden and explosive growth of global wildlife tourism is one of the clearest examples of these changes, as species are increasingly sought out and commodified for humans to experience (Reynolds & Braithwaite, 2001). Wildlife tourism has been embraced by many conservation organizations and researchers as an ostensibly non-consumptive way to monetize and conserve wildlife while meeting human demand for sustainable economic development (e.g., Vianna et al., 2010). However, there have been limited efforts to place these developments, and human-wildlife relationships more broadly, in their full historical context.

Chapter one, the introduction, situates the dissertation in relation to the field of interdisciplinary environmental history. Chapter two addresses the history and present status of academic research on wildlife tourism, and the impacts of current tourism practices on wildlife and human participants. It evaluates these as growing out of historic patterns of relation and intersection between scientists, wildlife, and the public. Chapter three uses the definitions and potential costs and benefits of wildlife tourism identified in chapter two to create survey questions for the general public about their understanding and perceptions of wildlife tourism. Chapter four demonstrates the potential of historical data to contribute to our understanding of conservation threats by exploring the long-term usage of scleractinian corals for medicinal purposes. Chapter five analyzes news reporting on shark attacks in South Africa to argue that “Jaws” may not be as valuable an explanatory frame for human-shark relations as previously believed. Chapter six
discusses the limitations which historical patterns of human-shark interactions are likely
to place on the potential expansion of shark tourism globally, and how these histories
may inform regulatory policy and management. Chapter seven examines how the
hybridization of polar and grizzly bears may upset historical understandings of “species”
and “speciation,” and explores how the public understands and applies those concepts.
The final chapter offers a synthesis of these cases studies and some general conclusions
about the potential value of environmental history to contribute to our understanding of
wildlife conservation challenges.
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# TABLE OF CONTENTS

| LIST OF FIGURES | vii |
| LIST OF TABLES  | x  |

Chapter

1 INTRODUCTION: INTERDISCIPLINARY POTENTIAL OF HISTORICAL PERSPECTIVES IN ENVIRONMENTAL RESEARCH ........................................ 1
   Environmental History as a Discipline and an Interdisciplinary Space ...... 2
   Applying an Historical Perspective to Diverse Case Studies .......................... 17

2 SCIENTIFIC KNOWLEDGE ABOUT THE IMPACTS OF WILDLIFE TOURISM: TERMS, COSTS, AND BENEFITS ........................................ 23
   Ecotourism and Wildlife Tourism ................................................................. 24
   Wildlife Responses to Tourism ......................................................................... 34
   Evaluating Wildlife Stress Responses ............................................................ 44
   Human Dimensions of Eco- and Wildlife Tourism ........................................... 57
   Wildlife Tourism and Economic Valuation ...................................................... 59
   Wildlife Tourists ......................................................................................... 63
   Local People ................................................................................................. 74
   Tourism Operators and Regulation of Wildlife Tourism ................................... 83
   Conclusion ..................................................................................................... 89

3 PUBLIC UNDERSTANDING OF TOURISM TERMS AND POTENTIAL IMPACTS ......................................................... 92
   Background .................................................................................................. 93
   Methods ........................................................................................................ 94
   Results and Discussion .................................................................................. 99
   Conclusion ..................................................................................................... 106

4 MEDICINAL EXPLOITATION OF SCLERACTINIAN CORALS: ANCIENT PRACTICE TO INFOMERCIAL ............................................. 109
   The Scope and Scale of Traditional and Alternative Medicine .................... 112
   Medico-spiritual Use of Corals in the Ancient World .................................... 113
   Coral Medicine in the Middle Ages (700-1400) .......................................... 118
   Coral Medicine in the Renaissance (1400-1700) .......................................... 126
   Early Modern Coral Medicine ...................................................................... 135
   Coral Medicine in the Non-Western World .................................................... 144
   Modern Medicine and Corals ....................................................................... 147

5 NEWSPAPER REPORTING ON SHARK ATTACKS IN SOUTH AFRICA 1850-2000 .............................................................. 157
6 LEGAL BANS OF SHARK PROVISIONING TOURISM IN FLORIDA AND HAWAII, USA ................................................................. 184
Methods .................................................................................. 186
Shark Feeding Tourism and Economic Valuation ...................... 187
Legal Aspects of Shark Feeding .................................................. 189
Case Study 1: Florida .................................................................. 199
Case Study 2: Hawaii ................................................................. 221
Conclusion .................................................................................. 226

7 GROLAR BEARS AND FLORIDA COUGARS: PUBLIC PERCEPTIONS OF HYBRIDIZATION AND SPECIES CATEGORIZATION .............................................. 229
Background ............................................................................... 230
General Methods ................................................................. 233
Case Study 1: Grolar Bears (or Pizzlys) .................................... 235
Case Study 2: Florida Panthers and Texas Cougars .................. 252
Conclusion and Future Directions .............................................. 261

8 CONCLUSION ......................................................................... 264

WORKS CITED ........................................................................ 276
APPENDIX 1 ........................................................................ 329
LIST OF FIGURES

Figure 3.1 Frequency of responses to item asking whether tourism is relatively beneficial or harmful to wildlife ........................................................................................................ 99
Figure 3.2. Percentage of participants indicating the importance of each factor for determining if a practice can be considered "sustainable," "eco," or "nature" tourism .......................................................................................................................... 106
Figure 3.1. Map of South Africa showing the distances between KwaZulu Natal/Durban and the Eastern and Western Capes .................................................................................................................. 165
Figure 5.2. Breakdown of shark species reported to be responsible for attacks on humans in South African waters. Articles in which an attacking shark was identified to species level or an inability to identify was discussed n=103. .............................................................................. 168
Figure 5.3. (a) Frequency of use of qualitative size descriptors to characterize attacking sharks. (b) Quantitative estimate of attacking shark size. Articles including size estimates for attacking shark n=117. .................................................................................................................. 170
Figure 5.4. Number of articles about shark attacks in South African waters 1850-2000 by age of victim. Articles containing victim age information n=196. .................................................. 171
Figure 5.5. Reported activities of shark attack victims immediately prior to attack. Articles containing details of victim activity n=225. .............................................................................................................. 172
Figure 5.6 Distribution of shark attack coverage by month. Articles identifying attack month n=231. ................................................................................................................................. 173
Figure 5.7. Coverage of attacks on swimmers (blue) and surfers (red) in South Africa 1850-1999. Articles containing details of victim activity n=225. .................................................. 174
Figure 5.8. Coverage of attacks characterized as “moderate,” “severe,” and “fatal” 1850-1999. Articles providing sufficient data to meaningfully evaluate injury severity n=222. ............................................................................................................. 175
Figure 5.9. Timeline of responses and explanations of attacks. Each category is listed once if it appeared during the respective time period. Red text denotes approaches which intend to manage risk of attack by lethal control of shark populations, orange text denotes proposed behaviors which may include killing sharks, and green text denotes approaches that involve changing human behavior in order to minimize risk of attack. .................. 177
Figure 5.10. Total coverage in word count over time n=229. .................................................. 179
Figure 5.11. Word cloud figures of article titles across time are used to explore shifting emphasis on different framings of shark attacks. ................................................................. 180
Figure 6.1. Percentage relevant terms in FWC minutes. .......................................................... 200
Figure 7.1. Inverse mean rank for each factor by hypothetical decision maker. Higher bar values indicate relatively higher rank and importance. ................................................................. 241
Figure 7.2. Mean participant agreement with statements regarding hybrids' versus non-hybrid bears' right to exist. Error bars represent the 95% confidence interval. Values on X-axis represent numerical value associated with response to single-item measure on a scale from 1 (strongly disagree) to 7 (strongly agree). ................................................................. 242
Figure 7.3. Mean participant agreement with statements regarding hybrids' versus non hybrid bears' importance to the ecosystems in which they live. Error bars represent the 95% confidence interval. Values on X-axis represent numerical value associated with response to single-item measure on a scale from 1 (strongly disagree) to 7 (strongly agree). ................................................................. 243
Figure 7.4. Participants’ mean willingness to pay for tourism opportunities to see hybrid versus non-hybrid bears. Error bars represent the 95% confidence interval. All values are significantly different. ................................................................. 245
Figure 7.5. Percentage of participants categorizing the theoretical cougar born in Florida as a Texas cougar, Florida panther, or "something else"........................................... 255
Figure A.1. Plant and Coral from page of Medicinal Herbal, Unknown, Italy, 1440. No. 4016 f 33.v. British Library ................................................................. 330
Figure A.2. Plant and Coral from page of Medicinal Herbal, Unknown, Italy, 1440. No. 4016 f 48.v. British Library ................................................................. 331
Figure A.3. Pharmacy Jar for Coral Syrup, unknown, ca. 1700s. Accession Number: 1991.0664. Smithsonian Institution Collections ........................................... 332
Figure A.4. Pharmacy Jar for Coral Powder, unknown, Germany, ca. 1700s. Accession Number: 1991.0664.(0884). Smithsonian Institution Collections ......................... 333
Figure A.5. Pharmacy Jar for White Coral, Unknown, ca. 1700s. Accession Number: 1991.0064.(0447). Smithsonian Institution Collections ........................................... 333
Figure A.6. Pharmacy Bottle for Tincture of Coral, Unknown, Italy, ca. 1700s. Accession Number: 1991.0664.(0250). Smithsonian Institution Collections ............................. 334
Figure A.7. Whistle and Bells, Unknown, England, 1750-1780. Acquisition Number: 2011.19.2. Yale University Art Gallery ................................................................. 335
Figure A.8. Whistle and Bells, Daniel Christian Fueter (Swiss/American), 1761-1765. Acquisition Number: 1942.91. Yale University Art Gallery ......................................................... 335
Figure A.10. Rattle, Whistle, and Bells, Nicholas Roosevelt, New York, 1755-1768. Accession number 47.70. Metropolitan Museum of Art ................................................................. 337
Figure A.11. Spoon of John II, King of Poland. Unknown, Germany, ca. 1600s. Inventory Number: Є-2390. Hermitage State Museum ................................................................. 338
Figure A.12. Coral Inlaid Cutlery Knife, Unknown, France, 1550-1600. Accession Number: 1985-103-45. Smithsonian Institution Collections ........................................... 339
Figure A.13. Virgin and Child, Joos van Cleve, Netherlands, 1525. Accession number: 1982.60.47. Metropolitan Museum of Art ................................................................. 340
Figure A.14. Madonna and Child with Angels, Pietro di Domenico da Montepulciano, 1420. Accession number: 07.201. Metropolitan Museum of Art ................................................................. 341
Figure A.15. Virgin and Child with a Donor Presented by Saint Jerome, Master of the Munich Bavarian Panels, Bavaria, ca. 1450. Accession number: 1975.1.133. Metropolitan Museum of Art ................................................................. 342
Figure A.17. Family Portrait, Anthony Van Dyck, Flanders, 1621. Inventory Number: Г®-534. The State Hermitage Museum ................................................................. 344
Figure A.18. Sarra de Peyster, Unknown, 1631. Accession number: 61.154. Metropolitan Museum of Art ................................................................. 345
Figure A.20. Physician Preparing an Elixir, from a translations of Discorides’ Materia Medica, Unknown, 1224, Iraq or Northern Jazira. Accession Number: 13.152.6. Metropolitan Museum of Art.................................................. 347

Figure A.21. Indian Merchant Selling Jewelry to a Woman, Unknown, Tanjore (Thanjavur), ca. 1840. Wellcome Library, no. 29060i................................................................. 348

Figure A.22. Website promoting coral calcium as more “bioavailable” than other forms of calcium .................................................................................................................. 349

Figure A.23. Website promoting coral calcium as “body-preferred”....................... 350
LIST OF TABLES

Table 3.1. Demographic characteristics of the sample ............................................. 97
Table 3.2. Percentage of participants listing factor in potential benefits of wildlife tourism .............................................................................................................. 103
Table 3.3. Percentage of participants listing factor in potential harm of wildlife tourism ................................................................................................................. 104
Table 7.1. Demographic characteristics of the sample .................................................. 235
Table 7.2. Median rank and (in parentheses) mean rank for each factor by who would theoretically be doing the deciding ........................................................................ 240
Table 7.3. Stepwise Regression Model Predicting Anti-protection attitudes .............. 251
Table 7.4. Percentage of participants listing factor in deciding how to categorize the hypothetical cougar in Florida across all participants and by the category they said they’d choose themselves. Bolded figures represent the three categories found most often across each group ........................................................................................................ 257
Chapter One

Introduction:
Interdisciplinary Potential of Historical Perspectives in Environmental Research
This dissertation takes an interdisciplinary, mixed-methods approach, using a diverse range of case studies to explore the contribution a historical perspective can make to modern issues of conservation concern. This introduction will briefly discuss the history of the field of environmental history, in particular the aspects which have been most influential and foundational to my own thinking and analysis herein. I will discuss reasons it is such a naturally suitable place for interdisciplinary work, while also pointing to some of the limitations it creates and how I have sought to address or work around them.

This work takes a post-structuralist stance on the interactions between modern thought on environmental topics, how people have thought about them in the past, and how those ways of thinking have interacted with modern and past events and material realities. Post-structuralism is by nature critical of historicism, in the sense of resisting the idea that there is a clear overall pattern or coherent metanarrative to history and historical events, or that history represents a catalogue of human progress (Sarup, 1993). In this dissertation, I suggest not that an historical perspective can provide solutions, but that it can create space for deconstructing and depersonalizing modes of thinking about environmental problems in ways that allow for new insights, and help us perceive modern challenges as having been based in and shaped by long-standing relationships.

**Environmental History as a Discipline and an Interdisciplinary Space**

Though it was initially created and conceptualized as a branch of academic history, American environmental history has grown rapidly as a field since the late 1960s and early 1970s, and has expanded substantially to include diverse topics and
techniques. According to Uekoetter, the limits of environmental history, as disciplinary boundaries go, are “especially fuzzy and porous” (2010, p. 4); Smout observes that according to some, environmental history is “…not so much a subject in its own right as a theatre where other subjects appear and interact” (2009, p. 1). This helps explain why it can represent a uniquely suitable arena for interdisciplinary environmental work, as all events up to the present moment are by nature historical.

Environmental history is probably most accurately described as a collection of historically-oriented related disciplines, which may include archaeology, history, geography, anthropology, ecology, sociology, landscape archaeology, landscape history, urban planning, and economics, and many other fields, all of which can be used to trace the historical roots of transformations of natural systems, and to talk about the ways people related to or used landscapes in the past (Merchant, 2007). As might be expected, this means that environmental history draws from an extremely diverse set of source materials, from pollen cores or sediment samples to landscapes to oral histories and written documents (Myllyntaus & Saikku, 1999).

There are three primary forms of environmental history, according to most environmental historians: material (based in the physical realities of the natural world), cultural or intellectual (based in the ways people think or talk about the natural world), and political or nation-state (based in policy and human action on a large scale). The balance of academic interest between the three has shifted substantially in recent decades, in part as a response to the increasing number of academic researchers working from an

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1 Although environmental history is a rapidly growing and maturing field with practitioners from around the world, this summary largely focuses on American historians, given their (at least, to date) relative global dominance in the field. The American Society for Environmental History was formed in 1976; the European equivalent did not form until 1999, although other regional societies are now forming and publishing with increasing rapidity (McNeill, 2003).
intersectional theory frame, which emphasizes the importance of class, race, gender, ethnicity and other factors as “intersecting” to create social identities and systems. This shift is also likely connected to growing recognition of the importance of political factors, which tended to be somewhat overlooked in early works of environmental history. However, the “three foci” approach to environmental history’s topics of study has remained popular to the present day, although exactly how the three are characterized varies across historians (McNeill, 2003; Lekan, 2010). Ultimately the three may be conceptualized differently even when the categories remain recognizable. Worster (1988) describes a Marxist tripartite structure: natural ecosystems, modes of production, and values/ideas/perceptions; while Xueqin (2007) argues that the branches of environmental history are the purely scientific (“natural history”), the history of the environment as a resource (e.g., geography, economic history) and “true” environmental history—the study of the relationship between man and nature. These approaches make clear the ways in which a historical perspective can create a space which is by nature welcoming to interdisciplinarity, because it treats a wide range of disciplines and data types as potential contributors without asserting the primacy of any particular input.

Of course, there are varying degrees of acceptance of these diverse approaches to work that can loosely be termed environmental history, with some historians pushing for a vigorous defense of disciplinary boundaries and (their own) historical expertise, and others embracing parallelism, cheerfully asserting that “we should accept environmental history in all its variety and confusion, embracing the sciences and the social sciences, making it an interactive performance” (Smout, 2009, p. 3).
Development of Environmental History as a Discipline

Throughout human history, humans have shown a distinct tendency to “comfortably assume the natural world constant and hence moot” (Hoffman, 2003, p. ix), and in large part the growth of environmental history as a field of study has occurred simultaneously with the recognition that humans are having substantial impacts on Earth’s natural systems to a far greater degree than previous generations would have believed possible. Thus the study of environmental history owes a substantial debt to earlier works like Marsh’s *Man and Nature* (1864), which chronicled human history from the perspective of humanity’s destructive effects on the world around us, and James Malin’s work, *The Grassland of North America* (1967), which represented one of the earliest attempts at an ecological analysis and emphasized how complex and interdependent relationships between natural and social systems may be. Environmental history also owes a considerable debt to more recent scholarship on human impacts on the environment, including Carson’s *Silent Spring* (1962), Glacken’s *Traces on the Rhodian Shore* (1967), and Ehrlich’s *The Population Bomb* (1968), all of which helped make a case for anthropogenic changes and the necessity of observing and cataloging alterations to ecosystems and the changing human relationship to nature.²

As mentioned above, environmental history today is widely inclusive of a variety of research techniques drawn from diverse disciplines, and thus owes a particular intellectual debt to the French *Annales* School of Bloch, Febvre, and Braudel, who in the

² It is also necessary to acknowledge the enormous popular literature which, while often not called environmental history, has pursued similar goals in terms of narrating past interactions between humans and natural systems. Writers from Muir and Leopold to Margolin, Schama, and Reisner, only a few of whom were professional historians, have written on similar topics, often to critical and popular acclaim. Although these works and many others have undoubtedly influenced the work of environmental historians, the scale and variety of this literature is too vast to encompass here.
mid-20th century radically widened western historiography’s view of what constituted a document, encouraging historians to look beyond the written and official to interrogate other vestiges of the past, including artwork, architecture, and altered landscapes (McNeill, Padua, & Rangarajan, 2010). The *Annales* school also emphasized large-scale trends over long time frames, rebelling against a historiography that “sought truth about the forest of human experience by cataloguing and describing individual trees”, a legacy that undoubtedly played a role in shaping the early practices of environmental history, which were often quite broad both geographically and temporally (Crosby, 1995, p. 1184). Unlike modern environmental historians, members of the *Annales* school tended to focus almost exclusively on “natural” events like droughts or famines and the effect of these events on human societies, without much interest in human impacts on nature, and often treated nature as fundamentally unchanging (McNeill, 2010b).

Environmental history was initially seen as a challenge to “traditional” historical approaches, since it asserted the importance of the natural world as a previously overlooked historical actor or factor, seeking to overturn politics and “great men” as the dominant basis of historical inquiry (Uekoetter, 2010; Lekan, 2010). Arguments for the agency of nature in shaping events, and the importance of recognizing it as having an “autonomous place in history” stem in large part from the somewhat radical idea (as far as classical historiography is concerned), “that there are different forces at work in the world and not all of them emanate from humans” (Cronon, 1990, p. 1132; Worster, 1988, p. 292). This focus on nature as an historical actor differentiates the field from history more broadly, which typically treats nature as “an object of human contemplation and
controversy or as the physical stage for a quintessentially human drama” (Demeritt, 1994a, p. 163).

**Paradigms within Environmental History**

There is an obvious false dichotomy in heuristic distinctions that separate “humans” and “human culture” from non-human “nature” as though the two are entirely discrete and independent, and this issue has been analyzed extensively by social scientists (e.g., Ortner, 1972; Glacken, 1973; Harrison, Pile, & Thrift, 2004; Haraway, 2013). Environmental historians remain divided when it comes to the importance of these conceptualizations and integration with more theoretical work in the social sciences. Some believe that presenting nature and culture as separate helps establish the independent significance of nature as an historical actor, while others assert that this forced dualism and the presentation of issues that are inextricably linked as somehow “separate”, lies at the root of the problems and shortcomings of environmental history as a discipline (Worster, 1988; Merchant, 1980). Recent scholarship in the social sciences has increasingly described “socionatures” which combine humans, non-humans and the environment (Swyngedouw, 2006), and my interdisciplinary historical approach attempts to recognize the importance of both human and natural systems (and the ways in which they interrelate) in shaping the past and present.

Some environmental historians caution against the relativism an historical perspective can impart when evaluating or making decisions about modern conservation challenges. As Worster points out,

If nature is nothing but a bewildering panorama of changes, many of them induced by human beings going back to ancient hunters setting fire to the bush, and if our attitudes toward nature are themselves demonstrably in a state of
constant flux, so that yesterday we hated wolves and today we love them, then what should conservation mean? (1994, p. 3-4)

While perceptions of the appropriate role of historical and historically minded research in policy debates varies, based on how often they quote him, most environmental historians would likely agree with G.K. Chesterton that “the disadvantage of men not knowing the past is that they do not know the present”, and believe that knowledge of past policy making, consequences, and human-environment relations has the potential to inform current issues (quoted in Smout, 2009, p. 5; McNeill, 2001, p. 9).

A similar modern example, in which framing definitively shapes what is considered a “problem” and a “solution”, is beginning to arise around the topic of “biodiversity”, an emerging topic in conservation and development. While there are clear biological referents to measures of biodiversity, the introduction of the term in the 1980s was not born out of an inability to describe the situation with existing ecological and biological concepts, but was generated in response to changing constructed discourses about nature within the scientific and environmentalist community. Thus academic definitions of biodiversity do not name something previously unrecognized, but rather reconceptualize existing areas of study within biology and ecology based on changing social systems and human attitudes. In doing so, they attempt to discursively transform ethical and moral questions about ownership and protection of “biodiversity” resources from complex issues anchored in power and human societies and values on multiple scales into a fixable bio-ecological problem that will be solved (and is solvable) by the practice of science and management (Escobar, 1998).

Early works in the field tended toward monocausalism, seeking out single, simple explanations for environmental decline. These arguments often had a Manichean
structure, drawing sharp distinctions between “before” and “after” what they believed to be specific environmental turning points (Uekoetter, 2010). This is also an area in which the discipline falls short: many historians do not seem to recognize that the processes captured in the study of environmental history are ongoing, a continuous relationship rather than a single transformative event that moves ecosystems or human attitudes from one stable state to another (Demeritt, 1994b).

In the past the dominant mode of environmental history has been to assume a common human history in which a global “we” has created environmental problems that are inevitable by-products of development. It has been rare to see studies that explicitly investigate contradictions within global human society over the use and exploitation of the natural world (Hornborg, McNeill, Martinez-Alier, 2007, p. 4). For example, while much of environmental history is framed in terms of resources, consumption, and exploitation, few case studies address these challenges as being distributed based on privilege, or as acting on disparate human communities giving varying degrees of consent, particularly as they address events in the more distant past (Hornborg et al., 2007).

Politically-minded historians have also embraced environmental history, asserting that ecology (and thus ecological history) is inherently political, allowing human groups with divergent ideas about how resources should be used and allocated to fight proxy battles that are nominally about resources, but truly about values; the full intellectual ramifications of this approach are also beginning to be more fully explored (Worster, 1990a; see also Escobar, 1998; Campbell, 2007; Sackman, 2010).
Contributions of Interdisciplinarity

History as an umbrella academic discipline does not have the tradition of collaboration that is common in some other fields of inquiry, particularly in the biological and ecological sciences, and to this day environmental history is a relatively small (but growing) sub-discipline globally. Interdisciplinary work can prove particularly challenging for social scientists, including historians, who may find that natural scientists have a limited understanding of the principles of their discipline, that disciplinary journals may hesitate to publish interdisciplinary work, that the publication norms (like the number of co-authors considered normal/acceptable) may vary widely across disciplines, and that funding sources in some cases may not yet fully appreciate the benefits of interdisciplinarity (Campbell, 2005; Pickett, Burch, & Grove, 1999). Of course, there are also critics of interdisciplinarity who feel that (particularly given the relatively porous boundaries of environmental history as a discipline) cross-disciplinarity which maintains strict boundaries of expertise is the only way for historians to defend their field from non-experts while producing collaborative work, and vociferously assert that the disciplines work best together when consciously kept at a distance (Sorlin & Warde, 2009).

Particularly in recent years, environmental historians have also shown themselves increasingly willing to engage with social theory scholarship more broadly, as the growth in interdisciplinarity has brought historians into closer working contact with environmental anthropologists and sociologists, among others, whose work tends to rely more heavily on social theory (McNeill, 2010a). While some historians describe themselves as “refugees from theory,” others have argued explicitly for a deeper
engagement with social and political theory (McNeill, 2010a; Sorlin & Warde, 2007).

The general reluctance of environmental historians to address social theory debates has led to what Moore describes as

…a strongly historical but weakly theoretical current at one pole and a robust theoretical-methodological but inadequately historical movement at another. The environmental historians don’t quite know what to do with social theory, and the environmentally-oriented social scientists don’t quite know how to translate their perspectives into historical research (2003, p. 307).

Increasing numbers of environmental historians are taking at least a cursory interest in theory, if only because the interdisciplinary literature of their field is increasingly enmeshed in quasi-theoretical debates. This process of stepping outside disciplinary norms to engage more fully with other social scientists has the potential to lead to work which successfully integrates historical questions with some of the complexity introduced by engaging with theory.

**Ecological Theory**

One place in which a failure of early environmental history holds particular value is in the perspective it can provide on the relationships between historical perspectives and the biological and ecological sciences. Early environmental historians were substantially affected by the tenets of ecology, tying themselves to ecological principles so tightly that upheavals in that discipline had dramatic impacts on environmental historians as well. In many cases, the ecological theories historians embraced rested on questionable key assumptions about the structure and organization of natural systems, with both historians and ecologists previously accepting that “complexity is good, simplicity is bad; natural systems seek equilibrium and battle disruption, [and] there is an ideal balance in nature that, once achieved, will maintain itself” (White, 1990, p. 1115; Scoones, 1999). These assumptions date to the earliest years of ecology as an academic
discipline, and are based primarily on the work of Frederic Clement, who first conceptualized the idea of succession and climax communities in nature (for a succinct summation of Clement’s ecological ideas, see Worster, 1977, p. 205-219). As ecology has moved away from these ideas about how ecological systems function, ecologists have increasingly come to agree that rather than existing in a stable state unless disturbed, natural systems are dynamic and constantly changing. This creates much more complex and muddier narratives around the interactions of social and ecological systems, and makes the process of evaluating human impacts as “good” (i.e., promoting stability) or “bad” (i.e., leading to change) much more difficult. As White observes, where environmental historians “thought ecology was the bedrock upon which they could build environmental history, it turned out to be a swamp” (1990, p. 1115).

More recent works of environmental history continue to relate themselves to ecological thinking, although such relationships are less tidy. They increasingly emphasize interconnectedness, also sometimes described as the “ecological principle” or “holism”—which asserts that “all does interact with all” (Hoffman, 2003). In this formulation, all social and natural changes reverberate throughout systems to often uncertain effects. “Holism” has also been used explicitly to call for the breaking down of disciplinary boundaries now seen as arbitrary by some theoreticians—not only those dividing various branches of the social sciences, but even those separating “social” from “natural” science, in the process questioning whether these truly do or should represent different kinds of knowledge (Wallerstein, 1998; 2011).

Growing numbers of scientists recognize that neither natural nor social systems can be effectively studied or conserved in isolation, and that there is a substantial place
for the work of social scientists (including historians) in fields concerned with the conservation of the natural world, though social scientists often remain a bit of an afterthought on interdisciplinary research teams (Jacobson & Duff, 1998; Saunders, 2003; Campbell, 2005; Mascia et al., 2003). As part of this process, as discussed above, there is a growing movement towards greater interdisciplinarity, or in the case of holists, unidisciplinarity that entirely rejects disciplinary thought boundaries (Wallerstein, 1998; Campbell, 2005). An interdisciplinary historical approach treats not only the findings of ecologists and biologists as of interest, but the process by which they frame, create, and discuss the questions they seek to answer.

**Postmodern Theories**

While postmodernism had a substantial role in challenging scientific authority and ecology as the basis of all environmental history, it has also had other far-reaching impacts on the field. A foundational concept of postmodernism is cultural relativism, the idea that there “is no standpoint beyond human cultures”—that reality is nothing more than the perceptions of it reached through the prisms of different cultural lenses (Sessions, 1996, p. 33). The argument that nature is socially constructed, rather than an objective material reality, emerges from postmodernism and Marxism. Under postmodernist interpretations, there is no objective truth. In the most extreme formulation, nature may be reduced entirely to an immaterial social construct, with no characteristics outside of those assigned by humans, and no greater meaning or claim on our care or attention (Hay, 2002).

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3 Of course, this is a limited and simplified explanation of one approach to postmodernism, which is in reality a profoundly diverse set of ideas and theories far too complex to be addressed in-depth here. The emphasis here is intended to capture the room for debate about the nature and production of “facts”, “truth”, and “reality”, and how this debate can yield new insights into existing environmental challenges.
Postmodernism creates challenges for many traditional academic fields, history not excepted. If scientific/intellectual paradigms “are socio-historical constructs—not given by the character of nature, but created out of social experience, cultural values, and political-economic structures” (Bird, 1987, p. 256)—history, as most of human intellectual inquiry, becomes a rather recursive activity, occupied with generating narratives about generated narratives. Under this understanding, there is nothing outside our perception to study.

The work of Latour and Woolgar (1986) suggests that scientific facts are essentially fabricated statements about the world created through a process of social negotiation among scientists, and do not reflect objective properties of the objects of study. Similarly, Foucault’s work on discourse, sometimes called “poststructuralist,” has moved beyond issues of cultural construction to “power”—emphasizing the extent to which human relationships are undergoing a constant process of negotiation over authority, power, and control of how reality is defined (Foucault, 1980). There have been ongoing efforts among social scientists to find innovative new ways to talk about and conceptualize these issues, including actor-network theory, which “treats everything in the social and natural worlds as a continuously generated effect of the webs of relations in which they are located” and assumes nothing has reality outside these relationships (Law, 2009, p. 141; Latour, 1996; Latour, 2005; Oppenheim, 2007).

Until recently, the activities of natural scientists, though treated with varying degrees of trust by environmental historians, were generally respected as representing objective truths about nature, especially given their heavy reliance on ecological theory. Since the publication of The Structure of Scientific Revolutions it has been increasingly
widely accepted that this is not the case—that, in fact, scientific inquiry can offer at best relative truths through one specific lens (Kuhn, 1970; although Kuhn backed away from the most inflammatory of his conclusions in a second edition in favor of a view of the progress of knowledge, his initial ideas are still influential). Environmental historians were quick to embrace Kuhn’s work to discredit claims of objectivity by foresters, natural resource managers, nuclear physicists and others seen as opponents of the environmental movement, but later had to grapple with these questions anew as the work of biologists and ecologists, on which many works of environmental history relied for scientific authority, were no more immune to Kuhn’s critique (Demeritt, 1994b).

While the most theoretically complex and ambitious approaches to these questions exceed my experience and training, throughout this dissertation I have attempted to remain mindful of the pitfalls of conflating the results of scientific inquiry (performed by specific humans in specific cultural and social contexts) with “truth”.

Despite these critiques, most environmental historians continue relying on scientific authority to varying degrees in their work—as I also do throughout this dissertation. In fact, in some cases they use theoretical critiques of scientific authority to assert their importance to the process of “solving” environmental problems. Crosby (1999) clearly expresses the unique value he thinks social scientists (and particularly historians) bring to environmental issues:

Scientists need the help of scholars, that is, people devoted to exactitude and truth but accustomed to bias (their own included) and the wringing of truth out of dubious data. Scientists need historians because historians can place environmental problems in their chronological and cultural context. The scientists sometimes seem to think that solving such problems is no more than a matter of putting things right, and they have little idea of how subjective a concept such as “right” can be. (Crosby, 1999, p. xii)
In his formulation, historians and natural scientists have mutually dependent responsibilities in which both must contribute. Demeritt (1994a) agrees, arguing that “science is too important to be left to just the scientists, just as nature is too important to be left to just the scientists” (p. 170). In particular, he argues against what he calls “foundationalism”—the basing of pro-environmental arguments (including some works of environmental history) solely on the authority of science and scientists (Demeritt, 1994b).

As Latour (1993) would have it, the related human version of the nature/culture dualism is science/politics. While science has always found a welcome reception in environmental history, politics has been less embraced in many cases, though, as described above, that tendency has shifted in recent decades (e.g., Hornborg et al., 2007). Among the sub-disciplines of environmental studies that are closely related to environmental history, political ecology in particular has emerged as an influential transdisciplinary approach to analyzing human-nature relationships; it came to prominence mainly as a tool for examining the environmental and social impacts of development in developing countries (Blaikie, 1999; Watts, 2000; Walker, 2005; Bryant, 1992; Peet & Watts, 1993). It grew out of criticisms of ecological anthropology and cultural ecology, which tended to operate exclusively at a local scale and failed to integrate the importance of national and international factors in mediating local relationships with nature (Wolf, 1972; Stonich, 1998). Political ecology tends to use multiple levels of analysis to study how political, social, economic and environmental forces interact at different scales (Bryant, 1992). In some conceptualizations, political ecology is treated as diachronic (i.e., it should properly incorporate history into
explanations of contemporary problems, patterns and processes). The most significant
shortcoming of political ecology as a research paradigm is the emphasis on political
factors; it inherently and definitionally assumes the primacy of politics in determining
environmental events (Adams & Hutton, 2007; Vayda & Walters, 1999).

Historical sociology has also had significant influence on environmental
historians, particularly since the publication of Scott’s Seeing Like a State (1998). While
the majority of environmental historians have not aggressively adopted postmodern
theory, Scott’s work

…disrupts the neat division of environmental history into biological, economic,
political, and cultural realms not by dissolving the material world into “discourse”
but by showing how state institutions narrowed and simplified the range of what
was worth knowing about the natural world to a few instrumental categories:
“forests” became “timber”, “meadows” became “pastures,” “nature” in general
became “natural resources.” (Lekan, 2010, p. 68)

This approach allows historians to grapple with the complex social construction of
thinking about the “natural world” and “resources” without abandoning the belief that an
objective, material reality also exists and has relevance to environmental history. This
perspective helps to protect and expand an interdisciplinary historical space in which
scientific knowledge need not be “fact” but also need not lack meaning or relevance
entirely.

**Applying an Historical Perspective to Diverse Case Studies**

The preceding summarizes some of the strands of thought in environmental
history that have most shaped my approach to writing an historically-grounded
interdisciplinary dissertation. My diverse topics allow me to make a case for the value of
historical techniques and perspectives in studying a range of questions about the
environment, including some with direct relevance to modern conservation challenges. In
my dissertation, I use a case-study and event-based framework from a critical-realistic perspective (Lees & Bates, 1984; Vayda, 1996). This approach, which recognizes the value of postmodernism but does not embrace fully constructivist approaches, does not pre-judge the importance of politics on any scale in shaping events, but allows actual events to dictate the course of historical or sociological study of the environment, while treating scale as an object of inquiry (Vayda & Walters, 1999; Campbell, 2007). My approach can also accurately be considered post-structuralist, in the sense that I will argue consistently that thought can serve to shape objects and events, and objects and events serve to shape thought. Throughout, I attempt to address questions about the impacts of the past on the present and the role of the past in shaping human-wildlife relationships at multiple scales while respecting the interplay between thought, action, and material reality. I recognize the importance of acknowledging the natural world as both consisting of material objects and being socially constructed; and respect the human capacity to constantly refashion our environment both physically and cognitively.

One of the greatest challenges of historically-based interdisciplinary work is to properly account for both physical and sociocultural realities, recognizing both “the idiosyncrasies of human meaning in particular contexts, and the material repercussions of such cultural systems” and that “cultural behavior takes place within a material world whose properties constrain what is possible and determine the environmental consequences of behavior” (Hornborg et al., 2007). In this introduction I have briefly outlined the history of the field, its potential as a space for interdisciplinary research, and some of the theoretical developments that have most influenced my own thinking. The chapters that follow will attempt to apply these lessons to a variety of specific case
studies to illustrate the disparate contributions historical perspective can make to modern environmental research.

Chapter two reviews the scientific literature studying the physical, ecological and behavioral impacts of wildlife tourism on wildlife. In doing so, it inquires into the kinds of questions researchers are asking about these impacts and how their formulations are shaped by historical relationships with wildlife species. I raise questions which recur throughout the dissertation about the extent to which, as in Escobar’s formulation, the practice of science may be used to discursively transform ethical and values questions into hypothesis-driven research which can provide an “answer”, mitigating the need for discussion and negotiation of complex human feelings and values in relation to the environment. In the second half of the chapter, a similar approach will be applied to studies of the impact of participation in wildlife tourism on tourists and local communities, uncovering the topics which researchers feel determine the “success” of wildlife tourism relative to humans. Interrogating these studies not simply as scientific facts but as historical objects created by specific people in a specific time and context allows for a more nuanced approach to understanding the social-ecological system created by the relationships between scientists, tourists, local peoples, and wildlife populations. These findings will also demonstrate that to a significant degree, the academic and conservation communities may be exceeding solid data in arguing that wildlife tourism yields net conservation benefits, since in many cases by their own metrics this is not the case.

The third chapter takes some of the questions raised in chapter two about the potential benefits and costs of wildlife tourism, and the terms and definitions used to
discuss them, and uses them as a starting point to create survey questions for the general public. This chapter provides preliminary data on the extent to which a survey validates (or fails to validate) the findings reported in the academic literature, exploring whether the costs and benefits of wildlife tourism identified in the scientific literature are perceived and understood similarly by lay-people. Findings suggest the extent to which non-experts may have valuable perspective to contribute to questions which cannot be answered adequately simply by the production of scientific knowledge. The survey further evaluates the extent to which existing definitions of “ecotourism” in academic research reflect (or fail to reflect) the ways the term is used and understood in society more broadly.

In my fourth chapter, on the historical and present-day use of scleractinian corals as medicine, I use primary and secondary source historical materials to draw explicit connections between ancient and modern uses of coral in medicine and healing. This chapter argues that an understanding of present and future patterns of exploitation is weakened in the absence of historical data, and that previous patterns of human relationships to the natural world can shape conservation challenges and debates to a greater degree than is presently recognized. This chapter will also discuss the ways in which both scientific signifiers and resistance to the scientific establishment can be co-opted to fuel pseudo-scientific exploitation of wildlife resources based on historical relationships and patterns of use. Finally, it illustrates the extent to which historical uses of wildlife can remain remarkably stable over long time periods.

The fifth chapter delves into newspaper media reporting on shark attacks in South Africa from 1850-2000. Although it has been widely assumed that human attitudes
towards sharks and shark attack have been shaped by popular culture, and particularly the movie “Jaws,” evidence drawn from in-depth quantitative and qualitative analysis of news articles paints a more nuanced picture of attitudes towards sharks, and how they have changed over the centuries. However, belief in the primacy of “Jaws”-based threat frames for thinking about sharks has emphasized that the shift away from seeing sharks as mindless killing machines is a relatively recent phenomenon. Particularly when data to validate anecdotal narratives about human-nature relationships is available, it should not be overlooked, and this chapter argues it may suggest alternate interpretations which can lead to new approaches to or ways of thinking about modern conservation challenges.

In the sixth chapter, the history of policies enacted in response to shark tourism in the United States is used to create a historical narrative around the political ecology of shark tourism, investigating the scales at which decisions about appropriate uses of natural resources were made, the various private and public interests that influenced the shape of debate, and the specter of legal liability that demanded the “problem” be framed and addressed in particular ways. It also delves into the extent to which an argument which was nominally about a relatively fringe diving activity offered by a few operators was actually only one facet of much larger-scale resource and power conflicts. As part of this process, ethical and philosophical differences were framed as solvable by the judicious application of science (which would in some cases eventually be used as a tool for evading those complex moral debates).

My final case study uses the hybridization of polar bear and brown bears (Ursus maritimus and Ursus arctis horribilis, respectively) to explore differences between how scientific experts and the general public understand speciation and define “species”.
Findings suggest that while the scientific literature is primarily concerned with the details of species as a (complicated) biological, genetic system of categorization, some portion of the public mentally and functionally treat species as incorporating numerous other factors, including “social” characteristics like habitat and behavior. The Linnaean system is far tidier than the actual biological relationships between species, as a growing body of work in genetics suggests. This chapter uses surveys of the general public to explore how the western historical and scientific context may affect public opinion about conservation of species in a rapidly changing world.

In my conclusion I argue for the utility of interdisciplinary historical perspectives as a basis for analysis of modern conservation challenges, and propose some future avenues for collaboration, particularly at the intersection of history, ecology and environmental policy. Most importantly, I expand on ways in which a historical approach to environmental problems can yield the potential for new or more effective ways of thinking, or foresee obvious problems with current solutions based on data from the past. It is not controversial to argue that the present and future are predicted by—and largely a function of—the past, but historical data has been an underutilized resource for understanding global conservation challenges.
Chapter Two

Scientific Knowledge about the Impacts of Wildlife Tourism: Terms, Costs, and Benefits
**Ecotourism and Wildlife Tourism**

In recent years, tourism has climbed to primacy as the world’s largest industry, and marine and nature-based attractions are two of the largest tourist draws globally (Phillips & House, 2009; Hall, 2001; Spalding et al., 2017). In addition to significant expansion in recent years and growing commercial attention, the industry is also becoming increasingly competitive (Hui, Wan, & Ho, 2007). Numerous studies have found that visiting wildlife-populated, unspoiled natural protected areas is a primary motive for many travelers (Gössling, 1999; Eagles, McCool, & Haynes, 2002), while a growing body of evidence suggests that nature-based tourism can be a significant contributor to the degradation of local ecological and social systems (Zhou & Huang, 2004; Wang & Buckley, 2010). The challenge of simultaneously exploiting and conserving wildlife resources appears to be a global one, as even relatively wealthy and democratically governed nations experience difficulties successfully shielding even protected species from tourism impacts (Duffus & Dearden, 1993), and in most cases revenue from tourism cannot realistically cover the overall costs of species conservation or protected areas (Laarman & Gregersen, 1996).

The theory of tourism succession suggests that in many cases operators who begin as small-scale, low-impact tourism providers, when successful, will gradually expand or be replaced by large-scale high-impact forms of tourism (Buckley, 2009; Getzner, Pfleger, & Jungmeier, 2012). This is in line with the concept that tourism tends to move progressively from a small number of expert and specialist visitors paying a premium for access to relatively undeveloped sites to much larger numbers of generalist tourists with considerably less knowledge and environmental awareness (Duffus & Dearden, 1990).
Ashton and Ashton (1993) suggest that tourism practices should be understood as existing on a spectrum, ranging from “pure ecotourism” to “specialty nature tourism” to “mass nature-based tourism”—without necessarily assuming that such practices will always progress sequentially. Although other researchers have argued that these models fail adequately to account for the specifics of individual wildlife species and their behavior and do not fully recognize the contributions of wildlife tourism to conservation (Buckley, Castley, de Vasconcellos Pegas, Mossaz, & Steven, 2012), there are many case studies in which the successive model has proven to be broadly accurate (e.g., Higham, 1998), and it is still considered useful for evaluating and understanding nature-based tourism activities.

There is significant debate about the extent to which wildlife tourism, in which travelers seek out encounters with captive or in situ wildlife, is or should be treated as a subset of ecotourism. Questions about the extent to which tourism encounters with wildlife are sustainable and lead to conservation outcomes are critical to weighing accurately the impacts and value of this burgeoning industry. In the following pages, I define and discuss the terms most immediately relevant to questions concerning wildlife tourism, and delve into the literature to draw conclusions about the existing state of scientific knowledge and how it can and should contribute to our understanding of wildlife tourism as a tool for future conservation and environmental health.

A review of this magnitude has not previously been undertaken on this topic broadly. In particular no previous review has attempted to combine our understanding of the theoretical or actual impacts of wildlife tourism on both wildlife and participating tourists. Thus, in treating wildlife tourism as representing complex and interconnected
systems and actors, this review is a new contribution to discussions of tourism impacts. It identifies some gaps in the existing literature, particularly in terms of quantifying conservation benefits of tourism for both wildlife and humans. In addition to identifying gaps in scientific understanding, I am inspired in part by Popper (1959), who suggests that the identification or elimination of error is a key purpose of human inquiry. It seems clear to me that the scientific data discussed here cannot answer questions about what policies “should” be enacted in relation to wildlife tourism, and the ways in which a lack of clarity on the divisions between moral, ethical, and scientific questions may lead to confusion.

**Ecotourism**

An in-depth analysis of the many definitions and criteria for ecotourism in the academic literature could easily become a dissertation itself, but some basic consideration of semantics is useful for recognizing the issues surrounding responsible tourism practices. Ecotourism has been given many definitions, but perhaps the simplest and most commonly used comes from the International Ecotourism Society: “[r]esponsible travel to natural areas that conserves the environment and improves the well-being of local people”.

Blamey (1997, 2001) argues that ecotourism should satisfy three core criteria:

1. Attractions should be primarily nature-based
2. Participants should be interacting with attractions for educational purposes
3. Both visitor experience and attraction management should, practically and as a matter of principle, be sustainable ecologically, socio-culturally, and economically.
While ecotourism (broadly defined) has been the fastest growing segment of international tourism for the last thirty years (Honey, 1999; Hawkins & Lamoureux, 2001), there is some debate about the extent to which “mass” or “soft” ecotourism should be considered substantively different from mass tourism more generally. Indeed, some researchers suggest that the term ecotourism has at this point become nearly meaningless, referring only to tourism involving nature in some way (Sharpley, 2006). It is important to recognize that in spite of numerous competing academic definitions of ecotourism, it is not clear that there is a broad, widely accepted definition that is well-understood by the general public, and no large-scale internationally recognized and accredited certifying body yet exists.

Further, recognizing, tracking and managing impacts on wildlife across a wide array of potential species and negative effects is a challenging and complex proposition for wildlife researchers. Results tend to be both species and site specific and not, on the whole, very generalizable (Higham, 1998; Ellenberg, Mattern, Seddon, & Jorquera, 2006). Some impacts are extremely difficult to detect, and lack of certainty that harm is occurring can be misleading, as negative impacts may not be immediate, obvious or easily detectable (Sorice, Shafer, & Scott, 2003). For example, whales have shown gradual but significant alteration in behavior and responses to tourist boats as a result of exposure to human activity that would not be considered notable in the absence of long-term data (Watkins, 1986). This lack of definitive baseline data makes calls for improved management challenging, particularly as supporters of ecotourism may reject data that contraindicates tourism activities when it is based on similar species or classes of animal,
and may consistently underestimate the impacts of anthropogenic disturbance (particularly their own) on target species (Taylor & Knight, 2003).

**Wildlife Tourism**

Wildlife tourism does not have a clear and precise relationship to ecotourism, though many undoubtedly consider it a subset. In reality, there is some overlap between the two, though probably more overlap in the public imagination than based on any academic definition. Most broadly, wildlife tourism can be defined as any intentional interaction in which people journey to seek encounters with wildlife.\(^4\) This obviously encompasses a wide range of activities, from attendance at zoos and aquaria to expensive and elaborate trips to remote locations to view rare species in their native habitats. While captive wildlife tourism is an important factor in meeting human demand for wildlife experiences, for the purposes of this dissertation (unless otherwise specified) wildlife tourism here refers to interactions between humans and wildlife in natural or semi-natural settings.

The main argument in favor of the continuing growth of wildlife tourism, both in natural habitats and in zoos and reserves, is that such tourism has the potential to help secure the long-term conservation of wildlife species and critical habitat (Higginbottom, 2004). Researchers report that wildlife tourism presently plays an important role in funding the operation of public protected areas (5-50%), generates political support for conservation and funding of these areas, and spurs the creation of private wildlife reserves which may protect as many as 10% of remaining individuals of some threatened species (Buckley, 2009). For better and worse, money raised by tourism is playing a role

\(^4\) Thus many definitions of wildlife tourism may also include “consumptive” activities like big game hunting or fishing, discussed in somewhat more detail below, although these activities are not a major focus of this review.
in conserving many threatened species, perhaps providing more conservation support than would otherwise be available, but simultaneously leaving species vulnerable to changes in tourism economics (Buckley et al., 2012; Hackel, 1999). Ideally, wildlife tourism may also spur local people and tourists to greater concern about and investment in the conservation of wildlife resources (See Ogada & Kibuthu, 2008; Wallace, Leslie, & Coulson, 2012)—although there are clear examples where this is not occurring (See Adams & Infield, 2003; Amoah & Wiafe, 2012).

Wildlife tourism may also lead to unintended negative conservation outcomes. In some locations where wildlife tourism is financially successful, wildlife habitat is becoming increasingly fragmented—sometimes by tourism related development (Broadbent et al., 2012). In fact, in keeping with the theory of tourism succession, further tourism development of financially successful sites is in many cases damaging or destroying the natural features which made the site initially attractive (Wang et al., 2012), and there is evidence that wildlife and ecotourism may lead to poor conservation outcomes by opening up ecologically sensitive areas to mass tourism while creating the misperception that these areas are adequately conserved by tourism revenues and practices (Isaacs, 2000).

Research conclusions run the gamut in terms of the relative costs and benefits for wildlife in becoming tourism attractions, with some researchers suggesting that even low levels of tourism are destructive to wildlife populations, and others arguing that the conservation benefits outweigh the costs. Of course, any consideration of the scientific literature on this topic is further complicated by the factors researchers may consider in selecting their study sites or study species, and the risk that findings of minimal effects
may prove more difficult to publish, leading to an underrepresentation in the literature of equivocal findings. A meta-analysis of wildlife tourism from 251 case studies concluded that between 20 and 36% of wildlife tourism programs were unsustainable due to negative impacts on target species, usually resulting from large numbers of poorly regulated or managed tourists. Though 63% of operations were classified as sustainable (in the sense of not resulting in the long-term destruction or degradation of the wildlife resources they exploit) only 18% were found to have made measurable positive contributions to conservation (Krüger, 2005).

Wildlife tourism may also have a range of unintended ecological consequences on the systems where it takes place that may not be noticed by operators or resource managers; for example, Cunha (2010) reported significantly lower species richness and abundance of medium-large mammals and birds in areas visited by tourists than in undisturbed areas. Paired comparisons of neighboring protected areas that allowed or disallowed low levels of dispersed, non-vehicular human recreation found a five-fold decline in native carnivore density and shifts in community composition that favored non-native plant and animal species in areas that allowed human recreation (Reed & Merenlender, 2008). Of course, there are also researchers and managers arguing that thoughtfully designed tourism programs with research components may find an optimal middle ground, maximizing the economic, social, scientific and conservation benefits of wildlife tourism while also adequately protecting species and individual animals (Rodger, Moore, & Newsome, 2007; Semeniuk, Haider, Cooper, & Rothley, 2010).
Consumptive v. “Non-consumptive”

Wildlife viewing tourism is often described as a “non-consumptive” use for wildlife resources by economists, non-profits and wildlife managers, defined as “a human recreational engagement with wildlife wherein the focal animal is not purposefully removed or permanently affected by the engagement” (Duffus & Dearden, 1990, p. 215). Unfortunately, it is not uncommon for “non-consumptive” to be interpreted as “having no significant impact on individuals or populations”—a supposition which is not borne out by existing evidence.

Whale watching has frequently been described as a benign substitute for whaling that can generate revenues for local people (Hoyt, 2001) and increase environmental awareness (Orams, 1997b). Setting aside questions about the impacts these activities have (or fail to have) on human beliefs, attitudes and behaviors towards wildlife (discussed further later in this chapter), this description fails to account for the likely impacts of whale watching activities on whale populations. While it is true that wildlife tourism does not remove individual animals from wild populations as whaling or captivity does, it does not necessarily follow that it has no impact on an animal’s ability to be “utilized” again (or simultaneously in other ways), or on that individual or a species population as a whole over time. There is evidence that even moderate levels of tourism exploitation may in some cases impact the reproductive success of bottlenose dolphins (*Tursiops truncates*) and lead to higher mortality of juveniles (Mann, 1999). Thus, a dolphin pod cannot simultaneously rebuild a depleted population and provide tourism experiences—tourism exploitation is, in this case, consumptive of the potential for a wildlife population to be utilized for another purpose. Similarly, if an animal’s physical condition is negatively
affected by tourism exploitation and this results in premature death, the practice of
tourism was consumptive of some portion of healthy lifespan for that animal. It is more
reasonable to see “consumptive” and “non-consumptive” as being the two ends of a
spectrum; realistically, the vast majority of wildlife tourism falls somewhere in between,
affecting individuals and populations in myriad ways. This dichotomous terminology also
gives a sense that one type of use is inherently morally superior to another, when in fact
both may serve variously to commodify the wildlife they utilize (Tremblay, 2001).

Similarly, while hunting or fishing, for food or recreation, are considered
“consumptive” uses of wildlife populations, there is evidence that hunting is not
necessarily depletive of wildlife at the population level—and, in fact, that regulated
hunting, which takes the lives of individual animals, may not be fundamentally
inconsistent with the conservation of animal species; hunters may in some cases represent
conservation constituencies that may advocate or create incentives for wildlife protection
(Tremblay, 2001; Packer et al. 2009).

For example, a population of cheetahs might be better served by very low levels
of high-cost trophy hunting than by large-scale photographic tourism: Cheetahs are
diurnal hunters, and the presence of tourist vehicles sharply impacts their hunting
success; occasional exposure to and mortality from hunters may prove far less disruptive
(at a population level) than frequent photographic safaris affecting a larger portion of the
population (Caro, 1994). In fact, in some cases hunting may generate substantially more
money with a smaller ecological footprint than non-consumptive tourism because of
much larger revenues per hunter, and may prove to be the most economically “efficient”
use of wildlife (Deere, 2011; de Boer, Stigter, & Ntumi, 2007; Kabiri, 2010). Selling the
right to hunt or collect trophies from wildlife can be economically important to
developing nations or indigenous peoples and may generate higher revenues for the
conservation of some species or populations than a mass tourism approach, though as
with tourism, benefits appear to be heavily dependent on good regulation and
management (Nelson, Lindsey, & Balme, 2013).5

Of course, within the academic literature (and, more recently, in the news) there is
heated debate about the validity of describing killing an animal as “sport”, “recreation”,
or “ecotourism”—and this approach may, quite reasonably, be difficult for some
conservation-minded people and organizations to accept (Kheel, 1996; Nelson,
Bruskotter, Vucetich, & Chapron, 2016). This is not to defend trophy hunting as
preferable to other uses of wildlife, but merely to point out that both trophy hunting and
tourism represent uses and as such they are both, as a general proposition, at odds with
animal rights based arguments which value animals as ends-in-themselves (Fennell,
2012). Thus the idea that one of them, tourism, is morally laudable and represents a win-
win for conservation and development requires greater scrutiny than has sometimes been
offered. The controversy surrounding this issue helps illustrate the challenges of
addressing simultaneously values-based moral questions about how humans can and
should relate to non-human animals and questions around economically efficient uses of
“wildlife resources”.6

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5 It is also possible that optics of trophy hunting and tolerance for such practices are changing, suggesting
that whatever the potential contribution of trophy hunting to conservation, negative global media attention
may be altering the landscape of potential for consumption-based conservation (e.g., Macdonald, Jacobsen,
Burnham, Johnson, & Loveridge, 2016).

6 Indeed, this issue has driven some conservation scientists to point out the limitations of the tendency
towards consequentialist and rationalist thinking about these issues, arguing that the existing attempts at
separation of logic and emotion in scientific discussions are not ethically defensible (Nelson et al., 2016).
Wildlife Responses to Tourism

Wildlife species are characterized, in part, by their relative intolerance to human presence. Hediger (1968) observes that...

…the primary reason for usefulness as domestic animals to man is not the horse’s pulling powers, nor the dog’s intelligence, nor the cow’s milk capacity, nor the hen’s egg output, but is basically of a very different domestic quality, namely, the disappearance of that tendency to escape, so fundamentally important for their wild ancestors…Escape tendency excludes usefulness.” (p. 49)

This description can be readily applied to wildlife tourism as well, with those species most willing or able to tolerate human presence in relatively close proximity being the most likely to accrue conservation benefits from the establishment of wildlife tourism operations. Moreover, targeted wildlife tourism is likely to be challenging beyond normal chance encounters with human populations, as it is characterized by a tendency to stare, an intensive type of seeing that is particularly likely to trigger anti-predatory fear behavior in wildlife, increasing the probability of wariness or avoidance and escape attempts (Tudge, 1993).

The risk-disturbance hypothesis (Frid & Dill, 2002) suggests that predation theory is a useful lens for understanding interactions between humans and wildlife. It predicts individual and population-level responses to disturbance by humans on the expectation that wildlife respond to humans as potential predators (Knight & Temple, 1995; Whittaker & Knight, 1998). This theory suggests that, under most conditions, wildlife will avoid interaction with humans wherever possible. This, obviously, would not be helpful for tourism businesses predicated on providing people with relatively intense and close-up wildlife experiences. Although the range of species and habitats participating in wildlife tourism means that many are largely unstudied, the existing body of literature on the interactions between humans and wildlife allow for well-referenced generalizations
about the impacts of wildlife viewing on animal behavior, habitat use, physiological stress, and inter- and intra-specific interactions, as well as likely population level effects (Discussed further below, also see: Duchesne, Côté, & Barrette, 2000; Higham & Lusseau, 2004; Müllner, Linsenmair, & Wikelski, 2004; Skagen, Knight, & Orians, 1991; Czech & Krausman, 1997; Steven, Pickring, & Castley, 2011). Existing data suggests that even sustainable wildlife tourism has use limits based on the number of participating tourists which may be difficult to detect before wildlife is significantly affected (Malo, Acebes, & Traba, 2011).

The extent to which wildlife tourism leads to fear responses is also related to the ways in which humans and wildlife interact—in one study of kangaroos (Macropus rufus), how closely tourists approached was only one factor in determining whether individual kangaroos fled. Approach type (i.e., indirect or direct) was also an important factor in determining individual threat perception (Wolf & Croft, 2010). Similarly, the range of voluntary and binding restrictions on dolphin and whale tour operators usually include limitations on both approach speed and approach vector, with low speeds and converging courses preferred to direct approaches as being less stressful for animals (Steckenreuter, Harcourt, & Möller, 2011; Wiley, Moller, Pace, & Carlson, 2008). As the fear of predation has been shown to amplify the impact of other environmental stressors, wildlife in already degraded ecological systems may be at particular risk of harmful effects (Sih, Bell, & Kerby, 2004).

**Habituation/conditioning**

Habituation of individual animals is “a waning of response to a repeated, neutral stimuli,” in this case, tourist presence or activities (Whittaker & Knight, 1998, p. 313).
Essentially, habituation occurs when wildlife tolerates human presence and shows a reduced disposition to escape or evade observation by humans. In some sense, it may be seen as the process of creating wildlife that is “unnaturally tame to approach by humans” (Reynolds & Braithwaite, 2001, p. 35). This is different from, though often confused with, innate tolerance—or “the intensity of disturbance an individual tolerates without responding in a defined way” (Nisbet, 2000, p. 315)—which has to do with a range of factors specific to the individual; both habituated and unhabituated individual animals have tolerance ranges for human approach and contact.

While some arguments suggest that habituation may be “good” for wildlife by suppressing the production of stress hormones or minimizing behavioral changes in response to tourist presence (as in seabirds, Yorio, Frere, Gandini, & Schiavini, 2001), it also has obvious potential to cause a variety of problems for both humans and wildlife. For instance, when manatees (Trichechus manatus) become habituated to the presence of boat traffic, they stop avoiding high traffic areas; boat strikes are a leading cause of manatee mortality (Shackley, 1992).

Habituation will likely occur most rapidly in wildlife populations when human encounters (stressors) are repeated predictably and uniformly, as opposed to intermittently or randomly (Pitman, Ottenweller, & Natelson, 1988; Martí et al., 1997). Fowler (1999) recommends concentrating tourist pressure on Magellanic penguins (Spheniscus magellanicus) in one area of the colony, habituating exposed individuals while leaving the rest of the colony undisturbed. While habituation will lead to reduction in physiological stress responses, it may also have other impacts, including population declines, resulting from mortality, slow growth, and emigration (Bejder et al., 2006). In
some cases, the temporal and spatial predictability of human presence will also allow
wildlife to alter their behavior to avoid human interaction, potentially minimizing impacts
on sensitive species or individuals (Rode, Farley, Fortin, & Robbins, 2007). On the other
hand, such predictability can contribute to overall behavioral changes as a result of
habituation with long-term results that are difficult if not impossible to predict.

**Provisioning v. Non-provisioning**

Habituation is a slow process that may take years. However, tourism operators
have found that habituated tolerance for and familiarization with tourists can be sped up
dramatically by provisioning (feeding) participating wildlife. Provisioning or
supplemental feeding of wildlife is an important part of the practice of wildlife tourism in
many parts of the world, because providing regular food resources to wildlife is a simple
way of increasing both the likelihood of wildlife being sighted and the proximity to
humans wildlife are willing to tolerate. It has been used in Nepal and India to attract
tigers for viewing by tourists (McDougal, 1980); by East African safari park staff to
attract leopards or lions to convenient viewing sites (Edington & Edington, 1986); and in
Indonesia to attract large monitor lizards for viewing and photography (Walpole, 2001),
among many other examples. Provisioning has been both controversial and important to
the development of the shark tourism industry globally (Brunnschweiler & Baensch,
2011; Clua, Buray, Legendre, Mourier, Planes, 2010; Maljković & Côté, 2011; Bruce &
Bradford, 2013; Hammerschlag, Gallagher, Wester, Luo, & Ault, 2012; Fitzpatrick,
Abrantes, Seymour, & Barnett, 2011) and has been used to attract manatees for easy
viewing (Shackley, 1992). While both provisioned and non-provisioned wildlife tourism
are common for a wide variety of species, because it is seen as particularly “unnatural”,
provisioning tourism is the subject of additional academic scrutiny. Knight (2010) argues that the provisioning of monkeys in Japan, which makes them predictably and immediately accessible to time-pressed tourists, actually serves to commodify and decontextualize the animals themselves in ways that do not (and perhaps could not) successfully serve conservation or education goals.

Although supporters of provisioning argue in favor of its “potential to manipulate wildlife distribution and behavior for close, benign, and extraordinary viewing experiences” (Gill, 2002, p. 222), there are many researchers who argue that provisioning is at the root of some of the most serious potential impacts associated with wildlife tourism (Knight, 2009; Orams, 1995). Unlike habituation, provisioning tends not only to normalize interaction with humans, but also to concentrate wildlife populations, leading to a variety of potential negative outcomes. Provisioning thus has the potential to result in the ingestion of inappropriate foods, and may alter wildlife distributions within habitat, facilitate the spread of disease, result in aggressive behavior towards humans or other animals, alter natural predator-prey relationships, and result in animal dependence on human handouts (Orams, 1995; Orams, 2001; Bruce & Bradford, 2013; Clarke, Lea, & Ormond, 2011). For provisioned southern stingrays (Dasyatis americana), impacts include higher parasite loads and reduced immune function—changes that can be extrapolated to their potential impacts on individual fitness and population health in the long term (Semeniuk, Bourgeon, Smith, & Rothley, 2009). Though the scientific evidence for significant negative outcomes is not overwhelming at this time, the risks are certainly real, and some locations that have previously offered provisioning tourism have
altered their practices in response to perceived unwelcome consequences (Walpole, 2001).

This is of particular concern for top predators—often in demand as tourism attractions—as they tend to be K-selected species that mature and reproduce slowly. This type of provisioning tourism may contribute to additional ecological consequences, including increased numbers of predators, altered dietary preferences and life history characteristics among predators, and changes in home range, habitat, and movement—potentially leading to trophic cascades and other harmful ecosystem level effects (Newsome et al., 2015; Macdonald et al., 2017). Of course, feeding of predators is also most likely to lead to serious concerns about human safety at tourism sites; unmanaged provisioning of dingoes (Canis lupus dingo) on Frasier Island, Australia was implicated in a human fatality, resulting in a contested governmental cull of dingoes (Burns & Howard, 2003).

Although the evidence for some of these impacts are equivocal, there is strong evidence that provisioning may lead to “begging” behavior directed towards tourists across a wide range of wildlife species, and that when unsatisfied, such behaviors may become aggressive. At a provisioning tourism site in Australia, bottlenose dolphins (Tursiops truncatus) were found to engage in progressively more risky and aggressive interactions with humans as their wait time to be fed increased (Smith, Samuels, & Bradley, 2008). Begging behaviors have been reported for a range of species, including bears and deer in American national parks (Tate & Pelton, 1983; Hockett, 2000), dolphins in Australia (Orams, 1995), iguanas in the Galapagos Islands (Edington & Edington, 1986), dingoes in Australia (Burns & Howard, 2003), and small primates in
Africa and Asia (Lee et al., 1986; Knight, 2005). Resulting aggression has also been reported for numerous species, and in some cases can lead to retribution by humans (Albert & Bowyer, 1991; Gildart, 1981; Fa, 1992).

**Impacts of Temperament/Personality**

The question of how individual differences may alter the way anthropogenic disturbance impacts wildlife is relatively new, and few studies have investigated this question in depth (McDougall, Réale, Sol, & Reader, 2006; Martin & Réale, 2008). That said, a growing literature supports the existence of individual differences in animals which scientists have variably termed temperament (e.g., Hansen and Møller, 2001), personality (e.g., Gosling & John, 1999), and behavioral syndromes (e.g., Sih, Bell, Johnson, & Ziemba, 2004). Evidence for these individualized traits has been found in species as various as water striders (*Aquarius remiges*; Sih & Watters, 2005), swift foxes (*Vulpes velox*; Bremner-Harrison, Prodholt, & Elwood, 2004) and chimpanzees (*Pan troglodytes*; Weiss, King, & Hopkins, 2007). The term “personality”, applied predominantly to humans but increasingly to some animal species as well, is seen as emerging from a combination of genetic, learned and environmental factors, while “temperament” is thought to be primarily the result of genetics (Box, 1999). Behavioral syndromes are typically defined at the population level—for instance, populations of funnel web spiders exhibit higher levels of aggression in a resource poor environment than in populations with abundant resource availability (Riechert, 1993). Regardless of terminology, there is clear evidence that individual behavioral and physiological differences in animals and animal populations exist and impact how animals make
decisions and respond to stressors, and that the severity and significance of stress responses can vary widely across individuals (Cockrem, 2013).

Initial research suggested that animals that flee from anthropogenic disturbance were those more impacted by the disturbance than animals that remained (Foster & Rahs, 1983; Fowler, 1999). However, more recent studies have suggested that individuals fleeing disturbance may be those who are able to do so by virtue of their strengths, including good body condition, experience/knowledge of other areas, or other factors (Stillman & Goss-Custard, 2002; Beale & Monaghan, 2004b). Under those circumstances, it is reasonable to assume that over time tourism may lead to changes in local wildlife population temperament, as the situation may consistently favor the reproductive success of bolder/more disturbance tolerant individuals over more cautious individuals.

In one study, “Temperament/Docility” was shown to be an important factor in determining the distribution of chipmunks (Tamias striatus) in response to human disturbance. More “docile” chipmunks were willing to tolerate closer proximity to humans, but also showed higher levels of cortisol stress hormones (Martin & Réale, 2008b). Similarly, a study of raptors found that some birds preferentially locate their nests away from roads, while others move towards them, suggesting that animal cost-benefit analyses of proximity to humans may vary among individuals of the same species occupying the same habitat (Martínez-Abrain, Oro, Jiménez, Stewart, & Pullin, 2010). Zookeeper evaluations of the temperament of individual clouded leopards (Neofelis nebulosa) were found to successfully predict the level of behavioral reactivity and physiological stress they exhibited in response to novel stressors, demonstrating
temperamental mediation of stress responses (DeCaluwe, Wielebnowski, Howard, Pelican, & Ottinger, 2013). In bottlenose dolphins, the likelihood of aggressive behavior towards provisioning humans was significantly variable across individual dolphins (Smith et al., 2008), suggesting that personality or temperament may play an important role in suitability for certain types of interactions. Similarly, individual personality traits were found to predict successful adaptation in response to translocation for Stephens’ kangaroo rats (Dipodomys stephensi), suggesting that resilience to certain kinds of environmental stress may vary substantially by individual as a result of personality (Baker, 2014). Although there are obvious challenges in definitively evaluating the temperament of individual wild animals, what is known clearly suggests that the personalities and the current physical state of individual animals will be likely to impact their tolerance of (and responses to) tourism by humans.

It is also clear that other individual traits like sex may predict individual response to the same stressor, both behaviorally and physiologically (e.g., captive giant pandas in Powell, Carlstead, Tarou, Brown, & Monfort, 2006; captive snow leopards in Sulser, Steck, & Baur, 2008). Male long-tailed macaques (Macaca fascicularis) were found to have substantially higher rates of aggressive interactions with tourists than females or juveniles (Fuentes & Garnerl, 2005), while grizzly bears (Ursus arctos) were shown to have individually varying sex-mediated tolerances of wildlife viewing activities, making long-term impacts of wildlife viewing difficult to assess and generalize about at a population or species level (Elmeligi & Shultis, 2015).

The physical condition of individual animals is also likely to mediate their response to stress and human disturbance. Lower body mass, poorer body condition and
depleted fat stores have been demonstrated to make Magellanic penguins (*Spheniscus magellanicus*) more physiologically responsive to capture stress (Hood, Boersma, & Wingfield, 1998); supplemental feeding of turnstones (*Arenaria interpres*) showed that individuals with enhanced body condition were more responsive to human disturbance, scanning more regularly for threats, fleeing while the perceived threat was a greater distance away, and going farther when fleeing (Beale & Monaghan, 2004). These studies suggest that temperament/personality is part of a suite of individual differences that affect how wildlife responds to stressors, including the presence of human tourists. Sociability may also play a role, as doves in flocks tend to “scan” for predators less frequently than solitary birds and tolerate closer approaches, and solitary birds detect and evade humans at greater distances than the flock as a whole, suggesting that that disturbances may be more energetically costly to solitary individuals in terms of reduced feeding time and altered energy budgets (Fernández-Juricic & Schroeder, 2003). Similarly, Smith, Herrero, and DeBruyn (2005) argue that bear-to-bear habituation and higher bear population densities reduce the risk of aggressive human-bear interactions through their effects on bear social dynamics.

Because personality and temperament traits are at least somewhat heritable and impact individual fitness, changes in level of disturbance may alter which personality traits are most adaptive, leading to potential local shifts in species temperament (Boon, Reale, & Boutin, 2007). In many species, while under conditions of intermediate ecological favorability (medium risk/medium reward; with high reward behaviors offset by high risk) a variety of equally adaptive personality traits may emerge. Under highly favorable ecological conditions populations will tend towards bold individuals while
under unfavorable conditions cautious individuals will generally prove more successful (Luttbeg & Sih, 2010). As a result, ecological changes induced by tourism and human disturbance may alter animal personality at the population level. Intensive tourism may also potentially impact populations over time through social learning (Higham, 2012), changes in individual gene expression as a result of stress (Murata et al., 2005), changes in population resilience (Reed, Briscoe, & Frankham, 2002), and the potential for significant genetic and behavioral impacts on future generations (Rodgers, Morgan, Bronson, Revello, & Bale, 2013; Dias & Ressler, 2014; discussed further below).

Evaluating Wildlife Stress Responses

Behavioral

Perhaps the simplest way to judge individual and group responses to exposure to humans is to observe wildlife behavior. While this metric may fail to capture other types of stress responses (as discussed below) and thus may not be adequate as a single metric for evaluating impacts (Gill, Norris, & Sutherland, 2001), behavioral data is typically simple, inexpensive, and relatively non-invasive to collect. Evidence from behavioral studies suggests that immediate behavioral responses to human presence often include changes in vigilance state and foraging, and may include efforts at concealment or evasion, behavioral attempts to reduce stress, and future avoidance of tourist sites (Regel & Pütz, 1997; Buckley, 2004; Kinnaird & O’Brien, 1996). These responses are seen in a wide range of species and families of animals, and are common. A review of the effects of anthropogenic disturbance on birds found that immediate behavior was negatively impacted in 90% of reviewed studies (Steven, Pickering, & Castley, 2011).
Wildlife species have been shown both to alter habitat use to avoid or minimize encounters with humans and to engage in self-soothing behaviors to reduce the effects of contact when it occurs. In response to human tourists, black howler monkeys (Alouatta caraya) move higher into the tree canopy to avoid direct, prolonged contact with humans (Treves & Brandon, 2005). Manatees have been shown to increase their use of no entry areas at tourist sites in an effort to avoid contact when there are numerous swimmers present (King & Heinen, 2004). When avoidance is impractical, wildlife may attempt to reduce their stress with a range of behaviors. Chimpanzees (Pan troglodytes) in the presence of humans increase their stress vocalization rate (Johns, 1996), and Barbary macaques (Macaca sylvanus) engage in self-soothing scratching behaviors (Maréchal et al., 2011). These responses are not limited to monkeys and apes: rock wallabies (Petrogale mareeba) engage in stress reduction techniques including increased self- and conspecific grooming (Hodgson, Marsh, & Corkeron, 2004).

For some species, behavioral changes are energetically costly. In Africa, cheetahs (Acinonyx jubatus) and lions (Panthera leo) in some tourism situations exhibit “high response” to tourism vehicles, including fleeing from them on sight (Ceballos-Lascurain, 1996). Herbivores also evince significant disturbance at human presence, and given the energetic demands of large-scale herbivory, lost feeding time or opportunity as a result of moving to less optimal habitat or increasing vigilance may decrease overall fitness (Fortin, Boyce, Merrill, & Fryxell, 2004), while energy budget disruption created by fleeing disturbance may increase caloric and energetic demand (Riddington, Hassall, Lane, Turner, & Walters, 1996; Houston, Prosser, & Sans, 2011). The Asian rhinoceros (Rhinoceros unicornis) shows increased vigilance and decreased feeding time in the
presence of tourists (Lott & McCoy, 1995), while Nubian ibex (*Capra nubiana*) abandon a desirable food source in areas heavily frequented by tourists or at times of particularly high tourist density (Tadesse & Kotler, 2012). Under disturbance, Bedwick’s swans (*Cygns olor*) similarly showed a lower giving up net energy intake rate (Gyimesi, Varghese, De Leeuw, & Nolet, 2012). While these impacts may be more severe on some species and individuals than others, no wildlife species is immune to the threat posed by human interference with available feeding time and opportunity.

Impacts are not limited to exposure to humans, but wildlife also responds to the presence of vehicles and is documented to have significant sensitivity to anthropogenic noise (with most research focusing on songbirds and marine mammals). Shannon et al. (2015) reviewed studies examining the impact of noise, and found that many species altered vocal behavior to mitigate masking by other sounds, were found in reduced abundance in noisy habitat, altered vigilance and foraging patterns and showed individual and population level effects. For example, dolphins approached by vessels more closely than 50m spent less time feeding and resting, tended to cluster together more tightly, and exhibited less “neutral” movement than pods who were approached no more closely than 150m (Steckenreuter et al., 2011). The presence of tourist vessels can alter foraging behavior and reduce the level of maternal care provided to calves (Mann, 1999); it also may lead to changes in vocalization and aerial behavior, and the sound of engines may result in increases in “milling” as communication becomes more challenging in a louder environment (Lundquist, Gemmell, & Würsig, 2012). Similarly, boat presence reduced foraging time for European Shags (*Phalacrocorax aristotelis*) in some of the most productive feeding areas around nesting grounds. Although this particular study looked at
adult behavior, it seems clear that reduced access to food for adults must also result in sub-optimal outcomes for chicks (Velando & Munilla, 2011). There is evidence that the degree of ongoing commotion may also be an important factor in driving negative impacts; tundra vehicles for polar bear viewing have a significant impact on male bear vigilance, but when vehicles remain still, bears rapidly acclimate to their presence (Dyck & Baydack, 2004). In at least some species, approach by vehicles is less alarming and disruptive than approach by humans on foot (Stankowich, 2008); while other species may be more affected by motorized vehicular approaches (Andersen, Teilmann, Dietz, Schmidt, & Miller, 2012).

Though these and many other studies show behavioral impacts on wildlife, measuring the effects of tourist presence through behavioral observations presents significant challenges. Behavior can be easy to misinterpret, particularly in the absence of nuanced baseline data. For instance, harbor seals (Phoca vitulina) are less willing to flee at human approach during breeding season, as they are unwilling to abandon their pups to a perceived threat of predation. However, an observer of seal behavior examining their responses to tourists only during breeding season might erroneously attribute an apparent “tolerance” of close human approach to low impact or habituation, when in fact such approach might represent an extremely stressful event which the seal is unable to flee or avoid (Andersen et al., 2012). In another example, in a controlled exposure study killer whale pods (Orcinus orca), when approached by three or fewer tourism vessels, increased path tortuosity in an effort to evade them. In the presence of more than three tourism vessels, pods continue on a straight line course, accepting the impossibility of evasion—a choice consistent with other findings in the field of fear ecology and
predation avoidance, but which might lead an assessor to misjudge behavioral impacts and conclude the pod was undisturbed by the encounter (Williams & Ashe, 2007).

Behavioral studies suggest that at least some species are capable of behavioral plasticity to mitigate stress responses to tourist activity, and thus may be resilient to negative impacts. Spotted hyenas (*Crocuta crocuta*) exposed to anthropogenic disturbance stayed closer to cover, were more nocturnal and cryptic, and formed smaller groups (Boydston et al., 2003). Although these behavioral changes would not make hyenas more attractive to a tourism operator, they do demonstrate the potential for successful or partially successful behavioral adaptation of wildlife to increasing human presence and suggest the extent to which some species may be better able to tolerate or effectively respond to exposure to humans than others—on the whole, hyena populations are more stable than many other large carnivores in similar habitats. Brown bears (*Ursus arctos*) showed similar plasticity, adjusting temporal and spatial aspects of their foraging strategies to avoid humans while maintaining food intake and body condition, a finding which emphasizes the importance of suitable nearby habitat and resources undisturbed by humans, to allow wildlife to respond in ways that minimize harmful impacts (Rode et al., 2007). However, research suggests that responses to perceived risks are likely to be reactive rather than predictive, and thus species are still likely to use substantial energy over time responding to anthropogenic disturbance (Broekhuis, Cozzi, Valeix, McNutt, & Macdonald, 2013).

**Physiological**

Even in cases where behavior is truly unchanged, a lack of impact cannot be assumed. Amo, López, and Martí (2006) found that while lizards (*Podarcis muralis*) did
not alter their anti-predatory behavior in response to tourist presence, those living in high
tourism areas showed poorer body condition, higher parasite loads, and reduced immune
function. Nephew, Kahn, and Romero (2003) found that in European starlings (*Sturnus
vulgaris*), behavioral responses, heart rate, and hormonal stress responses were regulated
separately. Behavioral observations may thus fail to capture wildlife stress in settings in
which behavioral stress responses may be difficult to detect or invisible to observers.

When disturbances occur in critical habitat or around important reproductive life events,
wildlife may have no other option but to endure the stress of exposure to and interaction
with humans (e.g., Creel et al., 2002; Dyck & Baydack, 2004).

In addition to or instead of behavioral changes, wildlife may exhibit physiological
responses to the presence of human tourists, including changes in temperature, heart rate
or stress hormone secretion (Müllner et al., 2004; Thiel, Jenni-Eiermann, Braunisch,
Palme, & Jenni, 2008). Wandering albatrosses (*Diomedea exulans*) showed higher heart
rates in disturbed areas than in non-disturbed (Weimerskirch et al., 2002), while nesting
royal penguins (*Eudyptes schlegeli*) showed elevated heart rates in response to human
approaches well prior to escape behaviors (Holmes, Giese, & Kriwoken, 2005). One
useful tool for assessing the stress impacts of tourism activities on wildlife is the analysis
of fecal glucococsterone (FGC), a stress hormone metabolite. A study of hormonal levels
in western lowland gorillas (*Gorilla gorilla gorilla*) showed that groups that encountered
humans had higher rates of stress metabolites in their waste, on average, than
unhabituated groups. As previously discussed behavioral research predicts, the group in
the process of being habituated showed the highest stress levels, exhibiting a cumulative
response in line with descriptions of hormonal adaptation to chronic but intermittent
stressors. The study also found that stress levels were significantly associated with the closeness of human approach (Shutt et al., 2014). Other wildlife, ranging from European pine martens (*Martes martes*; Barja et al., 2007) to black howler monkeys (*Alouatta caraya*; Behie, Pavelka, & Chapman, 2010) show higher levels of FGC than members of their species not visited by tourists. Barbary macaques (*Macaca Sylvanus*) deal with the stress of human interactions with different rates of self-soothing/anxiety behaviors (scratching), but also show elevated fecal stress hormones in response to aggressive interactions with humans (Maréchal et al., 2011).

Hormonal changes can allow for the detection of impacts which may not result in behavioral change, or are otherwise difficult to observe (e.g., species that are cryptic and difficult to sample through analysis of blood or behavior). Thus, for example, researchers demonstrated higher levels of FGC among wildcats (*Felis silvestris*) in reserve areas where tourist hiking is permitted, even though actual encounters between hikers and wildcats were uncommon (Piñeiro, Barja, Silván, & Illera, 2012). Habitat, prey abundance, and the presence of competitor carnivores were not found to impact FGC levels, suggesting that encountering humans is more physiologically challenging than other, “natural” stressors (Piñeiro, Barja, Otero, Silván, & Illera, 2015). Similarly, studies of giant panda (*Ailuropoda melanoleuca*) showed a correlation between FGC levels and the degree of anthropogenic disturbance taking place in their habitat (Deng, Jin, Hu, & Liu, 2014), and capercaillie (western grouse; *Tetrao urogallus*) living in areas utilized for skiing tourism showed significantly elevated corticosterone metabolites in their droppings relative to those living in comparatively undisturbed forests (Thiel et al., 2008). These examples suggest that even diffuse tourism that does not explicitly target
wildlife may have significant impacts on resident wildlife, including species of conservation concern.

One method of tracking habituation includes monitoring a decline in stress response over time. Studies show that many animals that are habituated to human disturbance produce lower levels of FCG in response to novel disturbance—although this is not always the case. In at least one colony of Magellanic penguins, habituated penguins reduced their production of corticosterone in response to human presence while still producing a physiologically robust stress response to novel stressors (Villanueva, Walker, & Bertellotti, 2012). However, a pattern of impaired stress response has been observed in penguins (Walker, Boersma, & Wingfield, 2005), marine iguanas (Romero & Wikelski, 2001), and European blackbirds (*Turdus merula*) (Partecke, Schwabl, & Gwinner, 2006).

It is hypothesized that this reduced stress response allows habituated animals to avoid the negative results of repeatedly elevated glucocorticoids while under stress (Wingfield, 1994; Johnson, Kamilaris, Chrousos, & Gold, 1992).

Elevated stress levels represent not merely a convenient marker for identifying present impacts, but have a well-established connection to animal health, survival and reproductive success (Romero & Wikelski, 2001; French, DeNardo, Greives, Strand, & Demas, 2010; Ellenberg, Setiawan, Cree, Houston, & Seddon, 2007). Because physiological stress can result in consequences at the individual as well as population level, measures of physiological stress are of vital importance in evaluating tourism impacts on any species of conservation concern (Charbonnel et al., 2008).
Impacts on Reproduction

Impacts of human tourism on the success of animal reproduction are likely variable and can be challenging to measure. However, strong evidence suggests that physiological stress can dramatically affect reproductive success. Pregnant snowshoe hares (*Lepus americanus*) exposed to intermittent, brief, and regular simulated predation risk (exposure to a dog for 1-2 minutes) showed dramatically higher levels of fecal corticosterone metabolites than a control group (837% higher in dams that failed to give birth to live young; 214% higher in dams that successfully gave birth). Even more critically, offspring from stressed dams were 37% lighter and 16% smaller than offspring from control, unstressed dams—clearly showing that glucocorticoid concentrations can lead to dramatic declines in reproductive output in both quantity and quality of offspring (Sheriff, Krebs, & Boonstra, 2009). Yellow-eyed penguins (*Megadyptes antipodes*) showed similar impacts as a result of tourist activities, with evidence of higher parental corticosterone concentrations and lower breeding success and fledgling weights at a colony exposed to unregulated tourism (Ellenberg et al., 2007). Evidence from some species, including royal penguins (*Eudyptes sclegeli*), suggests that in some cases humans may be perceived as a more serious threat than “natural” predators, making the potential reproductive impacts of tourist presence on some species particularly severe (Holmes et al., 2005).

There is plenty of other evidence for similar stress-related reproductive impacts on offspring development and on the phenotype of resulting offspring in adulthood. In a study of Japanese quail (*Coturnix coturnix japonica*), heightened maternal corticosterone was found to correlate to significantly higher levels of yolk corticosterone, and chicks
hatched from these eggs grew more slowly than controls and showed higher physiological stress responses to capture and restraint as adults (Hayward & Wingfield, 2004). Experimental increases in egg corticosterone reduced the rate and volume of late embryonic vocalizations and the intensity of chick begging behavior, and depressed T-cell-mediated immune function, suggesting that maternal stress may have significant long-term effects on offspring (Rubolini et al., 2005). Stress of male mice has also been shown to alter sperm microRNA content, also resulting in altered offspring stress responsivity (Rodgers et al., 2013). Research suggests that even small changes in egg incubation temperature, which could easily result from tourism pressures disturbing incubating adults, may lead to reduced growth rates, higher levels of baseline and stress-induced corticosterone, and reduced body size and condition (DuRant, Hepp, Moore, Hopkins, & Hopkins, 2010).

Many studies have found that a variety of birds show other reproductive impacts resulting from tourism activities as well. These impacts take various forms—reduced nest building or egg laying, or a reduction in the number of chicks successfully hatched or fledged (Liddle, 1997; Buckley, 2004; Liley & Sutherland, 2007). For some bird species, the mere presence of people is a strong predictor of poor nesting success, while other species will shift their nesting sites in an attempt to avoid human tourists (Beale & Monaghan, 2004b; Higham, 1998). This may even lead to abandonment of otherwise highly suitable and long-used colony sites among seabirds (Yorio et al., 2001). High levels of parental corticosterone are correlated with reduced parental investment during the incubation period, changes in incubation period and temperature, and even egg abandonment (Thierry, Massemin, Handrich, & Raclot, 2013).
Although the effects on birds are most thoroughly studied, evidence from other species suggests a similar degree of impact. One study demonstrated that the survival of dolphin calves born to provisioned mothers was considerably lower (36%) than the survival rate of calves born to dolphins that did not participate in provisioning interactions with tourists (67%) (Orams, 1997a). At one site, under even modest levels of tourism exploitation (more than one tourist boat in operation) dolphin abundance began to decline, although it is difficult to ascertain whether this decline is the result of direct mortality, reproductive failure, or even emigration away from tourism sites by individuals (Bejder et al., 2006). The nests of crocodiles driven into the water by tourism impacts were found to be highly vulnerable to opportunistic predation on nestlings and eggs by monitor lizards or olive baboons, reducing reproductive output (Cott, 1969). In addition to the risk of declines in parental care, infant mortality was substantially higher in Tibetan macaques (Macaca thibetana) exposed to tourism, most likely as a result of increasing aggression among adults in response to provisioning conflicts and range restrictions (Berman, Li, Ogawa, Ionica, & Yin, 2007).

Sea turtles are less likely to come ashore to lay eggs in the presence of bright lights, noise, or numerous people, and may abandon a nest site during the egg-laying process if disturbed (Wilson & Tisdell, 2001). A study of humpback whale reproduction found no correlation between exposure to whale watching vessels and calving frequency or calf survival, suggesting that individual humpback aversive responses to whale watching boats may not translate to long-term population level changes. However, the North Atlantic population of humpback whales, which is extensively exploited for
tourism, is growing more slowly than other global humpback sub-populations, for reasons thus far unclear (Weinrich & Corbelli, 2009).

Seasonality is likely to play a strong role in determining the extent of overlap between tourist high seasons and reproductive cycles, and in at least some species, the severity of impacts is clearly related to the time of year during which tourists are present (Yorio et al., 2001). Even within a given breeding period, there may be meaningful variability in parental sensitivity to standardized stressors based on reproductive stage (Adams, Cockrem, Taylor, Candy, & Bridges, 2005).

Even where tourism impacts on adults are manageable, young animals may not be able to tolerate the presence of tourists. While adults showed signs of habituation, hoatzin (Ophisthocomus hoazin) chick survival rates are negatively impacted by even low levels of tourism exploitation, and chicks hatched in areas with higher levels of tourism possessed a much greater physiological stress response to capture than chicks from undisturbed sites (Müllner et al., 2004). The adults were better equipped to handle tourist presence, and for hoatzin, tourist activity had no impact on egg incubation success. Magellanic Penguin (Spheniscus magellanicus) offspring hatched in colonies regularly visited by tourists, while significantly more tolerant of human approach than naïve juveniles, still produced a physiologically robust stress response to capture, even when habituated adults in the colony did not (Walker et al., 2005). This is highly suggestive that even among individuals of the same species, susceptibility to harm resulting from tourism may vary greatly depending on age and life stage, with pressures which are tolerable to adults in at least some cases resulting in juvenile morbidity or mortality (Müllner et al., 2004).
Finally, there is evidence that for a relatively small group of species, there may be some reproductive benefits resulting from tourism. Nevin and Gilbert (2005a) reported that female brown bears (*Ursus arctos*) may have actually benefited from tourism interactions with humans, as human presence helped them avoid unwanted interactions with male bears. The voluntary temporary displacement of large males resulting from tourist presence may create a “temporal refuge” for subordinate age and sex classes to feed at a resource rich site (Nevin & Gilbert, 2005a). In the absence of humans, avoidance of male bears reduced female bear fishing effectiveness by up to a third (Nevin & Gilbert 2005b). While male polar bear (*Ursus maritimus*) vigilance increases in response to the presence of tundra vehicles, female vigilance was found to be higher when vehicles were not present. The authors theorize that the tundra vehicle may act as a buffer against conspecifics, protecting female bears from male bear infanticide intended to return them to estrus (Dyck & Baydack, 2004). The presence of human tourists may also protect the nests of hawksbill sea turtles (*Eretmochelys imbricata*) from depredation by non-native mongooses in the Caribbean; limited daytime human presence on the beach was found to reduce the risk of predation on eggs by up to 56% by altering mongoose habitat use (Leighton, Horrocks, & Kramer, 2010). Moderate levels of human presence may also reduce natural predation rates on eggs of ground-nesting birds (Ibáñez-Álamo, Sallorente, & Soler, 2012).

While there are many debates about terminology and the degree to which wildlife tourism harms wildlife, existing evidence strongly suggests that even moderate levels of tourism exposure are likely to have some impacts on exposed wildlife. These impacts may be diverse and difficult to detect, ranging from effects on heartrate and hormonal
stress response to alterations in natural behaviors and community structures—but there are very few instances in which investigators did not find some degree of impact. Though in a significant portion of cases such exploitation is unsustainable, many examples are more ambiguous, particularly when the effects of tourist presence are apparently minor (Krüger, 2005). Due to the long-term and cumulative nature of most of these impacts, definitive judgments about their true severity are often difficult or impossible based on existing data, although in many cases they are likely to be less severe than other major anthropogenic impacts, including loss of habitat, loss of prey species, or other extractive activities. Despite a relatively small likely impact, where tourists are visiting rare and endangered species, or wildlife populations are already under significant anthropogenic stress, existing data would seem to argue for a precautionary approach to the regulation and management of wildlife tourism.

**Human Dimensions of Eco- and Wildlife Tourism**

**Ecotourism**

The human dimensions of ecotourism present different challenges. Although the environmentally responsible component of definitions of ecotourism is usually given primacy, in almost all technical definitions ecotourism is also associated with practices that are socially responsible (e.g, Blamey, 1997; Donohoe & Needham, 2006; Fennell, 2001). However, as ecotourism has entered public consciousness and become increasingly popular, there has been tremendous growth of a “soft” ecotourism (also sometimes called “mass ecotourism”) industry that espouses some of the same principles, but operates on a larger scale and with a lesser degree of commitment to sustainability. In many cases, expectations of good management or thoughtful planning and design of
tourism practices have not been met (e.g., Ruyooka, Mugisa, & Obua, 2000; Yu, Hendrickson, & Castillo, 1997). Although it has not been extensively studied, it seems clear there are a vast and growing number of tourism providers who engage in deceptive marketing and greenwashing, and that there is an overall lack of quality control in the industry (Wight, 1993; Weaver, 2001; Weaver & Lawton, 2007). That said, there are numerous examples of sustainable tourism projects that deliver the conservation, economic, and educational benefits ecotourism is intended to provide—however, they are far from universal and are heavily dependent on local contexts (Krüger, 2005; Zambrano, Broadbent, & Durham, 2010; Hunt, Durham, Driscoll, & Honey, 2015).

There is considerable debate about what contributions ecotourism is able to make to sustainable development and global biodiversity conservation. Some argue that it represents an opportunity to transition economies to sustainable “non-consumptive” uses of wildlife and natural resources. Others point out the considerable social, economic and environmental limitations on that potential (Ross & Wall, 1999; Gössling, 1999; Duffy, 2008). It does seem clear that neoliberal tourism-generated incentives alone are inadequate to meet conservation goals, and that ecotourism may further open up ecologically sensitive areas to mass tourism development while creating a false sense of conservation security (giving people the impression that natural areas are adequately conserved by recreational ecotourism) (Isaacs, 2000; Adams & Infield, 2003). Further, there is evidence that these projects may never produce the sought-after “sustainable development” benefits promised to local communities (e.g., He et al., 2008; Sekhar, 2003). Indeed, some researchers argue that the concept of ecotourism is itself another form of a Western imperialism that seeks the global imposition of Western values and
perspectives on non-Western people and societies (Cater, 2006) and results in the progressive neoliberalization of nature (Duffy, 2008).

Most ecotourists believe that their activities are less harmful to the environment than those of mass tourists, and expect that operators will minimize their impact on the environment as a matter of course—and thus do not consider company practices critically when choosing a provider (Mair & Jago, 2010). Some research suggests that tourists are able to detect false rhetoric in greenwashed “eco” and “community” initiatives (Curtin, 2010), but this detection may not serve to create sustainability pressure. Operators seem to believe that environmental and social responsibility are not a driving force for tourist choice, and many may not emphasize or even discuss these factors in their marketing (Smith & Font, 2014). In spite of hopes that tourist demand will drive operators towards greener practices, only 19% of tourists surveyed were willing to pay more for a vacation with a company with a strong environmental record (Holden, 2013), and a primary barrier to improvements in ecotourism sustainability practices broadly is tourist indifference (Budeanu, 2007; Beaumont, 2011).

**Wildlife Tourism and Economic Valuation**

One of the results of rapid growth in eco- and wildlife tourism has been the tendency for some economists, managers and conservationists to imagine that it may become possible (and may be desirable) for wildlife to “pay its own way”—that market incentives can take on some (or all) of the responsibility for protecting habitat or achieving wildlife conservation outcomes (e.g., Eltringham, 1994; Walpole & Thouless, 2005; Dharmaratne, Sang, & Walling, 2000). Much like the push to place dollar values on “ecosystem services”, this neoliberal approach assumes that the value we place on
nature should be based on the value determined by markets (as opposed to basing aregulated market on existing human values). Indeed, it posits that an appropriate degree of conservation will naturally follow as a result of the free market, with little to no need for governmental regulation or management.

Though wildlife tourism has been regularly touted as “non-consumptive” (and thus, according to many in the industry, not in need of regulation) there is considerable debate about what that actually means and the extent to which that characterization is likely to be true for even the most sustainable and environmentally conscious tourism operators. Orams (1999) argues that wildlife tourism simply represents a different form of harmful and destructive resource exploitation, while Münster and Münster (2012) maintain that the shift from agrarian to tourism-based commodification of wildlife may represent a continuity of economic exploitation rather than a rupture from commercialization to preservation. Some researchers and wildlife advocates take this argument further, claiming that “use”-based relationships between humans and wildlife deserve “moral skepticism”—that “[j]ust as whales are not here for us to kill for our purposes, they are not here for us ‘to study’, or ‘to watch’, or to ‘play with’” (quoted in Silva, 2015, p. 3).

Wildlife valuation practices have been extended in recent years to the point of placing dollar values on individual animals, though this is a hotly debated practice and even researchers who support economic valuation of wildlife at the population level may object to valuing individuals on the grounds that such estimates tend to be inaccurate, and may result in a weaker and less credible economic case for wildlife conservation (Catlin, Hughes, Jones, Jones, & Campbell, 2013). There are various techniques for estimating
the “value” of wildlife sightings and wildlife tourism, from willingness to pay (WTP) estimates to contingent valuation, all of which attempt to ascribe numerical dollar values to either individual wildlife or their populations. For visits to a conservation site for Manchurian black bears the average value was found to be US$4.99 per visiting household—however, actual willingness to pay has consistently been found to be about half of stated hypothetical willingness to pay (Han & Lee, 2008). Similarly, spiny lobsters were estimated to add at least $1-2 of value to scuba diver experience, which Rudd (2002) uses to argue for additional economic value estimates for marine protected areas (MPAs). However, the evidence from numerous studies seems to suggest that while in many destinations, wildlife tourism can cover the costs of actually providing tourism services, it is not typically able to generate sufficient revenue to cover all conservation or park operation costs, let alone to make meaningful contributions to local and national government budgets (Laarman & Gregersen, 1996; Walpole, Goodwin, & Ward, 2001).

Many researchers have emphasized the value of tourism and the potential of “non-consumptive” uses of wildlife to replace consumptive uses and lead to positive environmental policy change (Wilson & Tisdell, 2001). However, there are inherent problems with the expectation that “non-consumptive” uses can or should be called upon to create equivalent economic outputs as extractive removal or industrial development. This is part of a larger, heated academic debate about the extent to which economic valuation of nature should drive conservation approaches (McCaulay, 2006; Armsworth et al., 2007; Nunes & van den Bergh, 2001; Holden, 2013). Wildlife valuation may lead to economic efficiency arguments that are inherently at odds with Western conservationist or preservationist philosophy—if, for example, the demand for wildlife
tourism were to decline, this rationale would logically conclude that a shift to some other use of land or wildlife was immediately warranted, and may make conservation outcomes vulnerable to shifts in the tourism market (Buckley et al., 2012; Hackel, 1999). For instance, Barnes, Macgregor and Weaver (2002) argue that areas of high wildlife value and natural beauty create the greatest returns as wildlife tourism areas, but that less picturesque areas—even when they represent important habitat for wildlife—are more efficiently used for cattle ranching or ostrich or crocodile farming.

Operators, scientists, NGOs and governments appear to have a range of views about what wildlife tourism is “for”—to conserve wildlife or habitat, to benefit local people, to spur environmentally friendly development, to educate tourists—and thus success is often difficult or impossible to evaluate, and when tourism is unsuccessful by some of these metrics, it may be assigned other unquantified benefits rather than being seen as having failed. Interestingly, the vast majority of studies of wildlife tourism do not emphasize specifically associated conservation gains (evidence for which, as discussed, is equivocal). Eco- and wildlife tourism have in many cases had difficulty conserving wildlife habitat (e.g., Yu et al., 1997) or animals themselves, and the uncertainty of future tourism markets makes tourism revenue a precarious funding source for the conservation of threatened species (Buckley et al., 2012; Hackel, 1999). The metric most frequently used to evaluate the conservation success of ecotourism operations is instead their educational, attitudinal, or behavioral impacts on participating tourists or their economic benefits for local people—both of which will be discussed in greater detail below.
Wildlife Tourists

Many researchers break wildlife tourists into at least two groups: “serious” and “casual” tourists. Serious wildlife tourists construct their identities around wildlife tourism, and tend to emphasize the importance of travel, learning, and skill development, often creating a “culture” around tourism activities with certain norms of dress and behavior (Curtin, 2010b). More casual wildlife tourists tend to show an overall lower level of knowledge about and interest in wildlife species, and are more likely to have wildlife encounters as only one part of a larger tourism journey with multiple goals. Different levels of interest in educational content may create challenges in providing appropriate information to visitors—relatively remote polar bear tourism, which was expected to draw primarily serious/specialist tourists, was unexpectedly found to be made up primarily of novice/enthusiast tourists—in which case, in-depth educational content may not be geared to the interest level of those participating (Lemelin, Fennell, & Smale, 2008). Because these tourist categories are somewhat nebulous across research designs, for the most part this discussion will consider all tourists participating in wildlife and nature tourism together.

The motivations of eco and wildlife tourists have become increasingly important in assessing the future of the industry, especially given the frequency with which it is argued that demand for “green” wildlife and nature tourism will ensure a supply of environmentally and socially sensitive tourism. Studies have tended to focus on the demographic qualities of tourists rather than social or psychological factors of their decision making, although this is beginning to change (Luo & Deng, 2007). Although more data would be helpful, what is available is suggestive. The most consistent motives
given for participation in nature tourism were found to be education/learning about nature, self-actualization, recreation, and social contact/experiences (Krüger & Saayman, 2010).

Self-identified “eco-tourists” were found to be more likely to have interest in environmental education than individuals participating in the same activities who do not describe themselves that way; they believe that the primary characteristics that make them eco-tourists are a sense of environmental responsibility, an interest in learning about nature, a love of nature, and participation in ecotourism activities (Tao, Eagles, & Smith, 2004). It does not necessarily follow, however, that these tourists are particularly conservation minded—half of tourists engaging in a wild swim with dolphins ecotour reported they had never engaged in any conservation activity, while 43.9 percent had never made a donation to an environmental cause (Filby, Stocktin, & Scarpaci, 2014). A survey of ecotourists found that they scored, on average, no higher on biocentric values and concerns about sustainability than mass tourists (Beaumont, 2011).

Tourists are more likely to list “viewing wildlife” as an ecotourism activity than walks through nature (Tao et al., 2004). Wildlife tourism is seen by tourists as a pro-conservation activity which they imagine contributes directly to wildlife conservation (Duffy, 2008). In spite of professed interest in learning about nature, ecotourist interests are ultimately often affective rather than educational. Ryan, Hughes, and Chirgwin (2000) found that although tourists wanted to see and experience nature, one in four could not name three bird species they saw after visiting a protected area with abundant educational signage, and one in three could not list three species of plant.
Research suggests that participation in wildlife tourism activities is generally self-interested rather than altruistic (Cousins, Evans, & Sadler, 2009). Tourists are clearly concerned with the self-concept implications of their activities, and are self-interested consumers in terms of their expectation of what their experiences will be like (Nolan & Rotherham, 2012). Similarly, Campbell and Smith (2006) found that pay-to-volunteer turtle tourists were driven to participate by experiential, scientific, and aesthetic values, not by ecological, existence/intrinsic, or spiritual values. Thus existing data does not provide a clear picture of what, exactly, tourists are looking for in their encounters with wildlife, and of course it is possible (if not probable) that different segments of the tourist population may have substantially different goals, intentions, and desires, both intellectual and affective. This points to some of the challenges inherent in neoliberal approaches to conservation, as the conservation implications of the kinds of tourist experience desired by different market segments may be substantially different. This is further complicated by the fact that tourists tend to believe that their activities do not negatively impact the wildlife they interact with, and to feel that they can approach wildlife more closely than scientific data suggests without having a negative effect. Most are convinced that negative anthropogenic impacts on wildlife have to do with other people, and they rarely hold themselves up as part of the problem (Taylor & Knight, 2003).

While participation in wildlife tourism is not primarily altruistic, and tourist desires may be at odds with the wellbeing of wildlife, surveys suggest that tourists value the existence of wildlife species highly, as well as the bequest value (i.e., wanting the species to be around for future generations) and thus place some priority on the future
survival of the species they view (Han & Lee, 2008). They also care about the welfare of individual members of at least some charismatic species; activist demands led to the boycotting and eventual closure of all captive dolphin tourism operators in the UK over concerns about the morality of confining dolphins—resulting in significant alterations in the activity choices available to tourists (Hughes, 2001). Wildlife tourists at a turtle nesting site report that the most important factor in their satisfaction is that their activities have minimal impacts on the nesting turtles, and are uneasy about behaviors they see as having potential negative impacts (e.g., flash photography, tagging) (Ballantyne, Packer, & Hughes, 2009).

However, evidence suggests that, without guidance, most tourists are generally poorly equipped to determine for themselves what activities are likely to be harmful to the wildlife they are interacting with (Lalas & Bradshaw, 2001). The tendency for many is to behave thoughtlessly in ways that may be disruptive, a particular problem in larger groups of tourists or those accompanied by children (Acevedo-Gutiérrez, Acevedo, & Boren, 2011). That said, tourists appear to be aware they may theoretically impact wildlife: Needham (2010) found most tourists displayed “strong” protectionist attitudes towards coral reefs, though these attitudes are not necessarily matched by an understanding of what poses threats to wildlife, as tourism (particularly poorly managed tourism) is a significant and ongoing source of damage to coral reefs (Medio, Ormond, & Pearson, 1997; Barker & Roberts, 2004). Uneven levels of knowledge and the often inconsistent attitudes and behaviors of many tourists create further challenges in the use of voluntary regulatory frameworks (discussed further below), and the mixed results of
these approaches suggest that market demand is often not aligned with environmental best practices.

**What Tourists are Seeking**

A further important though inadequately studied aspect of wildlife tourism is the question of what tourists are looking for, or looking to gain, in their experiences with wildlife. This is likely to be as variable as wildlife tourism itself (which ranges from remote, expensive journeys to view elusive wildlife to brief excursions from a cruise ship), but is perhaps the best indicator of the forces shaping the tourism market. A central justification for the existence of this industry, in spite of growing evidence that it has negative impacts on participating wildlife species, is the theory that wildlife tourism makes people care about wildlife, and consequently change their attitudes and behavior in ways that further conservation goals (Milstein, 2008; Duffy, 2008).

Evidence suggests that tourist goals are diverse. Clearly, some hope to learn while others primarily intend to enjoy an affective experience or bond with other people over shared experiences. We know that, unsurprisingly, ecotourists prefer businesses that they believe are environmentally friendly and provide informative, courteous and trustworthy services, although their willingness to pay more for providers who are environmentally and socially responsible may be limited (Khan, 2003; Holden, 2013; Budeanu, 2007). They tend to be dissatisfied if they feel their experiences do not match what was advertised, and to express disappointment in response to a lack of quality educational content, crowded conditions, and high costs (Ziegler, Dearden, & Rollins, 2012), though tolerances for these things may fluctuate over time based on the type of tourist participating and the expectations set by existing infrastructure and operators (Catlin &
Jones, 2010). Tourists are also dissatisfied when they are unhappy with interactions between operators and wildlife (e.g., speeding, chasing, harassing, crowding animals) (e.g., Mustika, Birtles, Everingham, & Marsh, 2013; Tisdell & Wilson, 2002; Valentine, Birtles, Curnock, Arnold, & Dunstan, 2004; Ziegler, Dearden, & Rollins, 2015).

While surveys of wildlife tourists suggest that in general they support and seek out the inclusion of educational and conservation information in their experience, the self-reported range varies from 65% at a marine theme park to 95% at a protected turtle nesting site (Ballantyne et al., 2009). Visitors to non-captive sites emphasized educational aspects more strongly, while day visitors to captive sites placed greater importance “on the social, restorative and entertainment oriented aspects” of their wildlife tourism experiences (Packer & Ballantyne, 2012). These tourists tended to categorize interpretive educational content (in this case, signage) as an amenity similar to other tourist amenities like food, shade, seating, and access to restrooms (Ryan et al., 2000). While for some wildlife tourists educational content is crucial, this attitude is not universal.

Even in cases in which educational concerns are not paramount, it seems that tourists are seeking some level of interpretation and guidance from tourism operators. In general, guides or interpreters play two distinct roles, acting as both educators and social directors (Andersen & Miller, 2006; Curtin, 2010). Positive interactions with staff are a key factor in the overall quality of experience for wildlife tourists (Ballantyne et al., 2009), and particularly in cases where tourist expectations about wildlife sightings are not met, the handling of the situation by interpretive staff is the strongest predictor of tourist satisfaction in spite of disappointment at wildlife not being sighted, or being seen only distantly or in low numbers (Andersen & Miller, 2006). Lück (2003) found that tourists
strongly desired structured interpretation and education, both about target species and conservation issues more broadly. Numerous studies suggest that quality interpretation is important to tourist learning, attitudes, and overall satisfaction, though in many cases it may not be offered (Mayes, Dyer, & Richins, 2004; Orams, 1997; Filby et al., 2014).

Tourists also look to guides to set limits on and convey which behaviors are harmful to wildlife and to protect wildlife interests (Lalas & Bradshaw, 2001), which some argue could serve as a powerful method for reducing impacts on wildlife—but only if staff are adequately trained and experienced to act in this role (Campbell & Smith, 2006).

Social interactions with staff and other tourists are also important to setting the stage for potential future behavioral change, the basis for many defenses of the wildlife tourism industry (Ballantyne, Packer, & Sutherland, 2011b). Interpretive layering (presenting similar information using multiple approaches) has been shown to lead to more significant attitudinal and educational benefits (Coghlan & Kim, 2012).

Unfortunately, this also means that tourists are highly susceptible to messaging from even poorly trained or ill-informed staff; in one study, long-term pay-to-volunteer turtle tourists believed that local nest poaching was the cause of sea turtle population declines, a conclusion existing scientific data does not support (Campbell & Smith, 2006). On the other hand, well designed and executed interpretation programs may be able to deliver at least some educational and attitudinal benefits to tourists (Powell & Ham, 2008; Madin & Fenton, 2004).

One critically important question is the extent to which tourist satisfaction with wildlife interactions is dependent on how closely they are able to approach target species, given existing evidence that approach closeness is a key determinant of the level of harm
done to wildlife. Mustika et al. (2013) found that among participants in dolphin tourism, 40% participated to get close to the animals, and 30% out of curiosity. Some researchers have found a very close relationship between satisfaction and wildlife encounter intensity, suggesting that conservation and business incentives may be acting in opposition to one another and encouraging operators to engage in practices they know or suspect are harmful to wildlife (Dobson, 2008; Sorice et al., 2003). Others claim that tourists can be satisfied with wildlife tourism experiences that do not include close approach to wildlife. Orams (2000) claims that 35% of the tourists on a whale watching trip who didn’t see whales at all still reported satisfaction with their experience, while Filby, Stockin, and Scarpaci (2014) reported that neither number of dolphins sighted nor closeness of approach to dolphins was an important factor in tourist satisfaction (though less than 50% of tourists reported they were satisfied with the amount of time they swam with dolphins).

Most of the evidence suggests that fairly close, intensive and “meaningful” encounters are important to tourist satisfaction: Valentine et al. (2004) found that the number of whales seen, how closely they approached, and the total time they were present predicted tourist satisfaction, while tourist satisfaction at a captive tourist site viewing giant pandas was based on close interactions and encounters (Cong, Wu, Morrison, Shu, & Wang, 2014). Support for turtle conservation after participating in turtle tourism was closely tied to actually observing a nesting turtle, which suggests that tourism may not be a successful conservation strategy for hard-to-view wildlife, species that are intolerant of human disturbance, or for populations that have fallen under a certain threshold of rarity (Tisdell & Wilson, 2002). There is good evidence that tourists
prefer to get close to large and charismatic animals, even when this may not necessarily serve conservation goals (Cousins et al., 2009); however, although the number of animals sighted is important to satisfaction, tourists also care that these encounters are well managed and that their activities are not evidently harmful or stressful to the animals (Mustika et al., 2013). These encounters may well fuel the experience of the “sublime”—a sense of connection and wonder—which Milstein (2008) believes may allow wildlife to “speak for themselves” (i.e., make a compelling case for conservation).

**Impacts on Tourists**

The likelihood that tourists find their experience emotionally meaningful may also be partly dependent on the extent to which they feel “honored” by animals choosing to interact with them (Ballantyne et al., 2011b) and the extent to which they experience awe or feelings of the sublime (Milstein, 2008). In keeping with these findings, Jacobs and Harms (2014) found that affective and emotional messaging had a greater effect on tourist behavioral intentions than knowledge-based interpretation or conservation information. Tourism approaches that minimize emotional connections—which some researchers feel occurs with zoo tourism or provisioning tourism—could potentially result in reduced affective investment in encountered wildlife, while the easy accessibility of animals to time-pressed tourists may serve to commodify and decontextualize the animals, reducing the overall emotional impact and significance of the encounter (Knight, 2010). Other studies have found that any positive influences on attitude, learning, and behavioral intention were largely similar across safari wildlife tourism and zoo tourism, in which case viewing captive wildlife may be a better choice for conservation when it can reduce or eliminate stressors on wild animal populations (Skibins, Powell, & Hallo,
In at least one study, although outcomes were not different across captive and non-captive tourism experiences, data suggested that there was little impact on participants’ conservation awareness regardless of the type of wildlife tourism they engaged in (Moscardo, 2007).

Currently, the evidence linking affective experiences to behavioral change and shifts to more pro-environmental behaviors are nebulous (Packer & Ballantyne, 2012). There is also considerable debate about the degree to which self-reported intentions to change behavior or donate to support conservation are likely to reflect what tourists subsequently do, and the extent to which very small self-reported changes (in one study, 7% of tourists self-reported changing at least one environmental behavior) actually represent a meaningful conservation success (Ballantyne, Packer, & Falk, 2011a; Tisdell & Wilson, 2002). Slightly increased likelihood of participating in low effort and commitment conservation activities (like picking up litter or encouraging others to protect the environment) are the most realistic accomplishments. Multiple studies suggest that even significant emotional experiences with wildlife are likely to result in only low levels of attitudinal or behavioral change, even where learning takes place, and there is very limited evidence for substantial long-term influences on behavior (Smith, Ham, & Weiler, 2011; Ballantyne et al., 2011a; Ballantyne et al., 2011b; Zeppel, 2008).

The majority of studies attempting to quantify the impact of wildlife tourism experiences on tourists are based on self-reported intentions to alter behavior. Hughes (2013) found in a longitudinal study that relatively few tourists who reported an intent to alter behaviors followed through, suggesting that surveys in the immediate aftermath of a wildlife tourism experience are likely to substantially overstate the probability of tourist
behavioral change. Only 35% of long-term turtle tourist volunteers were members of any environmental or conservation organization, suggesting that interest in wildlife tourism is not necessarily strongly correlated with taking other conservation actions (Campbell & Smith, 2006). Even tourists who experience attitudinal change may not change their behavior; increased biocentric values may not meaningfully increase conservation actions (Filby, Stocktin, & Scarpaci, 2014).

Tourists’ pre-existing pro-environmental attitudes or behaviors are a strong predictor of their learning when participating in wildlife tourism, as are their goals—those with a desire to learn are more likely to show knowledge gains (Ballantyne et al., 2011a). Yet, it is difficult to clearly connect “value orientations” or even “attitudes” to conservation behavior. Similarly, tourist wildlife experiences are more likely to reinforce existing attitudes and beliefs or create “new” attitudes (e.g., “before I didn’t care much about wildlife…”) than reverse pre-existing attitudes (Smith et al., 2011). Even when interpretation programs are well designed and staffed and participant learning is significant, attitudinal gains will likely be slight when participants are already biocentric or positively disposed towards the environment (Smith, Scarr, & Scarpaci, 2009).

Despite the currently limited evidence of benefits, there is potential for increasing the positive impacts of ecotourism. Smith, Curtis, Mair, & van Dijk (2012) found that few visitors to zoos were dissatisfied at being repeatedly asked to engage in pro-conservation or pro-wildlife behaviors, suggesting that ecotour operators, who tend not to offer educational content in a similarly structured way, may be missing opportunities to encourage participants to be more environmentally conscious. It has also been suggested that post-tourism support in the form of continued contact and provision of conservation
information may significantly increase the likelihood of increased pro-environmental behaviors, so although current evidence for long-term benefits is thin, programs with a greater potential impact could likely be created (Hughes, Packer, & Ballantyne, 2011).

**Local People**

Another important factor in evaluating conservation impact is changes in the economic incentives for or attitudes of local people co-existing with targeted wildlife populations. Local people are unlikely to share tourists’ romanticized view of wildlife—as Akama (1996) observes, “[y]ou cannot interest a Maasai in seeing and photographing a giraffe any more than you can interest a New Yorker in a taxicab” (p. 571). Few local people, particularly in the developing world, share tourist views about the existence value of animals that may impose a variety of significant costs on locals (discussed further below). Some researchers have argued strenuously that nature tourism has the potential to generate considerable economic development returns for communities, and ultimately lead to improved human-wildlife relationships and positive conservation outcomes (Sekercioglu, 2002; Mbaiwa, 2005; Gadd, 2005; Gallagher & Hammerschlag, 2011; Vianna, Meekan, Pannell, Marsh, & Meeuwig, 2012); however, it seems clear that these benefits are highly species and local context dependent, and there are many cases in which local people are not adequately compensated for the costs of conservation (Ahebwa, van der Duim, & Sandbrook, 2012; Tumusiime & Vedeld, 2012; Rodríguez-Dowdell, Enriquez-Andrade, & Cárdenas-Torres, 2007).

Western preservation and conservation ethics may not seem culturally relevant to many non-Western communities, and in general there is a limited tendency to see wildlife as belonging to the people of the nation or the world—in many cases, farmers expect that
the government (or NGO) that “owns” the wildlife should control that wildlife in the same way that ranchers are responsible for controlling livestock, and may not be willing to take actions themselves that would limit wildlife-related damage (because in their view, it isn’t their responsibility) (Hemson, Maclennan, Mills, Johnson, & Macdonald, 2009; MacKenzie, 2012). The creation of protected areas and other conservation initiatives in much of the global south can also be viewed as part of the legacy of colonialism, and wildlife tourism and associated protected areas may contribute further to the breakdown of traditional management practices in some regions (Kideghesho, 2008). Similarly, seeking out interactions with native people as part of the tourism experience can be a positive experience for tourists and hosts, or can be met with hostility and even aggression by local people uninterested in acting as the “other” for tourists, or who want to assert their equality with more affluent visitors (Gray & Campbell, 2007; Abbink, 2000).

**Local Benefits**

The attitudes of local people towards protected areas are highly dependent on the tangible benefits they receive (Sekhar, 2003), but unfortunately benefits do not necessarily accrue equally within and across communities. Particularly in the global south, tourism-based jobs available to local people are typically manual—like cleaning, cooking, driving, and maintenance—while better paying tourism jobs, like naturalist or guide, may be dominated by expatriate foreigners with language, cultural, and scientific skills that make them acceptable to Western tourists (Mbaiwa, 2003). Similarly, expatriate ownership of tourism facilities and high barriers to entry for local people may lead to the development of enclave tourism, in which tourism revenue has a minimal
effect on local economies (Mbaiwa, 2005b). In spite of the difficulties in obtaining tourism employment (particularly for non-English speakers) and the manual nature of many of the tourism jobs available, those employed in tourism had higher incomes and larger savings than others in their community (Broadbent et al., 2012). While the benefits of tourism tend to accrue to the most educated and wealthy members of a community, changes in access to food, fodder, and firewood gathered from newly protected areas is likely to disproportionately affect the poorest individuals, who are least likely to receive direct economic benefits from tourism (Shrestha & Alavalapati, 2006; Spiteri & Nepal, 2008). These challenges are not necessarily insoluble, but there is strong evidence that the potential community-level economic benefits of wildlife tourism are often not being fully achieved (Mvula, 2001).

In general the benefits of wildlife resources accrue primarily to wealthier households unless there is a strategy in place to prevent this, as in some revenue sharing approaches (Richardson, Fernandez, Tschirley, & Tembo, 2012). Education level was a significant predictor of ability to imagine a livelihood based on wildlife tourism in protected areas, further demonstrating the tendency for tourism benefits to accrue to local elites (Owino, Jillo, & Kenana, 2012). Even in cases where the distribution of tourism benefits is relatively fair and actually goes to those most impacted by wildlife and tourism, widening economic differences between households that benefit economically from tourism and those that do not may lead to an array of social challenges (Osano et al., 2013). In Kaikoura, New Zealand, the relative monopoly right of Maori operators to offer whale tourism has led not only to many of the challenges associated with fast-developing
tourism destinations (e.g., rising property prices, crowding, increased cost of living, loss of community cohesion) but also a significant increase in racial tension (Orams, 2002).

Thus, even when a genuine effort is made by governments, NGOs or corporations to ensure fair distribution of economic benefits of wildlife tourism, ethnic and cultural divisions among local people may create challenges or resentments in regulating sharing of benefits (Hill & Hill, 2011). Revenue sharing may not be distributed equally and community projects supported by tourism revenues (such as school construction) may not be seen as an equivalent benefit by all households. Wide distribution of benefits facilitates conservation “buy in”, though distribution problems tend to increase when overseen exclusively by local elites, and accountability for the use of such funds can be challenging to ensure (Martin & Martin, 2010). Revenue sharing has been shown to be effective at reducing the illegal extraction of park resources and encouraging public acceptance of areas protected for wildlife tourism (MacKenzie, 2012). The most important factors in successful revenue sharing appear to be transparency, adequate revenue, and successfully managing different stakeholder priorities (Archabald & Naughton-Treves, 2002). Key factors in predicting overall success in developing sustainable tourism include strong intra- and extra-community interactions, open communication, broad participation, distributive justice, and tolerance (Matarrita-Cascante, Brennan, & Luloff, 2010).

In cases in which local people are genuinely involved in tourism and management and are given jobs with higher degrees of responsibility, positive outcomes are facilitated. When protected wildlife areas employ local people directly as game wardens or rangers, those employed report that the level of responsibility is an important
factor in determining their investment in the reserve (Brooks, 2005). Support may also be relative to the alternatives tourism opportunities forestall; it was also significant to these rangers and wardens that tourism-related employment helped them to avoid becoming migrant laborers (Brooks, 2005). Monitoring jobs may also be performed effectively by local people as opposed to Western expatriates; studies suggest that data collected by locals employed as rangers was found to accurately reflect wildlife population trends which were simultaneously measured using other techniques, pointing to the ability of local people to play a significant role in the production of scientific knowledge (Jachmann et al., 2011). Park staff may be skeptical about the conservation implications of increased local management and employment, but local buy-in is an important factor in successfully conserving wildlife and habitat (Weladji, Moe, & Vedeld, 2003). Some protected areas provide no employment benefits at all to locals, and under those circumstances there are few incentives for local people not to illegally utilize these areas, as in Amoah and Wiafe (2012), who found that 88.4% of local households had exploited plant or wildlife resources from the protected area.

Community based management has been one approach to this challenge, and particularly in cases where communities are culturally homogenous, it has been successful at creating fairer and more inclusive distribution of tourism related benefits (Mbaiwa & Stronza, 2011). In other areas, communities may lack the interest or infrastructure to play an active role in management or to take partial ownership of wildlife resources, and it is not uncommon for researchers to find that giving communities ownership of tourism rights to wildlife is not necessarily desired, or adequate to incentivize conservation (Pienaar, Jarvis, & Larson, 2013; Songorwa, 1999;
Songorwa, Bührs, & Hughey, 2000). Though corporations, mainly from the global north, have been criticized for imposing their values and desires on people and landscapes in the global south, in at least some cases partnerships with “paternalistic” companies have been seen by local people as beneficial and as successfully meeting their needs, and haven’t necessarily resulted in reduced economic returns to communities (Wunder, 2000; Skonhoft, 1998).

In some areas local people have been shown to be deeply resentful of the impact of wildlife tourism and associated protected areas on their lives, with some refusing to acknowledge that tourism provided any benefits even in the face of schools, community buildings or other tangible evidence of revenue sharing (Adams & Infield, 2003). Poorly designed programs, even where they result in distribution of funds, may leave local people dissatisfied with the share of revenues and other benefits they receive from tourism (Shoo & Songorwa, 2013). Even in communities where 85% of local people support the existence of the protected areas, they are likely to have diverse experiences of tourism compensating (or not) for the losses associated with conservation. It is not uncommon for bad relationships to develop between locals and protected area staff, especially if the staff are not local, and general (often well-founded) distrust of governments and management bodies is common (Karanth & Nepal, 2012; Parry & Campbell, 1992).

Even in cases in which tourism has measurable positive effects on attitudes—changing the way local people think about and interact with wildlife—other challenges may hinder conservation success. In the case of Mackinder’s Eagle Owl, a species that is hated and viewed as a harbinger of bad luck in Kenya, farmers who allowed owls to nest
on their farms financially benefitted from birding tourism, and were more likely to be knowledgeable about owls and consider them “good”. However, lack of ecological literacy may still hinder farmers from acting in ways that will benefit the owls, as with one farmer who felt he was helping owls by offering them rats he had poisoned as a food source (Ogada & Kibuthu, 2008).

Similarly, communities seeking to develop successful tourism industries may have limited understanding of ecological realities like carrying capacity, or of what tourists are looking for (e.g., in Var, Yalçinalp, and Pulatkan (2010), communities in the highlands of Turkey replaced traditional dwellings with more modern, globalized architecture for practical reasons, but tourists strongly preferred staying in traditional homes). The economic attractions of participating in wildlife tourism may even lead to migration into critical wildlife habitat as local people attempt to make use of available economic and development opportunities (Melita & Mendlinger, 2013). Both in terms of local people’s happiness and satisfaction with tourism and their economic security, ecotourism functions best as a conservation tool when it is one part of a larger, organized conservation and management strategy (Stem, Lassoie, Lee, & Deshler, 2003).

**Local Costs**

As Broadbent et al. (2012) and others make clear, there are also meaningful potential social costs to large scale tourism, including localized inflation, alcoholism, drug abuse and prostitution, as well as failures of cultural sensitivity (Orams, 2002; Duffy, 2008). Economic benefits, direct and indirect, tend to result in more positive attitudes towards tourism, and locals recognize that tourism is related to parks and conservation areas. However, even direct benefits from tourism do not necessarily result
in more positive attitudes towards wildlife conservation (Walpole & Goodwin, 2001). Walpole and Goodwin (2001) found that the more reliant on tourism revenue a community is, the more negative their attitudes towards it, with particular mention of the problems that arise when tourists dress or behave in ways that are not sensitive to local cultures.

There are also numerous negative externalities associated with living near wildlife tourism areas. Perhaps the most obvious is the potential to lose access to resources that were previously relied upon when tourism leads to wildlife habitat protection or limitations on land use. This is a problem across both species and cultures, although it is likely to be more or less serious depending on local contexts—the loss of some areas of grasslands for ranchers may not have a tremendous economic impact, but in areas where logging or mining are likely to generate substantial revenues and local jobs, the opportunity cost of wildlife conservation can be extremely high (Wilkie & Carpenter, 1999). In one study of national parks in Uganda, when asked the worst thing about living near a protected area, 70% of respondents said crop raiding by wildlife, 20% mentioned the risks posed by animal attacks on humans, and only 10% felt the most damaging change was loss of access to protected area resources—however, these responses are likely to vary widely based on local circumstances (Archabald & Naughton-Treves, 2002).

Crop raiding by wildlife is a primary complaint by local people about the impacts of tourism-generated protected areas. In many areas, the value of agricultural profits forgone exceeds what tourism revenue sharing is realistically able to return (Adams & Infield, 2003; Gadd, 2005). While crops may be decimated by herbivorous wildlife,
livestock is also vulnerable to predation, which is a primary complaint by those living near large wild carnivores. Ranchers and farmers tend to feel that the government is responsible for the actions of protected species because the government “owns” the wildlife in question, and may support governmental solutions to the problem, like building a fence around the park (61%) or killing the lions (16%), but are largely unwilling to take steps themselves to reduce stock loss, which is primarily associated with stock wandering at night (Hemson et al., 2009). In some districts troubled by elephant crop raiding, local people have shown resistance to building elephant trenches to protect their crops on the grounds that elephants belong to the park authority and are therefore their responsibility (MacKenzie, 2012).

In some cases, these problems have been approached using barriers or electric fences around parks, but these can be costly to build and maintain, and are particularly impractical over large areas (Martin & Martin, 2010). In other areas, wildlife diseases (50%) and access to forage and water (19%) may prove to be larger challenges than direct impacts on crops (Owino et al., 2012). People may also perceive wildlife as a threat to other livelihoods, as when giant otters compete with local fishermen for fish or damage nets by becoming entangled in them (Recharte, Bride, & Bowler, 2015). Pests like the Tsetse fly, which may persist in wildlife populations in spite of efforts to prevent impacts on stock and humans, can also represent a significant negative externality of coexisting with large wildlife populations (Brooks, 2005).

While local people’s economic losses resulting from the presence of wildlife populations are often not compensated, an even more serious problem arises when wildlife represents a threat to human safety. In fact, in a case in which a tourism protected
area for snow leopards was supported by local people in Nepal and India, an important factor in their acceptance of the protected area and tolerance of the human-wildlife conflict that resulted was that human safety was rarely an issue (Karanth & Nepal, 2012). Tourism revenue can impact perceptions of wildlife—in the lower Zambezi valley, crocodile tourism employment helped shape attitudes towards crocodiles: while 80% of households with tourism employment reported crocodiles were a problem, 97% of households not employed in tourism felt they were (Wallace et al., 2012). At the same time, only 50% of men and 25% of women surveyed were receptive to financial compensation for increased risks of crocodile attack, indicating that economic incentives can only go so far in offsetting concerns over death or serious injury. This study also found that local people were relatively fatalistic about the risk of crocodile attack, and few were taking any measures to mitigate their attack risk (Wallace et al., 2012).

**Tourism Operators and Regulation of Wildlife Tourism**

Tourism operations are first and foremost businesses, and it is reasonable to expect that profitability and meeting the demands of customers, so that operators can remain in business, will likely take precedence over minor decisions about environmental protection and animal wellbeing (which are, of course, often difficult for non-experts to quantify) for most operators (Williams & Montanari, 1999). Tour operators may defend even irresponsible practices as a means of promoting awareness and conservation, and argue that economic benefits to local people and the “non-consumptive” nature of their activities compensate for any potential negative impacts (Kiss, 2004; Topelko & Dearden, 2005). In addition to challenges in regulating interaction with animals, there are essentially no requirements for the quality, structure, or effectiveness of education and
interpretation, a regular complaint from wildlife tourism participants (Whitt & Read, 2006).

There has been considerable support, particularly among tourism operators, to allow the industry to self-regulate by designing, implementing, and adhering to voluntary guidelines for how wildlife tourism should be conducted, and operators strongly prefer these to governmentally generated guidelines (Sorice, Shafer, & Ditton, 2006; Parsons & Woods-Ballard, 2003). Even in cases in which operators are compliant, this is unlikely to accomplish more than a reduction in disturbance for wildlife, which must still contend with tourist exploitation and other anthropogenic stressors (Curtin, Richards, & Westcott, 2009). The reliance on voluntary compliance is undoubtedly in part a recognition of the very real difficulties of policing an industry that often takes place in remote areas, or in countries where enforcement mechanisms are limited or such enforcement is not politically feasible (King & Heinen, 2004; Sorice et al., 2003). However, without assessment of compliance and enforcement, such guidelines are demonstrably inadequate (Allen, Smith, Waples, & Harcourt, 2007), and codes and compliance have been found to vary widely by country and region, even for the same or similar species (Garrod & Fennell, 2004; Mason & Mowforth, 1996). Other suggestions for managing tourism impacts on wildlife populations have included creating limited entry markets by permitting only a certain number of operators to be licensed, implementing zonation of reserve areas, or attempting to distribute existing tourism pressures across a larger area (Kessler & Harcourt, 2012; Newsome, Moore, & Dowling, 2012). Especially in cases where there is substantial tourism demand and multiple competing tourism operators, voluntary codes are likely to be inadequate to protect wildlife, with at least some
operators consistently breaking rules about length and frequency of interactions, approach types, and prohibited interaction types (Allen et al., 2007).

There are significant problems with existing regulatory structures. Their piecemeal nature ensures that many activities harmful to wildlife won’t be offered where they could best be regulated, but rather, these activities will be displaced to the country or region with the lowest regulatory burden. For instance, wild swim-with-dolphin tourism is illegal in the United States under the Marine Mammal Protection Act of 1972, while it is a meaningful and growing revenue generator for the Bahamas, where regulation of interactions with wild marine mammals is less strict and enforcement mechanisms are considerably weaker. Even in US waters, some boat-based dolphin tourism operators were found to be compliant with legal restrictions only 60% of the time, maneuvering inappropriately, coming too close to dolphins, and failing to terminate encounters when dolphins showed signs of disturbance (Whitt & Read, 2006).

Operator practices can be complex and difficult to regulate. Government agencies, non-profit organizations and tourism operators all have different definitions and value judgements about what constitutes harm and harassment, terms which in some cases may be rather ill-defined legally (Sorice et al., 2003). In cases in which zonation has been used to provide wildlife with a refuge from tourism pressure, operators may not respect these limits (Howes, Scarpaci, & Parsons, 2012). Finally, there are cases in which the punishments for violating laws that protect local wildlife are not commensurate with the economic or marketing benefits of failure to comply, and some operators will simply break the law and pay the fine, or attempt to obey the letter of the law while working around the spirit.
Even when no questions about terminology, legal status or relative harm of various practices exists, enforcement is a complex problem. While it may be helpful to ensure that tourists have marked approach distances to wildlife colonies or have their visits timed seasonally or in connection to daily cycles to minimize disturbance to wildlife, compliance with such limitations is far from assured (Otley, 2005). In one study of tourist interactions with bottlenose dolphins, tourists were far more likely to initiate risky or aggressive interactions with dolphins than dolphins were with tourists (Smith et al., 2008). King and Heinen (2004) concluded that over half (60-73%) of interactions between manatees and swimmers constituted harassment under Florida Fish and Wildlife Conservation Commission guidelines, and that while humans initiated most contact, manatees were far more likely to seek to terminate encounters than humans were.

This is not to say that management of human-wildlife interaction at tourism sites is impossible. One study found that even in the absence of posted regulations, the presence of an “official looking” observer—who did not say anything to tourists unless approached—decreased tourist harassment of juvenile seals from 38.4% of tourist groups to 13% (Acevedo-Gutiérrez, et al., 2011). The construction of fences to limit the closeness of tourist approaches to a seal colony in Uruguay was found to reduce overall fur seal response to tourists by 60%, while also reducing occurrence of some of the most harmful behavioral responses from seals (e.g., fleeing the colony, threat displays) and the impacts of the more harmful tourist behaviors (e.g., arm waving, shouting, running at seals) (Cassini, Szteren, & Fernández-Juricic, 2004). Guides can also fulfill useful regulatory functions by setting norms for tourist groups. Commercial seal swims tend to be less disruptive to seals than those taking place from private boats, in part for this
reason, and the presence of a guide on walking tours also reduces rates of seal behavioral responses (Boren, Gemmell, & Barton, 2008).

It is clear that at least some segment of the tourist population are concerned about minimizing the impact of their activities. In one study of a “swim with whales” tourism operator, a primary complaint was that crew members or other participants weren’t following the rules and regulations laid down for interactions, or were chasing or otherwise disrupting the whales (Valentine et al., 2004; as discussed above). Scarpaci, Dayanthi, and Corkeron (2003) found that even when regulations are kept as simple and straightforward as possible, and an observer is present, approximately one third of vessel approach vectors in a wild dolphin swim tour were illegal under regulations (which forbade a direct, head-on approach to pods). This paper found that only 40% of swims were in full compliance with three simple regulations: utilizing converging approach vectors, limiting the amount of time swimmers were in the water with dolphins, and prohibiting swimming with fetal fold (very young) calves. Sixty percent of swims violated time limits, and thirty percent took place in the presence of fetal fold calves (Scarpaci et al., 2003).

In a study of whale shark (*Rhincodon typus*) tourism, 56% of divers failed to obey mandatory minimum distances from sharks, and 18% disobeyed the prohibition on touching sharks (Quiros, 2007). In a national park in Tanzania, regulations for chimpanzee tourism are violated about 23% of the time, with operators regularly exceeding the numbers of tourists allowed in a tour group, while problematic tourist behavior (e.g., moving too close, observing chimpanzees without mandated guides, multiple tourist groups viewing one group of chimpanzees) occurred regularly
Seventy-eight percent of whale watching companies in the Northeastern United States were found to be non-compliant with industry designed voluntary speed guidelines intended to reduce negative impacts on whales (Wiley et al., 2008), and groups of tourists observing turtles violated the code of conduct 77% of the time, with 51% of those disturbances resulting in avoidant behavioral responses from the turtles (Waayers, Newsome, & Lee, 2006). If these levels of regulatory violation are taking place, sometimes in the presence of observers there to study regulatory compliance, it is likely that violations are even more common when observers are not present.

On the other hand, as discussed above, even tourists who see problems with disruptive wildlife tourism are unlikely to find their own behavior at fault. For instance, tourists watching whales from shore are considerably more likely to assess boat-based whale watching as potentially harmful to whales than whale watchers on boats (Finkler & Higham, 2004). Fewer than 30 percent of surveyed swim-with-dolphin tourists agreed or strongly agreed that swimming with dolphins could have a negative impact on dolphins (emphasis mine), and that number declined further, to 20 percent, six months after swim participation (Filby, Stocktin, & Scarpaci, 2014). If tourists tend not to accept that their actions can have a negative impact, their ability to influence operator behavior for the better through demand mechanisms is likely to be very limited. Despite reported enthusiasm among tourists for minimizing impacts, the boats on which this survey was carried out were in satisfactory compliance with only two of eight assessed regulations (Filby, Stocktin, & Scarpaci, 2014). Indeed, Holden (2013) argues that in the absence of a stronger overall environmental ethic in society, it will prove challenging to impose
controls on behavior to conserve or protect wildlife that curb tourist enjoyment and satisfaction.

There is substantial evidence that tourist education can represent an effective tool for managing impacts on wildlife (Orams, 1996). While voluntary regulations have a mixed record as a successful way of protecting wildlife from the impacts of tourism, in at least some cases studies have found that tourists report being eager to comply, showing a 100% compliance rate with regulations governing diving with grey nurse sharks (Smith, Scarpaci, Scarr, & Otway, 2014); a previous similar study had found compliance to range from 88-100% (Smith et al., 2010). While tourist compliance is a hopeful sign, tourists have a limited ability to alter operator practices, since tourists generally receive the majority of their information and interpretation from operators themselves, reducing their ability to independently assess operator practices (Filby, Stocktin, & Scarpaci, 2014), and evidence in general suggests that consumer demand has done relatively little to drive sustainable practices in the tourism industry (Budeanu, 2007).

**Conclusion**

It is attractive to believe that there are development strategies that represent a “win” for local people and economies in the developing world and lead to natural area conservation, while also teaching both locals and tourists to appreciate and protect the natural world. However, there is relatively little evidence suggesting this is occurring globally on anything more than an occasional, highly context dependent basis. The evidence suggests that wildlife tourism may be challenging to wildlife populations in a variety of ways; that local people may or may not benefit much economically from such tourism, and that even in places where they do benefit, they are often ambivalent about
the experience; that the evidence for wildlife tourism changing either local attitudes or the conservation behaviors of tourists is fairly patchy and indefinite; and that, on the whole, existing regulatory structures to limit the harmful impacts of wildlife tourism are ineffective even in countries with enforcement resources and functioning judicial systems. This is not to say that there is no potential for wildlife tourism to build local economies or lead to conservation outcomes, only that its probability of doing so in any given case has likely been overestimated, and that there is urgent need to rethink the regulation and oversight necessary to build a sustainable wildlife tourism industry.

Beyond helping describe the present state of the tourism industry and academic understanding of it, this review illuminates some of the knowledge gaps and limitations that constrain current tourism policymaking and management. Of particular concern are problems of definitions and consumer knowledge, and questions about how to meaningfully compare disparate costs and benefits. The review also points to the extent to which the academic study of wildlife participating in wildlife tourism has become, in some cases, a part of a complex tourism system. This system is post-structuralist in nature, in that it is shaped by a cycle in which conceptualizations of tourism created by academics or tourists shape tourism practices, which will then shape future thought about tourism by tourists and academics on multiple levels. Among the most important unanswered questions is how existing research findings on a limited number of species and locations can or should relate to tourism more broadly as practiced in the real world. This data is the available basis for scientific decision making for tourism regulation, and it suggests that benefits are potentially significant but rather nebulous, harms are highly

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7 See, for instance, chapter six, where the practice of affiliating commercial shark feeding tourism operations with federally funded scientific research in Hawaii has allowed operators to avoid being subject to efforts to strictly regulate (or ban) their industry.
variable but common, and that consumer choices and preferences are likely to play a significant role in managing tourism and determining outcomes. In chapter three, we use this understanding of how the scientific community has conceptualized and studied wildlife tourism in the past to frame questions about how these terms have been defined in practical usage, and how well scientific data aligns with public perceptions of the potential harms and benefits to wildlife from tourism.
Chapter Three

Public Understanding of Tourism Terms and Potential Impacts
Background

As discussed in chapter two, although there are many different academic definitions of ecotourism, most coalesce around three key characteristics: that ecotourism should involve tourism that is focused on nature, that it should be socially and biologically sustainable, and that it should provide educational benefits to participants (Blamey, 1997; 2001). Although the term ecotourism is in common use outside of academia, including in marketing for a wide range of tourism experiences, the extent to which the general public understands ecotourism experiences as meeting all of these criteria is unclear. Indeed, some academics have argued that the term has come to be so widely and imprecisely used that it no longer has much meaning (Sharpley, 2006).

Chapter two provided an overview of the kinds of questions that are being asked by scientists and academic researchers about the relative costs and benefits of wildlife tourism and how they should be measured. However, the academic literature does not adequately capture how the public actually uses terms like eco- and wildlife tourism, or what they mean by them when then use them. In tourism research, important questions have been raised about whether tourist demand for eco-friendly experiences can or will drive responsible behavior in the tourism industry in the absence of large-scale regulation (e.g., Holden, 2013). The implication is that tourist preferences and buying power have a unique potential to drive conservation, and that under such a neoliberal scenario the market can become responsible for positive environmental outcomes. Thus questions about how the public understands and defines ecotourism, and the impacts they perceive tourists as having on wildlife, have real world significance. Existing research suggests that tourist indifference may allow for bad operator behavior in the tourism industry, and
that environmental sustainability and responsibility may not be a primary driver of tourist choice (Smith & Font, 2014; Budeanu, 2007). Any consideration of tourist attitudes and values, or their potential to contribute to wildlife conservation, first requires a basic understanding of non-expert perceptions of tourism issues, in particular definitions of key terms.

This chapter hopes to provide preliminary data to further our understanding of how the American public defines key terms in conversations about tourism in the natural world, particularly definitions of ecotourism, sustainable tourism, and nature tourism. It also seeks to determine the extent to which the public considers wildlife tourism to be harmful or beneficial to wildlife conservation, to assess what they believe to be the potential harms and benefits, and to place this in the context of existing findings of academic researchers (discussed in depth in chapter 2).

Methods

Participant Recruitment and Sample Screening

A sample of United States (US) residents (N = 350), aged 20-70 years (M = 34.80, SD = 10.06), was recruited from an online participant pool via Mechanical Turk (www.mturk.com). Mechanical Turk is a service provided by Amazon, which permits online “requesters” (e.g., scientists, marketing researchers, etc.) to post tasks for “workers” from the online pool to complete for small fees. Studies into the Mechanical Turk platform have found that samples from it are more representative of the US population than many other traditional attitude and psychological sampling pools (e.g., those based on university undergraduate classes) and other online pools. The Mechanical Turk population is not perfectly representative of the population in general, tending to be
younger, more highly educated, less likely to be employed, less religious and less politically conservative (Berinsky, Huber, & Lenz, 2012; Shapiro, Chandler, & Mueller, 2013). Recent studies have also found that this population indicated signs of anxiety and depression at significantly higher rates than other non-clinical populations, suggesting it may be inappropriate as a data source for certain research questions (Arditte, Çek, Shaw, & Timpano, 2016). Despite this, surveys conducted on Mechanical Turk have been shown to have the same degree of reliability and validity as those conducted using more traditional sampling methods (Paolacci & Chandler, 2014), and the use of Mechanical Turk across multiple social science disciplines has increased dramatically since 2011 (at which time only 61 studies had been published using Mechanical Turk samples, while as of 2015 that number had increased to over 1200) (Bohannon, 2016).

This survey was advertised on Mechanical Turk as a general “attitude survey” with eligibility restricted to those 18 years of age and older, fluent in English, and residing in the United States. Residency is determined by Mechanical Turk in advance, allowing researchers to pre-filter those who are able to see and complete a given task. Interested participants were directed to an online questionnaire hosted by Qualtrics. Upon completion, participants were paid $1.50. Research protocols were reviewed and approved by the Institutional Review Board at the University of Miami (protocol #20161151).

The data collection included in the current chapter was part of a larger survey which was estimated to take approximately 10-15 minutes to complete. Participants who took less than 2 minutes or more than 500 minutes were removed from the sample (final average completion time $M = 14.79$ minutes). Data was screened using a randomly
placed attention check within a battery of Likert items located toward the end of the survey (“Humans are sometimes distracted when filling these in, please leave this item blank.”). Participants who marked a response for this item were excluded unless they noted in the feedback section at the end of the survey that they had marked this item by accident (once marked, it could not be changed to leave it blank). Data was also screened for common rapid answering patterns (e.g., straightlining). Exclusion of individuals with these characteristics left a final sample of \( N = 334 \).

**Measures**

**Perception of tourism’s harm/benefit.** Participants were first asked to indicate on a single Likert scale item “In general do you think tourism is beneficial or harmful to wildlife?” using a 7-point scale from “extremely beneficial” to “extremely harmful”. This question was framed as broadly as possible to capture participant’s overall perceptions of tourism’s impact on wildlife populations.

**Open response items.** Using an open response format participants were asked to “List three ways tourism may benefit wildlife” and in a separate box to “List three ways tourism may harm wildlife.”

**Characteristics of types of tourism.** Participants were randomly assigned to one of 3 groups: “nature tourism”, “ecotourism”, and “sustainable tourism”. For their respective tourism type, participants were asked to consider a list of possible characteristics which would be necessary for tourism to qualify as belonging to their type: “Involves nature, including landscapes, plants, animals,” “Benefits local people,” “Protects the environment,” and “Has an educational component.” They were asked to
check all characteristics they considered necessary for an activity to qualify as that type of tourism.

**Demographics and environmental attitudes.** Demographic variables were collected to characterize the sample including gender, age, highest level of education achieved, income, and race/ethnicity (US Census categories). Participants also indicated their political party affiliation, if any, and rated their ideological lean on a 7-point Likert scale ranging from 1 (very conservative) to 7 (very liberal). “Pro-environmental
attitudes” were assessed using an 8-item measure adapted from Dunlap, Van Liere, Mertig, & Jones (2000)’s New Ecological Paradigm scale (α = 0.78). Demographic characteristics of the sample are summarized in Table 3.1.

**Analytical Approach**

The frequency and distribution of the item measuring perceived benefit/harm of tourism to wildlife was determined and graphed. A Shapiro-Wilk test was used to assess skewness. Correlation of this factor with demographic variables, political ideology, and pro-environmental attitudes was tested (Pearson correlation, 2-tailed significance, significance level of \( p = 0.05 \) chosen *a priori*).

**Qualitative analysis.** Both the primary author and a secondary coder read each of the open-ended responses. After reading all of the responses, a list of coding categories was generated to capture the range of answers provided, organized under broad headings of “direct” or “indirect” harms or benefits. If a particular coding category was represented in a participant’s response, that category was marked with a ‘1’ to indicate presence and otherwise was marked ‘0’ to indicate absence. Non-responses, including random letters typed in the box (e.g., “asd”), were not included in the analysis (total \( N_{\text{benefit}} = 331 \); total \( N_{\text{harm}} = 332 \)).

Cohen’s \( \kappa \)—a measure of agreement between two coders of a categorical variable which takes into account potential for chance agreement—was calculated for each coding category. Inter-rater reliability across categories ranged from \( \kappa = 0.510 \) to \( \kappa = 0.92 \) (\( M = 0.80 \)) or “moderate” to “near perfect” using benchmarks established by Landis and Koch (1977), with only two categories falling below the benchmarks for “substantial” or “near perfect” agreement. The primary author’s coding was used to conduct all further analysis.
Descriptive statistics were used to determine patterns in the open-ended response items across the total sample as well as across the spectrum of responses to the “perception of tourism’s harm/benefits” item. The pattern of responses to items asking participants to define types of tourism were described and graphed.

**Results and Discussion**

**Perception of Tourism’s Harm/Benefits**

Responses are displayed in Figure 3.1 ($M = 3.94, SD = 1.44$). Though visually responses appear nearly normally distributed, there was a slight but statistically significant skew toward the “beneficial” side of the scale ($skew = 0.06$, *Shapiro-Wilk* $(322) = 0.94, p < 0.05$). This item did not correlate with gender ($r (322) = 0.02, p = 0.72$), age ($r (323) = 0.06, p = 0.29$), political ideology ($r (321) = -0.07, p = 0.19$), or reported pro-environmental attitudes ($r (317) = 0.05, p = 0.40$). This suggests that opinions about tourism harm and benefits vary across experience and background, and are not necessarily closely correlated with some of the predictable attitudinal differences.

![Figure 3.1. Frequency of responses to item asking whether tourism is relatively beneficial or harmful to wildlife](image)
seen in other areas of environmental psychology. There is strong evidence that environmental attitudes scales can predict at least some types of values and probable behaviors (e.g., Barr, 2007), but these scales have primarily been used to study scenarios in which there is clarity about whether a particular policy will help or hurt the environment (e.g., Rauwald & Moore, 2002). This suggests that data on pro-environmental attitudes may have less predictive value in responding to policy questions where impacts are ambiguous.

**Perceived Potential Harms/Benefits Coded through Open Response**

The results of the coding of open responses are presented in Table 3.2 (factors listed as potential benefits to wildlife from tourism) and Table 3.3 (factors listed as potential harms to wildlife from tourism).

All respondents were asked to list both the potential benefits and the potential harms of wildlife tourism. The benefit that respondents mentioned most often was the ability of tourism to provide money to support conservation (83.48%); aside from financial benefits, they were most likely to mention indirect and difficult-to-quantify benefits like “increasing awareness” (52.57%), changing participant’s attitudes or emotions towards wildlife (38.37%), or increasing participant knowledge about wildlife (28.70%). This finding echoes the intuition seen throughout the scientific literature; researchers perceive changes in awareness, attitudes, or knowledge as meaningful conservation benefits without necessarily being able to point to a concrete mechanism explaining how or why these effects would significantly impact wildlife conservation (e.g., Zeppel & Muloin, 2008; Hughes et al., 2011). However, unlike in the scientific literature, respondents made negligible mention of the potential of wildlife tourism to
contribute to or result in positive, pro-environmental behavioral change among participating tourists.

When asked to list the potential harms of tourism, a large majority of respondents (71.69%) expressed the view that tourism, broadly speaking, is bad for the environment (e.g., “trashing environments,” “too many visitors destroy the environment/habitat”)—a conclusion largely, if broadly, in alignment with the scientific consensus about the effects of mass tourism on natural systems (e.g., Zhou & Huang, 2004; Wang & Buckley, 2010). Half of respondents (50.90%) discussed tourism as representing a disruption of natural processes or a human intrusion into natural spaces or cycles. Respondents also pointed to numerous potential negative direct effects of tourism on wildlife, including risks of physical harm or injury to wildlife (47.89%) and the risk that tourism might lead to a range of negative behavioral impacts (41.27%) including changes in stress response, habitat use, and mating and feeding behaviors. About a third of participants (30.12%) theorized that wildlife tourism might also serve to encourage bad behavior by humans, including increases in hunting, poaching, or demand for exotic pets.

It is clear that there are informational barriers to some members of the public evaluating the significance of wildlife tourism impacts based on a limited understanding of basic principles of ecology and animal behavior. Some respondents (5.74%) opined that the opportunity to see and interact with people could represent a benefit for participating animals, and that tourism might “help the animals learn to accept humans”, “show the animals people care”, “give friendly companions to wildlife”, or “entertain the animals” (among other suggestions). A smaller percentage (3.63%) identified the happiness humans might feel as a result of encounters with wildlife as a potential benefit.
to wildlife, despite the fact that such emotions are, presumably, a significant driver of demand for wildlife tourism but otherwise likely have a minimal impact on wildlife wellbeing. Similarly, some respondents (8.16%) described food that wildlife might receive from humans as a potential benefit to wildlife, despite substantial academic debate about the ethics and potential harms of provisioning tourism (e.g., Orams, 1995; Knight, 2010).

Over all, there was no discernible difference in the benefits and harms identified by respondents with varying perceptions of whether tourism was harmful or beneficial to wildlife. Respondents who viewed it as mostly beneficial were able to identify the same potential harms as those that saw it as having a neutral effect or as mostly harmful. The primary difference was that those who perceived the effects of tourism as beneficial were more likely to mention monetary benefits (90.78%) than those who saw those effects as neutral (79.37%) or harmful (74.80%). They were also more likely than other groups to mention raising awareness (64.54%) and changing tourist emotions or attitudes (41.13%). Those who believed tourism was neutral or harmful were more likely to note in their open-response request to list three benefits that they were unable to think of three ways in which tourism could benefit wildlife (among those who thought it was harmful, 6.30%, among those who were neutral, 7.94%, among those who considered it beneficial, 0.71%).
Table 3.2. Percentage of participants listing factor in potential benefits of wildlife tourism.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Total</th>
<th>Sees tourism as beneficial</th>
<th>Sees tourism as neutral</th>
<th>Sees tourism as harmful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td></td>
<td>N = 322</td>
<td>N = 141</td>
<td>N = 63</td>
</tr>
<tr>
<td>Provide money or funding for conservation efforts</td>
<td>82.48%</td>
<td>90.78%</td>
<td>79.37%</td>
<td>74.80%</td>
</tr>
<tr>
<td>Lead to protection or setting aside of areas or habitat</td>
<td>16.31%</td>
<td>16.31%</td>
<td>15.87%</td>
<td>16.54%</td>
</tr>
<tr>
<td>Provide food or other care for the animal</td>
<td>8.16%</td>
<td>7.09%</td>
<td>6.35%</td>
<td>10.24%</td>
</tr>
<tr>
<td>Provide attention/interaction for the animal</td>
<td>5.74%</td>
<td>6.38%</td>
<td>9.52%</td>
<td>3.15%</td>
</tr>
<tr>
<td>Indirect</td>
<td></td>
<td>N = 322</td>
<td>N = 141</td>
<td>N = 63</td>
</tr>
<tr>
<td>Increase awareness of wildlife or conservation problems</td>
<td>52.57%</td>
<td>64.54%</td>
<td>39.68%</td>
<td>45.67%</td>
</tr>
<tr>
<td>Change emotions or attitudes toward wildlife or conservation</td>
<td>38.37%</td>
<td>41.13%</td>
<td>36.51%</td>
<td>36.22%</td>
</tr>
<tr>
<td>Increase knowledge or understanding of wildlife or conservation</td>
<td>28.70%</td>
<td>26.95%</td>
<td>31.75%</td>
<td>29.13%</td>
</tr>
<tr>
<td>Funding or increasing wildlife or conservation research</td>
<td>5.74%</td>
<td>6.38%</td>
<td>3.17%</td>
<td>6.30%</td>
</tr>
<tr>
<td>Lead to economic development for tourism area</td>
<td>4.23%</td>
<td>6.38%</td>
<td>3.17%</td>
<td>2.36%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>N = 322</td>
<td>N = 141</td>
<td>N = 63</td>
</tr>
<tr>
<td>Participant noted they were unable to think of 3 reasons</td>
<td>4.23%</td>
<td>0.71%</td>
<td>7.94%</td>
<td>6.30%</td>
</tr>
<tr>
<td>Seeing wildlife makes people happy or leads to human enjoyment/entertainment</td>
<td>3.63%</td>
<td>2.84%</td>
<td>1.59%</td>
<td>5.51%</td>
</tr>
</tbody>
</table>

Note: Participants categories are defined as follows: “sees tourism as beneficial” includes participants who marked “extremely beneficial” to “somewhat beneficial”; “sees tourism as neutral” includes participants who marked “neither beneficial nor harmful”; “sees tourism as harmful” include participants who marked “extremely harmful” to “somewhat harmful” on the scale item asking participants to indicate their perceived harm or benefit of wildlife tourism.
Table 3.3. Percentage of participants listing factor in potential harm of wildlife tourism.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Total</th>
<th>Sees tourism as beneficial</th>
<th>Sees tourism as neutral</th>
<th>Sees tourism as harmful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tourism as generally bad for the environment</td>
<td>71.69%</td>
<td>75.00%</td>
<td>65.08%</td>
<td>71.32%</td>
</tr>
<tr>
<td>Tourism leading to the destruction of habitat</td>
<td>7.23%</td>
<td>8.57%</td>
<td>7.94%</td>
<td>5.43%</td>
</tr>
<tr>
<td>Negative impacts on the animal physically (e.g., increase risk of harm or conflict)</td>
<td>47.89%</td>
<td>50.00%</td>
<td>55.56%</td>
<td>41.86%</td>
</tr>
<tr>
<td>Negative impacts on the animal behaviorally (e.g., stress reactions, changes in habitat use or feeding/mating behaviors to avoid humans)</td>
<td>41.27%</td>
<td>40.71%</td>
<td>38.10%</td>
<td>43.41%</td>
</tr>
<tr>
<td>Indirect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exploitation or commodification of wildlife</td>
<td>11.14%</td>
<td>13.57%</td>
<td>11.11%</td>
<td>8.53%</td>
</tr>
<tr>
<td>Disruption of natural processes or intrusion of humans into natural cycles/spaces</td>
<td>50.90%</td>
<td>48.57%</td>
<td>52.38%</td>
<td>52.71%</td>
</tr>
<tr>
<td>Encouraging negative behaviors (such as hunting, poaching, desire to keep wildlife as pets)</td>
<td>30.12%</td>
<td>33.57%</td>
<td>23.81%</td>
<td>29.46%</td>
</tr>
<tr>
<td>Leading to incorrect or bad thinking (e.g., negative experiences with wildlife or the perception that wildlife is doing fine when conservation is needed)</td>
<td>12.05%</td>
<td>15.00%</td>
<td>11.11%</td>
<td>9.30%</td>
</tr>
</tbody>
</table>

Note: Participants categories are defined as follows: “sees tourism as beneficial” includes participants who marked “extremely beneficial” to “somewhat beneficial”; “sees tourism as neutral” includes participants who marked “neither beneficial nor harmful”; “sees tourism as harmful” include participants who marked “extremely harmful” to “somewhat harmful” on the scale item asking participants to indicate their perceived harm or benefit of wildlife tourism.
**Defining Sustainable, Eco, and Nature Tourism**

The results of the questionnaire item asking participants to check the factors that needed to be met to qualify a tourism operation as either “sustainable,” “eco,” or “nature” tourism are presented in Figure 3.2. Academic definitions of ecotourism typically include some mention of all of these components (e.g., Blamey, 2001). Data from respondents suggests that the general public understands ecotourism as a broader category with fewer specific criteria, believing that ecotourism must involve nature (91.89%) and protect the environment (77.48%), but showing less conviction that it had to have an educational component (53.15%) or necessarily be sustainable (51.35%), and in general they did not think it was by definition required to provide benefits to local people (25.23%). Indeed respondents placed relatively little emphasis on benefitting local people in defining all three types of tourism (33.33% for nature tourism, 25.23% for ecotourism, 32.71% for sustainable tourism), although academic research strongly suggests a connection between successful wildlife conservation tourism and “buy in” from communities that bear the costs of living near wildlife (e.g., Mackenzie, 2012). Further, the only type of tourism that a large majority of respondents believed needed to be performed sustainably was sustainable tourism—and even there, it was somewhat surprising that only 82.24% of respondents felt sustainability was a necessary condition for sustainable tourism.
Conclusion

Findings in this chapter suggest that layperson intuitions about the potential harms and benefits to wildlife from tourism are, with a few exceptions, relatively accurate and nuanced. As in the academic literature, the harms tend to be more concrete and easily proven than some of the theorized benefits. It is also clear that survey respondents understood that potential harms and benefits are heavily context dependent, making generalizations about the widely divergent practices and range of operators offering wildlife tourism experiences difficult (“If tourism dollars are put towards conservation efforts, then it is beneficial,” “maybe the money won’t [sic] go back to [the wildlife]”).

The tourism practices and examples given when participants discussed potential harms or benefits were highly variable. This seems to indicate that participants perceived that the potential for harm or benefit depended substantially on the context and particulars of the
individual tourism operation. In other words, tourism operations were in general not described as either all good or all bad, but as having a broad range of potential impacts. For example, a tourism operation could contribute money to conservation, but many do not. On the other hand, the construction of tourism infrastructure could lead to the wholesale destruction of habitat and harmful exploitation of wildlife for profit, but of course not all tourism operations do so. Thus potential harms and benefits, and the degree to which the scales of “benefits” and “harms” are in balance, depend on the behavior of the actors involved—which can be shaped by many forces from markets to norms to regulation. Although there are contentious ongoing scientific debates about whether the benefits of wildlife tourism broadly outweigh the harms, respondents were largely able to recognize that it depends on the particular type of wildlife in question, the kind of tourism, and the behavior of participants and operators (among other factors). This non-expert intuition suggests that targeted, similarly structured studies of individual operators or small groups of operations (which can later contribute to larger meta-analyses), and can potentially answer questions such as “under what circumstances is tourism most beneficial and least harmful?” and “what actions can be taken to maximize benefit and minimize harm?” might prove more useful overall than philosophical or theoretical debates about whether wildlife tourism is, in aggregate, harmful or beneficial to wildlife—to which the answer—from the scientific literature and the public’s intuition—seems clearly to be, “it depends”.

Similarly, respondents demonstrated the extent to which academic definitions are only useful insofar as they are able accurately to reflect real world practices and understanding—researchers’ definitions of ecotourism are less relevant if consumers and
self-identified practitioners of ecotourism do not share them. Evidence from respondents suggests that the real-world meanings of key tourism terms may be significantly different, and much less specific and demanding, than the way the same terms are used in the academic literature. This finding has implications for future tourism research. The hope that market demand for ecotourism experiences will lead to best practices and greater quality control within the tourism industry is significantly undercut by the reality that the public apparently does not expect that ecotourism operators will, by definition, do anything to help local communities, operate on the basis of principles of sustainability, or provide quality (or any) educational interpretation.
Chapter 4
Medicinal Exploitation of Scleractinian Corals: Ancient Practice to Infomercial
This chapter utilizes extensive historical research to identify patterns in the use of scleractinian corals to treat and prevent a variety of diseases throughout human history. Although there are many historical works that mention coral medicine in passing, there has been to date no comprehensive effort to collect in-depth information on the medicinal use of corals across cultures and time periods, or to study the continuity of belief that may underlie such use. Although this chapter began as a strictly historical project, driven by interest in how humans have related to corals and coral reefs (on which relatively little historical work has been done, outside of research into decorative objects), surprising connections emerged between past beliefs about the medicinal uses of coral and the modern marketing of coral calcium as a health supplement by the unscrupulous. Although we like to think of ourselves as modern, deconstructing similarities between historical and modern medicinal uses of coral suggests that modern patients may not be as different from their historical counterparts as they might like to believe. This case study thus became an opportunity to better understand the present in the process of learning deeply about the past, and to identify some of the underlying structures and human motivations which have made coral such a powerful locus of interest for healers and charlatans throughout human history.

Coral has been used for its perceived magical and pharmaceutical properties for centuries in medicinal preparations intended to prevent or treat a variety of diseases and ailments, and has been employed for these purposes more or less continuously from prehistory through the modern day. In some cases, these treatments are strictly physical in nature—but the line between medicine, religion, and folk tradition is often difficult to discern. There is room to debate whether the medicinal practices associated with coral are
based in “magic”, “religion”, or “science”—but in reality, the situation “resembles nothing so much as the endless shuffling and redealing of a deck of but three cards” (Faraone & Obbink, 1997, p. vi). As we will see, pharmaceutical lore throughout history may be enduringly understood and accepted by patients as representing simultaneously both empirically tested, practical treatments for illness and magicolegndary beliefs.

Thus corals have been used through history both to heal ulcers and to ward off demons, to treat disorders of the eye and protect infants from witchcraft. Corals represented mystical, liminal objects—were they plants? stones?—of beauty and mysterious power, with the potential to heal or harm. This allure is key to understanding that the historical processes which created corals as medicine is enmeshed in social and spiritual context. As Slack (1977) observed,

…illness is always a social as well as biological phenomenon. It produces strains and anxieties which need treatment as much, if not more than, the disease itself, and the doctor’s role has never been as simple as that of an administrator of an effective physical cure (p. 242).

Thus the question is not simply one of the effectiveness of coral in treating, in a variety of ways, a variety of ailments. Corals, like many other medicinal cures throughout history, were part of treatment strategies that were, in turn, “part of a system of belief and behavior participated in by physician and layman alike” (Rosenberg, 1992, p. 12). In fact, while cures have changed over the centuries, this system of belief is still at the heart of medicine. Perhaps most importantly, these beliefs have shown themselves to be powerfully enduring, shaping the way humans perceive and interact with corals through the present day.
The Scope and Scale of Traditional and Alternative Medicine

This chapter addresses the historical use of corals as medicine, and modern practices of alternative medical practitioners related to corals. Traditional medicine is a broad term used to describe non-Western medical practices, both past and present. Complementary and alternative medicine here refer to treatment methods outside the modern biomedical mainstream, particularly as employed in developed countries, used in preference to or conjunction with Western medicine (Bannerman, Burton, Chen, & Foster, 1983; Bodeker & Kronenberg, 2002). Although coral reefs are increasingly of interest to Western biomedical researchers (as discussed later) scientists believe the potential contributions of coral reefs to Western medical science primarily lies ahead (Radjasa & Sabdono, 2009).

The World Health Organization estimates that a third of the world’s population has no regular access to modern Western medicine; in some parts of Africa, Asia and Latin America the estimate is closer to half. Up to 80 percent of the global population relies on animal and plant-based medicines for primary or complementary medical care (WHO, 1993). The demand for these products has led to the overexploitation of numerous species, and the trade in medicinal plants and animals is valued at billions of dollars per year (Anyinam, 1995; Still, 2003; Alves & Rosa, 2007). Traditional Chinese Medicine (TCM) utilizes more than 1500 animal species (Alves & Rosa, 2007), while traditional Indian medicine (TIM), also called Ayurvedic medicine, bases 15-20 percent of treatments on animal derived substances (Unnikrishnan, 1998).

Nor are these practices likely to be displaced rapidly by Western medicine as a result of economic development or globalization. In industrialized countries, the growing
use of complementary medical practices is associated with higher income and levels of education; and traditional, alternative, and complementary medicine have generally been gaining Western adherents over the last several decades (Bodeker & Kronenberg, 2002). Meanwhile, communities in which these traditions have been long established often resist the replacement of their practices. The affordability, availability and cultural familiarity of traditional medicine is likely to contribute to the continued use of providers of traditional medicine even in countries where western medicine enjoys widespread acceptance (Schippman, Leaman, & Cunningham, 2002).

Medico-spiritual Use of Corals in the Ancient World

Prehistoric evidence is suggestive of a very ancient relationship between humans and Mediterranean corals, probably initially through the collection of pieces of coral washed ashore following storms (Marzano, 2013). While the difficulties of determining the nature of coral as animal, vegetable, or mineral meant that it was often misclassified through the mid-eighteenth century, the commonality and wide geographic distribution of zootherapy has led to the suggestion that all human cultures with developed medical systems will utilize animals as medicines (Costa-Neto, 2005). Fossil records suggest the human use of plants for medicinal purposes as early as the middle Paleolithic, some 60,000 years ago (Lietava, 1992). Great Apes have also been documented to self-medicate with plants to address parasitic infections, suggesting that the medicinal use of plants (and, perhaps, animals) may considerably predate the emergence of modern humans (Huffman, 2001). Coral has been found with 25,000-year-old Paleolithic human

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8 A 2007 survey found that 4 out of 10 adults in the United States had used complementary or alternative medicine in the previous year, and that they were more likely to do so when they could not afford access to medical care or were forced to delay receiving it because of cost (Barnes, Bloom, & Nahin, 2008). Thus, changes in health care access may further fuel demand for alternative treatments.
remains, and is present among ex-votos (religious offerings) in Malta dating from the 2nd Century BCE (Marzano, 2013). There is evidence of intentional targeted harvest of coral using dredges in the Mediterranean dating to the 6th century BCE (Marzano, 2013).

Though archeological evidence implies a Western cultural tradition associating healing, spiritual protection, and medical prophylaxis with stones, including coral, it is impossible to pinpoint the earliest adoption of corals for specifically medicinal purposes, though the earliest known work which details the medicinal properties of stones was written around 315 BCE, and included coral (Harris, 2009). If later practices are any indication, some substantial portion of the early practice of coral medicine would likely have entailed the consumption of ground powder made from coral, which would functionally disappear in the archaeological record.

Egyptian tombs contain coral beads and, occasionally, amulets, and corals seem to have had particular importance to funerary practices in later dynasties; while the Egyptian practice of associating colors with important spiritual outcomes suggests that red coral would have been valued highly (Lucas & Harris, 2012). However, the earliest detailed written records of corals being used medicinally are drawn from Ancient Greece, Rome, and Persia, while trade routes and exchanges of medical knowledge suggest that awareness of coral medicine would have been disseminated widely in the ancient world.

It is within the Homeric epics that scholars can first discern the idea of a “drug” among the Greeks. Used alone, the Greek word now translated as “drug” can mean “magic”, “charm”, or “enchantment”—but eight further adjectives used by Homer divide it into variations based on effect, ranging from harm-causing (poisons) to beneficial (remedies) (Faraone & Obbink, 1997, p. 139). The Alphabet of Galen, a Latin text of
uncertain date and origin—but with manuscript copies dating back to the 7th century at least—describes 300 “simples” (natural products) for medicinal use, including coral, which it notes is “red in colour, like a lobster. It has styptic properties wonderful for those spitting blood” (Everett, 2012, p. 211). This text is considered by scholars to be “a precious survivor of a rich tradition of ancient scientific literature from the third century BCE to the first century AD that has mostly been lost” (Everett, 2012, p. 3).

During the first century in classical antiquity, Pliny the Elder reported myriad additional medicinal uses for the skeletons of precious corals:

Branches of coral, worn as an amulet by babies, are believed to be protective, and reducted to powder by fire and taken with water are helpful in gripings, bladder trouble and stone; similarly taken in wine, or if fever is present, in water, coral is soporific. There is also a statement made that if this medicament is frequently taken internally, the spleen will be gradually consumed. Powdered coral, too, is an excellent remedy for patients who bring up or spit blood. Calcined coral is used as an ingredient in compositions for the eyes, being productive of certain astringent and cooling effects: it makes flesh, also, in the cavities left by ulcers, and effaces scars upon the skin. (Pliny, p. 70)

Pliny here mentions two important medicinal practices related to coral that will crop up throughout history: the use of coral as a special protective for children, and the consumption of powdered coral as a treatment for illness and disease. He also mentions a recurrent theme in the use of corals medicinally—that while the correct (or correctly prepared) coral might serve as powerful medicine, corals used incorrectly also have the potential to cause harm—in this case by consuming the spleen. Around 47 CE, another Roman, Celsus, published *De Medicina*, which also contained information about the medicinal values of coral, including a compound medicine which “relaxes, opens, and cleans” and two treatments for vitiglio (Spencer, 1938, p. 29, 175).⁹

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⁹ The treatment for vitiglio was as follows: “Another application for the same purpose, ascribed to Irenaeus, is composed of coral, soda, cumin and dried fig-leaves, in equal quantities, pounded up with vinegar added.”
In Greece, Pedanius Dioscorides (40-90 CE), a doctor in the Roman army who studied pharmacology at Tarsus, in present-day Turkey, recorded that coral,

> By its strength is therapeutic for the bowels, cools gently, represses abnormal growths, takes off scars on the eyes, fills up hollow sores and cracks, works effectively against spitting up blood, is good for frequent painful urination, and (taken as a drink with water) reduces the spleen.” (Osbaldeston & Wood, 2000, p. 815)

The uses he reports are not identical to those in Pliny or Celsus, but they are similar, and these similarities will reoccur frequently throughout the history of coral medicine, as scholars quote (though only sometimes credit) various texts from history (which were, of course, also contemporaneously drawing on each other for authority).

Although many of the relevant surviving treatises are focused primarily or solely on medicine, ancient uses of coral were not strictly prophylactic or medicinal. Around the first century CE, Gratius recorded the use of dog collars set with Maltese coral to treat rabies; however, rabies was clearly not understood as a malady with physical origins, as the remedy was intended to appease the gods, and break the charm caused by “an envious eye” (Kunz, 1971, p. 131). Damigeron, whose 4th century lapidary, *The Virtues of Stones*, was later used as a basis for many medieval lapidaries, reported that coral also controls storms, heals the damage to crops produced by hail, and protects houses from robbery (Harris, 2009, p. 67). Instructions for a coral amulet from a surviving fragment of a third or fourth century Greek lapidary calls for attaching an amulet containing coral to the prow of a ship using strips of seal skin to guard the vessel from wind and waves (Kunz, 1915, p. 39).

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The vitiligo is smeared with this in the sun, then it is soon washed off, lest it corrode too much.” (p. 175)...another, more difficult type “is treated by pounding up together coral, frankincense, barley and bean-meal; and these are sprinkled on, using no oil in the bath before the patient sweats; then this kind of vitiligo is rubbed off.” (p. 175).
Thus coral was thought to have both practical and spiritual efficacy. Soranus of Ephesus, a Greek physician who practiced in Alexandria and Rome in the first and second century CE, clearly understood that the treatment of illness extended beyond amelioration of physical symptoms, writing in his famous gynecological treatise that “…one should not forbid their [amulets’] use; for even if the amulet has no direct effect, still through hope it will possibly make the patient more cheerful” (Temkin, 1956, p. 165). Though coral was understood as potentially having both physical and spiritual power, doctors might also turn to it as an offering that could provide comfort in the absence of a more efficacious treatment.

In the Islamic world, philosopher and mathematician Al Kindi (801-873) also expounded on the virtue of corals in treating illnesses. In his “Medical Formulary” published in 830 CE, he reported that corals were best used to treat ailments of the eye (Rulandus, 1964). Avicenna, another author of a widely distributed formulary in the Islamic world, probably drawing on previous works, claimed that coral may “concentrate the breath or prevent it from dissipating rapidly” and could also be used to treat epilepsy and blood disorders, or prevent nightmares or blindness (Borchardt, 2002). Although there was a strong independent medical tradition in the Islamic world, it is also clear that the works of Greek and Roman medical practitioners and philosophers were widely known there, and Arabic and Persian manuscript translations of many Western medical treatises survive, while many later European authors draw on ancient authors from both traditions for authority.

Even in ancient times, the more fanciful or less empirical of these practices had their detractors. Pliny, who recommended coral’s medicinal properties in his *Natural
History, also made a point of noting that before he began describing precious stones of proven utility in healing,

…I mean first to have a fling at the magicians, to refute their detestable lies and unnatural vanities, for in no way have they so overstepped themselves, as in their accounts of gems and precious stones. These exceed the statements of doctors and even the limits of medicine, and as good and efficacious remedies they tell us a tale of the great medicinal virtues and values of precious stones; both incredible statements. (Ball, 1950, p. 37)

Here we see an early iteration of what will prove to be a long history of skeptics and experts condemning charlatanism and quackery (although, of course, quackery is a moving target). Both unproven and unrealistic claims about coral’s medicinal properties and people who emphatically dispute those claims have followed the medicinal uses of corals through ages of history and into the present day. Ancient people were no more immune to promises of a miracle cure than modern ones and ancient authors like Dioscorides acknowledged the persistent staying power of medicinal folk traditions linked to particular pharmaceuticals, even in the absence of any evidence that they were effective (Osbaldeston & Wood, 2000).

**Coral Medicine in the Middle Ages (700-1400)**

Many ancient medical traditions continued into the Middle Ages, and although in the early medieval period written treatises remained fairly rare, some lapidaries, which described the medicinal properties of stones (including coral), were written in verse. Although this has not been proven definitively, it seems probable that like many other popular poems of the day, verse lapidaries may have been circulated through oral tradition and memorization, and thus may have been far more widely known than the few surviving manuscripts from this period would suggest (Harris, 2009, p. 20).
We also know that ancient medicinal uses of coral continued both in and outside of Europe, as records show that prominent Egyptian physician Maimonides (1135-1204) prescribed compound medicines that included coral, including one containing pearls, amber, coral, gold filings, shredded silk, roasted river crab, cucumber seed, and numerous other ingredients, which he used to treat his patron Prince al-Afdal’s “actual or imagined heart condition” (Davidson, 2004, p. 482).

Medieval medical texts relied heavily on the wisdom of the ancient world, including that of Arabic scholars like Al-Kindi and Avicenna, and corals continued to be perceived as possessing protective and medicinal properties. In the late 1200s, the Book of Secrets of Albertus Magnus reported:

If thou wilt pacify tempests and go over floods. Take the stone which is called Corallus, Coral, and some be red and some white. And it hath been proved that it stemmeth anon blood, putteth away the foolishness of him that beareth it, and giveth wisdom. And this have been proved of certain men in our time. And it is good against tempests, and perils of floods (Best & Frank, 2000, p. 35).

Here we can see that to a certain extent the magical and medical properties of coral may be related; thus coral’s identity at the time as a mysterious liminal “plant” and “stone” that came from the ocean suggests how one might come to imagine that it could protect a sailor at sea, resist the perils of floods, and stop bleeding—all of which require it to have some powerful relationship to the behavior of liquids. In 1240, Bartholomaeus similarly reported that

witches tell that this stone withstandeth lightning. His might and virtue is wonderful, for it putteth off lighting, whirlwind, tempest and storms from ships and houses that it is in…And the red helpeth against the fiend’s guile and scorn, and against divers wondrous doing, and multiplieth fruit, and speedeth beginning and ending of causes and of needs. (quoted in Seager, 1896, p. 70)

Vincent of Beauvais wrote a widely circulated lapidary in the 1240s that quoted from ancient Latin, Greek, Arabic and Hebrew sources, and had this to say about coral:
Coral checks hemorrhage, reduces corpulence, draws harmful humors from the eye, cures ulcers, and benefits heart, intestines, and spleen. Suspended over the mouth it stops stomachache; suspended from the neck it prevents epileptic fits. Suspended from trees or sown with seed it protects the fruit or crops from hail storms. Decayed teeth are filled with it in order to extract them, and it is terrible to demons because it is so often found in the form of a cross. (Thorndike, 1941, p. 470)

This and other similar texts likely helped further establish coral as an important part of medieval medical practice, particularly the role it could play in treating bleeding and hemorrhage. Here, Vincent of Beauvais also hints at the complex relationship between corals and Christianity—particularly the ability of coral to represent the cross and the blood of Christ.

This sanguinary association probably also led to a lasting link, across many sources, between coral and women’s health. The *Trotula*—the most popular and widely available medieval assembly of materials on women’s medicine—dates to the 1100s and continued in wide use up through the fifteenth century. It called for suspending a piece of coral from the neck of a pregnant woman, especially one in labor, and provided recipes for a range of compound medicines which included coral as an ingredient (Green, 2010, p. 70, 82, 130, 208). John of Gaddesden, author of *Rosa Angelica*, a lengthy late medieval medical encyclopedia, similarly recommended the wearing of a coral necklace to assist in childbirth (Robbins, 1970, p. 412).

During the Middle Ages, there was also a definite increase in the active marketing of medicinal cures, reaching a peak of fervor during plague outbreaks. The widely used late thirteenth-century manuscript *Antidotarium Nicolai*\(^\text{10}\) included a recipe for “Galen’s Great Theriac”—note, of course, that this Medieval manuscript, like others, drew on the

\(^{10}\) The *Antidotarium Nicolai* first appeared in Salerno around 1150, attributed to Nicolaus Salernitanus; it was widely used in Europe and had been incorporated into the medical curriculum offered in Paris by 1270.
authority of the ancients (Galen, 129-200 CE) as evidence of the efficacy of their cures. The recipe included over seventy ingredients (“simples”), among them ground coral, viper’s flesh, cinnamon, saffron, pepper and several ounces of opium. To prepare the theriac, all ingredients were exactly portioned, ground in a mortar, steeped in wine for three days, boiled, cooled, mixed with honey and stored (Fabbri, 2007, p. 257-258). It was recommended to treat

…the most serious illnesses of the human body, for epileptics and cataleptics…for headaches, and for migraines…also for sore throats, and for constriction of the chest;…optimal for arthritics and asmatics, icteric, hydropic, peripneumonic, also…for kidney stones, and colics…menstrual disturbances and difficulties in elimination associated with older age…the treatment of venoms, snake bites and bites of other poisonous animals…but of greatest merit was its general utility in a wide variety of bodily ailments; it kept the heart, lungs, brain, liver and stomach healthy; it helped the entire body stay well. (quoted in Fabbri, 2007, p. 258)

This is perhaps the most expansive description of the medicinal qualities of coral we have seen thus far, asserting sweeping curative properties, addressing almost every type of human ailment.

Coral as a medicine to be taken internally would have been largely the province of the prosperous during the Middle Ages. Records of Edward I of England, who died in 1306 of dysentery, show numerous remedies purchased for the royal physician’s use in treating the king, including precious gems and metals, coral, garnets, amber, myrrh, and herbal ingredients (Duffin, 2013, p. 84). However, unlike more precious materials, coral may also have been available to some degree to the middle classes. Coral appeared in the Treasury of Health, a materia medica which was geared towards the medical needs of ordinary people, and offered remedies composed of materials that would have been readily available at low cost, including those made from farm animal waste, burned barely bread, donkey milk, willow twigs, and ashes of snail or frog—it also included
some lapidary cures, including coral (Harris, 2009). It cited Avicenna—an exotic, ancient expert—as the authority for the recommendation that coral can be used to soothe gums or remove a decayed tooth (Harris, 2009). Similarly, the Poor Man’s Treasury, written around 1270, offered coral as a treatment for syncope and recommended it as an amulet/talisman, advising that “coral, if kept around the house, destroyed all evil influences” (Kunz, 1971, p. 199-120).

Of course, in the Middle Ages, as in ancient times, the most grandiose of these medicinal claims were not without skeptics. Arnald of Villanova (d. 1311), in his chapter on epilepsy, wrote of his desire to rid medicine of “enchanters, conjurers, and invokers of spirits, diviners and augurs, from the field of medicine as a godless crew who are servants of the devil” (quoted in Thorndike, 1941, p. 848). Of course, whether you were a legitimate, accepted medical practitioner or a “servant of the devil” was (and remains) a highly subjective distinction based on time and place.

**During the Plague**

During outbreaks of the Black Death in 1347 and 1348, there was a dramatic jump in the popularity of various “theriacks”, which had been originally marketed as antidotes for poison, but were ultimately offered as “cure alls” used both to treat and prevent the plague (Fabbri, 2007). Many recipes for theriac exhibited what today might be considered “magical” features and ordinary people’s responses to the plague commonly combined magical protection (often in the form of talismans or amulets) with inexpensive natural remedies. However, this combination of medicinal and magical elements was not practiced only by the poor or uneducated, or those who could not afford better; Maynus de Maineriis, a physician-astrologer on the medical faculty in Paris in the
mid-twelfth century, recommended both his own proprietary recipe for theriac and another prescribed combination of ground coral, rubies, emeralds, and a stone found in an asp’s head to combat the plague (Fabbri, 2007, p. 276).

These practices do not appear to have been seen as magically or spiritually inconsistent with Christian religious devotion. According to Pettigrew,

Quills of quicksilver were commonly worn about the neck as a preservative against the plague. The powder of toad was employed in a similar way. Pope Adrian is reported never to have been without it. The ingredients forming his amulet were dried toad, arsenic, tormentil, pearl, coral, hyacinth, smarag, and tragacanth. (1844, p. 91)

Indeed, in some cases theriac might treat disorders of both the body and spirit. In a quasi-medical treatise written before his death in the plague of 1361, Henry of Grosmont, the duke of Lancaster, described theriac as being not only physically but morally curative; a medicine “to make a man reject the poisonous sin which has entered into his soul” (quoted in Cantor, 2001, p. 174).

During outbreaks of disease, the inclusion of precious gemstones, gold and coral in “health food” preparations for the wealthy (well or sick) as a precaution became fairly routine (Scully, 1995). In one of the more surprising formulations, “Badger powders” were used by wealthy Portuguese to defend against plague. In a supremely odd ritual, a live badger would be inebriated using wine blended with gold, seed pearls, and coral. The animal was then decapitated and drained of blood, which was mixed with spices and wine and consumed by the patient (de Oliveira Marques, 1971). As with many other medicinal uses of coral, badger powders were considered potentially dangerous if compounded improperly, or if the ingredients used were insufficiently fresh.
Although theriac likely had a spotty record at either “curing” or preventing the plague, and has often been dismissed by historians as simple quackery which preyed on the desperate, it is fair to suppose that it may have possessed some benefit in treating the infected. Most theriac recipes included at least some opium, which would have been the most effective analgesic available to plague victims, and likely would have helped the ill remain calm. The tendency of opium to cause constipation may have counteracted some of the diarrheal effects of the disease, which might in turn have helped prevent dehydration and improve chances of eventual recovery (Fabbri, 2007). Those utilizing theriac, however limited its efficacy, truly were availing themselves of the best treatment available at the time. When theriac failed, it was often blamed on compounding apothecaries, who were suspected of replacing the most costly ingredients with less expensive and “effective” alternatives (Fabbri 2007).

Coral and Poison

In both the Middle Ages and during the Renaissance, it was believed that coral had the power to detect poison in food, and so (in addition to being used as an “antidote”) it was built into cutlery or incorporated into credenzas at the entryways of homes—often in company with fossilized shark teeth, which were also believed to detect poisons (Ward, 2008; see Appendix 1 for a few examples of cutlery incorporating coral).¹¹ From the thirteenth to sixteenth centuries almost all courts of Europe used fossilized shark teeth and other means, including coral, to detect poisoned food or drink (Zammit-Maempel, 1975). In some cases, coral was incorporated into ritual objects to detect poisoning, called

¹¹ It is worth noting that the origin of fossilized shark teeth was likely obscure to those using them in this manner; in German they were called Nattern-zungen (“adder’s tongues”) or Schlangenzungen (“serpents’ tongues”), while elsewhere they were called glossopetra (“stone tongue”), or “St. Paul’s tongue” (Linguae S. Pauli), or, in Malta where many originated, Ilsien San Pawl. It was widely believed that they were spontaneously generated by stones, particularly in Malta (Zammit-Maempel, 1975, p. 393).
Languier or Natternzungen-Kredenzen in different parts of Europe. These were branching trees (with at least half of the known examples incorporating coral) with fossilized shark teeth hanging from the branches; it was believed that they would detect poison by sweating or changing color, and that dipping the teeth into wine would counteract any poison that might be present. Although only a few of these objects have survived intact to the present day, they seem to have been in relatively common use among nobility in the late middle ages through the Renaissance; inventories of Jean, first Duc de Berry (1340-1416), show he owned at least 32 “serpent tooth èpreuves”, which also made appearances in the records of Edward I of England (1239-1307) and Charles V of France (1338-80) as well as in the inventories of numerous other nobles (Duffin, 2017, p. 129).

Coral was also believed to pre-emptively protect against venoms and poisons. In the mid-fourteenth century, Johann Jacob Wecker recommended drinking beverages containing powdered coral and gemstones five times a day, to act as a “defence of the principall partes” in cases where patients were bitten by “serpant, lysarde, viper, spider, toade & c.” (quoted in Duffin, 2013, p. 104). Of course, the dichotomous nature of coral meant that in addition to detecting and curing poisonings, corals could also become poisonous if handled improperly:

The grinding of coral in a brass mortar, instead of one of marble, was also regarded as a very dangerous proceeding, which would have the worst possible results for the unlucky patient who took the powder, for some particles of the brass might be rubbed away and mix with the coral. This was said to have often produced very serious illness. (Kunz, 1915, p. 123)

Thus corals could cure poison, detect poison, and even be poison; further evidence for their liminal power to be used for good or ill.
Coral Medicine in the Renaissance (1400-1700)

Even as medicine became a more organized and formally accredited profession, the Renaissance did not put an end to magical or supernatural uses of coral in complement to its more quasi-scientific medicinal purposes. In the late fifteenth century, the *Peterborough Lapidary* recorded that coral

…defends against tempest in the place where it is, and the stone is good to set in a vineyard, or in gardens or fields, for it keeps away tempests and all evil, and makes fruit multiply. And he delivers a man from fantasies, and gives a good beginning and a good ending, and staunches blood, and he is good for the foul evil. This coral is like raw flesh when washed, reddish. Also whoever bears this stone upon him or on his finger, he will obtain love; and if he has any sickness upon him he will soon be whole. Also powder of this stone drunk is very good for cramp. […] Witches say that this stone withstands light-ning; and Isidore says the same, that it puts away tempests and whirlwinds. (Young, 2016, p. 24-25)

In 1502, Camillus Leonardus further reported that corals

Being carried about one, or wherever it be in a house or ship, it drives away Ghosts, Hobgoblins, illusions, dreams, lightnings, winds and tempests. *Methrodorus* calls it the Gorgon; which he interprets of its resisting whirlwinds and lightnings, and that it protects from every Incursion of wild Beasts. It gives relief in pains of the stomach and heart. Being hung down upon the stomach, or taken internally, it helps the weakness thereof. It is good for an Impostume in the Spleen or Intestines. It makes sound the wasted gums; cleanses putrid sores, and represses any hurtful medicine. The shavings or scrapings of it, drank with wine, are good against the Gravel. Being broke to pieces and strewn, or hung up among fruit bearing trees; or dispersed with seed in a field, it gives fertility, and keeps off hail and blighting winds. (Leonardus, 1750, p. 83-84)

Parcelsus, an itinerant, iconoclastic doctor and miner, believed that red coral could be used medicinally to cure melancholia, which he described as “a disease of compulsive sadness, weeping, and of ‘speculations’” which “can be treated with red coral; brown coral may make it worse” (Weeks, 2008, p. 242). He wrote that these corals were

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12 Of course, the lapidary also recorded more prosaic uses for coral—in addition to staunching blood with red coral, white coral was recommended to treat a familiar list of physical ailments: “If a man has sore eyes, or sore teeth, or sore in the roof of the mouth that is full of blisters, take the white coral and grind him to small pieces, and mix it with water, and wash your eyes with it and your mouth and your teeth, and your blisters will be whole. Also if a man or woman has the bloody flux, drink the powder of this stone, and they will be whole” (Young, 2016, p. 26).
“disagreeable not only to Phantasmata, but also to Monsters, Incubi, Succubi, and other evil spirits”, but that the wrong type of coral (brown instead of red) would actually serve to attract evil spirits and monsters (Wheeler, 1897). Similarly, Van Helmont observed in the early 15th century how

…unvoluntarily the Devil could endure this stone: Because I knew a Noble-man enchanted, on who, although bracelets of beads of coral were strongly bound, yet they would presently burst asunder from thence: the like whereof doth occure in that… But not any kind of simples do equally cure the enchanted (Van Helmont, 1977, p. 612)

In some iterations, these quasi-mystical powers were associated with astrology and astrological medicine, which at this time were relatively mainstream and practiced by prominent and acclaimed physicians.

According to several authorities, coral could even be used in magical cures in which illness or injury were transplanted into other objects:

The patient had a most violent pain of the arm, and they beat up red corals with oaken leaves, and having kept them on the part affected till suppuration, they did in the morning put this mixture into a hole bored with an augur in the root of an oak, respecting the east, and stop up this hole with a peg made of the same tree; from thenceforth the pain did altogether cease, and when they took out the amulet immediately the torments returned sharper than before. (Pettigrew, 1844, p. 104)

In another example, John Webster reports on a servant maid who was taken with intense pain in her left arm, that, as it appeared to be without cause, “the beholders did fear some sort of venefice or Witchcraft” (p. 249). They determined thus to apply a “well tryed medicine, which in such a case is said to be much approved” involving beating red corals with oak leaves, and mixing the corals and rose-water “into the form of a cataplasm” and applying it for twenty-four hours. After repeated treatment, an abscess rises and is broken, in which is found “needles, hairs and burnt coals”. As in the previous case, the pain then ceased and the object was put in the roots of an oak and contained there with a
peg. However, a similar group of skeptics, “deriding such things, and thinking them to be prestigious delusions, do pull them forth of the hole again” at which point her pains resume until the process is repeated and the amulet safely restored to the oak roots, at which point “all the pains did forthwith vanish, and she afterward lived altogether sound” (Webster, quoted in Pettigrew, 1844, p. 249).

Astrological medicine was popular, and many astrological medical practices incorporated coral and other precious materials. Von Nettesheim (1898) records that coral is “under Venus” and describes how “fumes” can be used to impart characteristics to a person or lead to desired outcomes, like bringing things closer, sending them away, raising ghosts, or supporting soothsaying. His recipe for a fume of Venus suggests taking “musk, ambergris, lignum aloe, and red coral, and mak[ing] them up with the brain of sparrows and the blood of pigeons” (p. 136). However, it is clear that he perceives a significant relationship between the mental, physical, and magico-spiritual aspects of these cures. Thus Venus is “fiery” (p. 56) and “set”

…over the kidneys, the secrets, the womb, the seed, and concupiscible power, as also the flesh, fat, belly, breast, navel, and the venereal parts and such as serve thereto; also the os sacrum, the back-bone, and loins; as also the head, and the mouth, with which they give a kiss as a token of love. (p. 89)

Venus (and, thus, coral) is also set over human actions and behavior, including “dances, embraces, laughters” and people “of an amiable and cheerful countenance” (p. 156). In these examples it is possible to see the dual role of corals as both medically and spiritually efficacious treatments, and the ways in which those identities might have comfortably coexisted and intertwined in the contemporary mind.

Coral also remained popular for straightforward medicinal purposes throughout this period, even among those who rejected its more mystical properties. Lemnious insists
that the effects of coral and other simples are not supernatural, but simply represent
naturally occurring gifts offered by god. Thus,

…if any man think they may be given to drive away devils; let heathenish
superstition, and vanity be laid aside, let there be no foolish prayers, and strange
words used, whereby such as professes Magical Arts are use to effect their
incantations; if there be any force in plants, as we find by experience there is, you
must remember they had it from God. For all medicaments and hearbs that are
applied to mens bodies, become effectual, not from themselves, but by the
blessing of God. (Lemnius, 1698, p. 391-392)13

He also records the following recipe for heart trouble: “saffron, cinnamon, pearls, red
roses, citrons, coral, jacinth, gold, cloves, the bone of a stags heart, also the smell of new
bread, good wine that refresheth and recreateth the Heart” (Lemnius, 1698, p. 260). We
can see here that a doctor who rejects “heathenish superstition” might still have beliefs
that the modern observer would consider based in magic. He also notes, without further
comment, that “coral, piony, misseltoe” can “drive away the falling sickness, either
hung about the neck, or drank with wine” (p. 391). Coral also continued to be included in
medicinal preparations intended to protect against poisons as well as plague-like

“So Epidemick distempers” (Charas, 1678, p. 235).

13 He goes on to criticize those who practice idolatry by applying herbs “consecrated with some fained
prayers, to cure witchcrafts, or go about to conjure away diseases by them”—he in fact is outraged not only
from a religious perspective, but by their intent to “gull the rude and ignorant people and dazel their eyes,
that they may cheat them of some moneys, and wipe their noses of what they have…” (p. 392). On the
other hand, Paracelsus—who was hostile enough to medical tradition and intellectual orthodoxy that he
publicly burned the works of Avicenna and Galen in 1527—and who was considered a quack by many
contemporary doctors—showed at least the same disdain for the accumulated knowledge of the medical
establishment, writing “And [yet] you are all such fools that you think it is merely a matter of crushing and
of cribrentur & misceantur, fiat pulvis cum zuccaro [filtering and mixing, let there be powder with sugar].
What Pliny and Discorides wrote about herbs they did not test out themselves…Therefore, you should stop
your whining. You and your universities are nothing but beani, rank beginners, in these matters. All you
ever do is read: Here it says this. There it says that. And this is black. And that is green. For the love of
God, I can do no more than say, I’ve read where it said this or that. If no one had written it, you wouldn’t
know a thing…Tell me, who is to be believed in regard to the arts and powers of the natural things? Those
who have written something and do not have the knowledge to prove it, or those who do have the
knowledge to prove it but did not write it? Is it not a fact that Pliny never demonstrated his proof? What has
he written? What he heard from the alchemists. If you do not know that and do not know who they are, you
are Doctor Lamebrain” (Weeks, 2008, p. 230-233). Of course, for clarity, it should be noted that in the
same work, Paracelsus goes on to quote ancient authors for authority for many of his own cures.
Corals set in jewelry were believed to reflect the health of the wearer. In addition to turning pale in the presence of poison, Johann Wittich, a Bavarian doctor, reported that while attending the bedside of a dying youth, he observed the boy’s coral necklace to turn “first whitish, then of a dirty yellow, and finally [become] covered with black spots” (Kunz, 1915). The same effect—a change in the color of the coral—was expected if the wearer were poisoned. Another physician claimed to have observed this phenomenon more than once and theorized that in cases where the coral changed color but no disease was evident, the dangerous “vapor”, though not strong enough to produce clear symptoms, was able to impact the more delicate coral. Nor were these beliefs about coral’s sensitivity to the wearer geographically limited to central and Western Europe. In 1584, as Ivan the Terrible lay dying, he is reported to have proven the severity of his illness by instructing his companion: “This faire currell [coral] and this faire turcas [turquoise] you see; take in your hand; of his nature are orient coullers; put them on my hand and arm. I am poisned with disease: you see they shewe their virtue by the change of their pure culler into pall: declares my death” (Horsey, 2010, p. 200).

In fact, the coral must in some sense be “alive” to feel these impacts. As Van Helmont explains, “stones could neither move, nor alter, if they had not an act of feeling of their own object: for neither could red Coral wax pale, if being born about, it shall touch the flesh of a menstrous woman, unlesse it self felt the defects thereof” (Van Helmont, 1977, p. 1114). Lemniius attempts to explain differences in coloration of corals

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14 According to Horsey, Ivan’s enthusiasm for the magico-medicinal properties of stones extended far beyond the prediction of his own death, as he went on to describe uses and properties of diamonds, rubies, emeralds, and onyx, and says of the stones “…these ar Gods wonderfull guifts, secreats in natur, and yet revells [reveals] them to mans use and contemplacion, as frendes to grace and vertue and enymiess to vice” (2010, p. 201).
15 Of course, that implies that corals can also “die”—and, indeed, Paracelus tells us that “as the Coral diminishes in redness, so it weakens in its qualities” (Waite, 1894, p. 17).
by explaining that coral, when removed from the ocean “hardneth like a stone, and
becomes black or red, or if the moisture be lesse digested, white”—which explanation
may also clarify why white would be believed to be of less medicinal value, containing
less “digested” moisture (Lemnius, 1698, p. 72). Or Paracelcus, who expressed his view
that the “life of gems and corals is mere colour, which can be taken from them by spirits
of wine”, while further observing that “the paler a coral of the red or brown variety is, the
weaker are its virtues, and its use or worth also is less” (Waite, 1894, p.136; Moran,
1993, p. 119). Perhaps in line with these beliefs, at least some medical practitioners
argued that coral would be most efficacious in treating illness in a less processed state,
with Charas arguing that tinctures and other preparation which exposed coral to the
“violence of the fire, or corroding spirits” would lead to a loss of the coral’s color,
potency, and medicinal value, while preparations where coral was “dissolv’d with less
violence” should be preferred (Charas, 1678, p. 125).

Associations between coral and women’s medical concerns also continued,
particularly a perceived relationship between coral and blood—including childbirth and
menses. Nicolas Culpepper, in his famous Directory for Midwives, advised coral as an
ingredient in prescriptions to strengthen both mother and child in the womb, including
not only those intended to be consumed, but also amulets—including bags of “nutmegs,
cloves, mace, mastic, coral” applied to the navel (Culpepper, 1762, p. 257). Coral was
also part of preparations to treat excessive bleeding from the womb (before, during, or
after birth), excessively heavy menses, or miscarriage (p. 281; 71; 204). Culpepper
further suggested its use in the treatment of “frenzy of the womb”—or lust-driven
insanity (p. 229). Women might keep or wear corals as amulets for menses, and these
corals were believed to grow pale while a woman menstruated. According to Van Helmont, when women were “ill at ease [during menses], bright golden coral doth presently wax pale, as it were taking compassion on them; the which notwithstanding, doth resume its former brightness or redness, with the health of the womans womb” (Van Helmont, 1977, p. 612). The *Pharmacopaeia Londinensis* of 1691 categorized inferior “pale” or white coral as “female” and red coral as “male” and recommended the use only of the red (Harris, 2009, p. 172). Some authors were even less charitable in describing the relative impacts of men and women on coral:

But a woman abounding with excrements, and sending out ill smells by reason of her terms; makes all things worse, and spoils their natural forces and imbred qualities…so she will corrupt and spoil hearbs, destroy seed, and take of the Lustre from a looking Glasse. The like reason serves for Coral: for this made into round pieces, and polished Smooth, if a man carry it, it will grow more red, than if a woman should wear it about her. For by being long with a woman it will grow pale and wan, and lose its natural heat, partly by reason of the fuliginous thick vapours that breath from her, and partly because she hath but a weak heat, and is cold and moist of constitution; which qualities can keep and preserve nothing: but a man hath a gentle sweet vapour that proceeds from his substance by naturall heat, and he is almost aromatified by it. (Lemnius, 1698, p. 124)

Lemnius was not alone in this sort of characterization of the ruinous qualities of menstruating women, as Paracelcus chimes in similarly, observing that a menstruating woman

… also carries poison in her eyes, in such a way that from her very glance the mirror becomes spotted and stained. So, too, if she looks at a wound or a sore, she affects it in a similar way, and prevents its cure. By her breath, too, as well as by her look, she affects many objects, rendering them corrupted and weak, and also by her touch. You see that if she handles wine during her monthly courses it soon turns and becomes thick. Vinegar which she handles perishes and becomes useless. Generous wine loses its potency. In like manner, amber, civet, musk, and other strongly smelling substances being carried and handled by such a woman lose their odor. Gold, corals, and many gems are deprived of their colour, just as the mirrors are affected In this way. (Waite, 1894, p. 123)
Coral charms could also purportedly be used to predict the timing of menstrual cycles, but were thought to lose their power if seen by a male (Kunz, 1913). In addition to efficacy in treating the effects of both normal and abnormal menses, many sources made clear that coral could be used to ease childbirth and prevent miscarriage.

Similarly, throughout the Renaissance, it continued to be accepted that coral could serve a particularly valuable protective function for children. Lemnius records the same information that had been appearing in medical lore since ancient times, that “coral…drives away the falling sicknesse, either hung about the neck, or drank with wine” (Lemnius, 1698, p. 391). In John Pechey’s herbal of 1694, he offered a simple, practical, and plausible explanation for another way coral might be useful to babies:

Nurses in England hang it about Children’s necks, to promote cutting of the Teeth; for by reason it is soft and cold, Children love to have their Gums rubbed with it; and so the Eruption of the teeth is render’d more easie. (quoted in Harris, 2009, p. 191)

However, this reasonable rationale may not represent a full explanation, as Sir Thomas Browne observed in his work intended to discredit superstitious practices:

Though Coral doth properly preserve and fasten the Teeth in men, yet is it used in Children to make an easier passage for them; and for that intent is worn about their necks. But whether this custom were not superstitiously founded, as presumed an amulet or defensative against fascination, is not beyond all doubt. (Brown, 1658, p. 329)

That these practices were relatively widespread, at least among the upper classes, is supported by a range of evidence, although for the most part the full motives for the use cannot be recovered. Unsurprisingly, skepticism about these practices continued as well. As Reginald Scot recorded in 1584:

The corrall presi’veth such as beare it from fascination or bewitching, and in this respect they are hanged about childrens necks. But from whence that superstition is derived, and who invented the lie, I knowe not: but I see how readie the people
are to give credit thereunto, by the multitude of corrals that waie employed. (Nicholson, 1886, p. 239)

Many museums have rattle-like objects incorporating coral; described as “teething sticks”, they were designed for the entertainment of infants and to ease teething. Surviving portraits of children include many examples of children wearing coral necklaces (or sometimes bracelets)—including many paintings of an infant Christ, so attired (see Appendix 1 for representative examples of all of the above). While there are other, plausible rationales for the presence of these objects—to ease teething, or explaining their appearance in paintings as symbols of prosperity—their ubiquity suggests something more at work, a passive if not an active belief in their magical efficacy. Their presence as status objects would not adequately explain the frequency with which they appear, given coral’s status as “semi-precious”, or explain the relative absence of a greater diversity of more expensive ornaments in children’s portraiture.

Surviving apothecary shop records show that coral was widely available in London in the seventeenth-century, either as raw ingredients for those who made their own remedies, or in higher priced pre-mixed compounds available to the wealthy (Harris, 2009, see also Appendix 1 for numerous examples of pharmacy containers for coral powders, syrups, and tinctures). Every apothecary record reviewed by Harris contained multiple entries for coral, which was one of the most common items in a range of forms, grades (fine, middle, coarse, worst) and colors (2009). While the most expensive coral remedies likely continued to be used primarily by the wealthy, the scale of the medical trade in coral suggests that it was a relatively common part of medical treatment more widely. Nor was it abandoned by the upper classes even as the frequency with which it was used by middle class patients likely increased. In 1663, a compound of red coral and
pears was made by the court pharmacy for the queen of Denmark, and records show Louis XIV of France taking a similar compound in 1664 (Kunz, 1913, p. 126, 133).

**Early Modern Coral Medicine**

Scientific advances during the early modern period began changing the relationship between people and corals, but did not rapidly overhaul how they were used in the practice of medicine or alter convictions about their efficacy. Both white and red coral were called for in recipes from *The Royal Pharmacopeea [sic]* in 1678, including in compound medicines to prevent plague and infection, in a powder “of great use to fortifie the Stomach, create an Appetite, and expel Wind”\(^\text{16}\) (Charas, 1678, p. 120); one to treat “diseases that proceed from weakness” (Charas, 1678, p. 122); and one used to treat “malignant Fevers, and all Epidemic Distempers, and against all sorts of Poysons” (Charas, 1678, p. 126; 128). In 1720, Culpepper’s *Pharmacopoeia* had the following to say about coral:

Red coral is cold, dry and binding, stops the immoderate flowing of the Terms, Bloody Fluxes the running of the reins and the Whites in women, helps such as spit and piss blood, helps Witchcraft, being carried about one. It is an approved remedy for the falling sickness. Also if ten grains of red coral be given to a child in a little breast milk as soon as it is born, before it takes any other food, it will never have the falling sickness nor convulsions. The common dose is from ten grains to thirty. Also [both pearls and] red coral preserve the body in health, and resist fevers. (Culpepper, 1720, p. 48)

These uses are closely aligned with those proposed by ancient scholars, illustrating the remarkable stability of beliefs about the medicinal properties of corals. It also appeared in other treatises—the 1722 *Pharmacopoeia officinalis* contained detailed instructions for those interested in making coral salts or tinctures, recommended both “Venice treacle”

\(^{16}\) This recipe also continues the association of coral medicine with the heart and spleen, as “it is particularly appointed for maladies of the liver and spleen…[and] weaknesses and Faintings of the Heart” (p. 120).
(theriac) and other coral remedies for treating fever, particularly fevers “which precede the Small Pox and Measles”, as an antacid, as an alexipharmic (a substance which would ward off infection or poisoning, an antidote, a prophylactic), and as part of a compound medicine “affirm’d to cure green Wounds almost immediately; to strengthen sprain’d and luxated Limbs; to heal bruises” (Quincy, 1722, p. 609, 627, 473, 528). It was also listed as an ingredient in electuaries (medicinal substances or potions mixed with sweeteners, usually honey), including one intended to treat hemorrhages, fluxes, and ruptures, and one for miscarriage (Quincy, 1722, p. 599).

Corals also continued to be strongly associated with women’s health. The 1678 *Royal Pharmacopeea* includes it in the “Alabaster Plaister” which included white-lead, yellow wax, alabaster, amber, red coral, human skull, burnt harts-horn, and turpentine, which is “very much recommended against Abortion of Great-Belly’d women…for it strengthens the Ligaments of the Matrix, and the parts to which they are fix’d” (Charas, 1678, p. 262). The *Pharmacopoeia officinalis* (1722) called for coral as an ingredient in the “Electuarium contra Abortum”, which “greatly strengthens Women in Child-bearing, and helps them to sustain the Load, that otherwise might thro Weakness fall away before its due time” (Quincy, 1722, p. 599). It also appears as a plaster to prevent miscarriage, which “may be laid both upon the Belly and Back, where there is any apprehension of Miscarriage, and likelihood to prevent it; otherwise Strengtheners do mischief” (Quincy, 1722, p. 655). It was also featured in the 1766 publication of *The Compleat Housewife*, as part of a recipe to prevent miscarriage. The treatment called for combining dragon’s blood (a red plant resin), red coral, ambergris, and East-India Bezoar. It instructs:

…make all of these into a very fine Powder, and mix them well together, and keep them close in a Box; and if you are frightened, or need it, take as much as a
Time as will lie on a Penny, and keep very still and quiet… Take it in a Morning fasting, and at Night going to Bed; this do ‘til you are out of Danger… (Smith, 1766, p. 294)

First published in 1684, Aristotle’s Masterpiece—a sex manual and mid-wifery book which was in print continuously through the late nineteenth century—also included coral as a treatment for “immoderate fluxes”, citing Galen as an authority, and as a component of a plaster to prevent miscarriage, and a treatment for spitting blood (Pseudo-Aristotle, 1704, p. 85, 120, 139).

This continuity of belief in coral-based cures endured through the public acceptance, beginning around 1750, that coral was, in fact, an invertebrate animal rather than a plant. The degree of continuity is perhaps particularly remarkable in light of other fairly widespread changes to the practice of medicine taking place around the same time. The fifth London Pharmacopoeia, published in 1746, was edited with the intention of removing folk and magical remedies, and while changes included eliminating the use of human fat, spider webs, moss from human skulls, unicorn’s horn, and virgin’s milk as recommended medicinal treatments, coral remained a medically sanctioned remedy (Porter, 1999, p. 269). The 1760 edition would also remove theriac, which often contained coral, partly as a result of physician William Heberden’s 1745 treatise decrying it as useless and “a heap of discordant simples”, but coral would continue to be a popular remedy and ingredient in other compound medicines, included in many medical texts, well into the nineteenth century (Norton, 2006, p. 60).

Although theriac was no longer in common usage, during the eighteenth century coral medicine would undergo a period of intense popularity in England as a component of “Grascoign’s Powder” (also sometimes rendered as “Gascoingne’s Powder”), a famous cordial medicine named for the physician who compounded it. Grascoign was
said to have profited more than £50,000 from the sale of this remedy, which reportedly contained “Oriental bezoar, white amber, red coral, crab’s eyes, powdered hartshorn, pearl and black crab’s claws” (Kunz, 1913, p. 128). Although this preparation was likely primarily used by elites, given the rare ingredients and high cost, an 1836 pharmacological treatise differentiates between “true” Grascoign’s powder, which included bezoar, and “common” Grascoign’s powder, which still utilized coral but forwent some of the other costly ingredients (Gray, 1836, p. 470, 472). The powder became so well known as to have been a meaningful cultural reference, at least among the elite: In a 1759 letter, Horace Walpole, fourth earl of Orford, told his correspondent that he had managed to embarrass and torment an enemy in attendance at a ball sufficiently that: “In short, I believe we made him take a double dose of Grascoign’s powder when he went home” (Cunningham, 1891, p. 221). In 1722, the Pharmacopoeia officinalis suggests an alternative powder, also containing coral, as “much better than the Gascoign’s Powder,” and adds, rather tartly, that “some have the Courage to prescribe it in its stead”, suggesting that name recognition and reputation were significant drivers of consumption, and that patients might have been resistant to proposed alternatives (Quincy, 1722, p. 483).

Coral-containing remedies also appear in The Compleat Housewife, published in 1766. The contents of this book include “receipts” [recipes] for cookery, pickles, pastry, cake, preserves, wines, cordial waters and powders, and medicines and salves (Smith, 1766). The inclusion of medical instruction in the cookbooks of the time conveys the extent to which medical treatment was not considered solely the province of physicians or medical professionals; indeed, a familial arsenal of medicinal recipes was
indispensable. The preface observes that in addition to providing assistance in caring for the reader’s own family, they are “very proper for those Generous, Charitable, and Christian Gentlewomen that have a Disposition to be serviceable to their poor Country neighbors, laboring under and of the afflicted circumstances mentioned” (Smith, 1766, p. 3). *The Compleat Housewife* recommends coral as an ingredient in a cordial for “cases of the greatest illness; two or three spoonfuls almost revive from death”, but also for making necklaces for children used “in cutting teeth”¹⁷, a treatment for heartburn, as an ingredient in a cordial to treat “trembling at the heart”, as part of “a Powder for convulsion fits” which further notes the value of giving it to newborns, as well as to older People “as much as they have Strength and Occasion”, as part of the recipe for Gascoigne’s Powder, and to prevent miscarriage (Smith, 1766, p. 234; 259; 279; 303; 323; 320; 294).

A similar popular medicine, “Lady Kent’s remedy”, called for white coral (among other ingredients). A relatively early recipe from *The Royal Pharmacopoea*, published in 1678, was as follows

Take the Sea and the River-Crabs in the Month of June, while the Sun is in Cancer. Take and cut the Flesh from the extremities of the Claws, bruise the Claws and Crabs-Eyes in a Brass-mortar first, then grind them upon a Porphyrie, moist'ning them with some Cordial-water; and spread the Powder upon clean Paper, to be dry'd in the shade. Prepare the Pearl, Coral, and Amber-grise in like manner. Beat the Bezoar in a Brass-Mortar, and mix all the Powders. Then in a glaz'd-Earth'n-pot over a very gentle fire, boyl four large Vipers, well prepar'd, in a pint of Balm-water, till the Broth be reduc'd to the consistency of a Gelly. Strain it and press out the Vipers. Then put the Powders into a great Marble-Mortar; and when they have suckt up the Honey prescrib'd, add at several times the Gelly of Vipers, till the whole Mass be become thick and solid enough to make Trochishes, to be dry'd and us'd as before. (Charas, 1678, p.118)

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¹⁷ Interestingly, unlike many other formulations in which coral itself is used in teething, this recipe calls for soaking pieces of root cut into beads in a solution of coral and peony-root powder for more than a day before rubbing children’s gums with it (Smith, 1766, p. 259).
It goes on to add that this medicine is famous and in demand in England “against Epidemic Distempers, particularly against the Small-pox, and Measles. It is also highly commended for the Plague, as well to preserve, as cure” (p. 118). It is credited with strengthening the heart “and all the Noble-parts” against these diseases, “Pestilential-Air”, and infection (p. 118).

Although these remedies were popularly used and esteemed by notables during the eighteenth century, they also increasingly became the target of skeptical critique. In 1849, Eliza Cook used Lady Kent’s Powder as an example of “absurd ‘carmins’ of quackery” and observed that “accordingly we find no end of curious and extravagant preparations, the really useful components of which are masked in a crowd of unnecessary ones” (Cook, 1849, p. 412). Similarly, a pharmaceutical manual describes it as “a cordial formerly in great esteem” (Hooper, 1860, p. 325), and Dr. William Lewis reports on behalf of the medical establishment that “notwithstanding the addition [expensive ingredients, particularly bezoar] made to the price [of Gascoigne’s powder] it added nothing to the virtue of the medicine” (Lewis, 1786, p. 551). Although there is a tendency to imagine the history of medicine as one of steady progression towards an empirical and rational present, and several sources from the mid-nineteenth century describe these coral-containing remedies as unappealingly old fashioned, it is worth remembering that the longevity of coral medicine has also frequently been used to validate the efficacy of these practices, and that skeptics of coral medicine have a history

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18 Hooper also mentions a “celebrated anti-epileptic powder formerly in use” which included peony, mistletoe, elk’s hook, human skull, red coral, and sugar, among other ingredients (1860, p. 1398).

19 Although Lewis is here referring specifically to the inclusion of bezoar as increasing the price without adding anything medicinally, the fact that the new recipe he offers to replace Grascoigne’s powder also omits coral suggests that it was similarly considered a costly but unnecessary addition; however, coral appears elsewhere in the same work as an approved remedy (1846, p. 85-86).
as long as that of coral medicine itself, without having much discernible impact on belief in efficacy or popularity.

In 1846, Adams reported that “the red coral held a place in our English dispensatory until a recent date. It was much used in infantile convulsions. It is still admitted to be a good antacid” (p. 188). Here he both dismisses red coral and cites an ongoing medicinal use for it; while on the same page he includes The Electarium de Gemmis, in which coral is an ingredient, recording that it “is said to be most efficacious in cold affections of the brain, heart, stomach, liver, and womb; an excellent exhilarant and cordial; and restorative in palpitation of the heart, and syncope” (p. 188). In fact, coral continues to crop up as a treatment for many of the illnesses it was recommended to treat historically. Coral continued to be seen as a potential antidote to poisons, with Orfila’s popular 1818 treatise on poisoning reporting that while the best remedy was magnesia, if it was not available, “Spanish white or chalk, pulverized coral, crabs eyes, prepared pearls, or burnt hartshorn diffused in water, in any quantity, may be extremely useful” (p. 13). It also remained associated with treatment of dental ailments, included in a recipe for a “Electuary for the Teeth” which included red coral, cuttlefish bone, cream of tartar, and honey, among other ingredients, to “whiten and preserve the teeth”, though it is “most serviceable in foul or scorbutic gums”; it also appears in recipes for dentifrices intended mostly for cosmetic purposes (Cooley, 1846, p. 263, 461, 487).

An association with mental well-being and mental illness also continued. In 1907, Psychology of Botany, Minerals, and Precious Stones asserted that coral would “benefit decrepit persons and those prematurely old” and could further be used to treat poor

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20 Orfila also did not hesitate to go after those he considered unscrupulous medical professionals, writing, “It is much to be desired that patients would so far consider their own good, as to avoid consulting quacks, who fearlessly undertake to cure the most serious diseases” (1818, p. 67).
eyesight caused by “gradual loss of energy in the optic nerve” and would “strengthen the mental faculties” (Kozminsky, 1922, p. 428). In the late nineteenth century, occultist and doctor Franz Hartmann asserted:

I know of some cases of melancholy, depression of mind, hypochondria, &c., that have been successfully treated by the wearing of red corals, while other articles employed for the same purpose had no effect, and the cure could therefore not be attributed merely to the belief of the patient. The ignorant will find it easier to ridicule such things than to explain them. (Hartmann, 1896, p. 81)

This reliance on irrefutable (by virtue of being unscientific) testimonial and anecdotal evidence would continue to be used to support the marketing of medicinal use of corals through the present day. Although the large range of miraculous properties assigned to coral had been somewhat curtailed by the end of the nineteenth century, they were still at least occasionally employed for both medical and folkloric or magical purposes in many parts of the world.

At least some illness that would previously have been seen as being related to evil spirits or possession were increasingly likely to be recognized as having roots in physical illness. Although it is likely that in the early modern period the depth of belief commonly held about the use of witchcraft and the dangers of the evil eye—a malevolent gaze or stare which would lead to harm to the recipient—were reduced, there is plenty of evidence that coral continued to be used in charms and amulets, particularly in Italy, where there was a long history of coral’s use in warding against the evil eye. In order to exercise power in protecting against “spells, or enchantments, coral must be worn where its brilliant color makes it conspicuous” (Kunz, 1913, 69). “In Italy the coral was also called the Witch Stone, because it was said to protect women from the wizards and men from the witches” (Kozminsky, 1922, p.174). Corals, and teething sticks containing coral, continued to appear in portraits of children. These teething sticks, which typically had
small bells on them as well, may have served the practical purposes of amusing babies and giving them an object to gum, but in 1844 Pettigrew noted that

the bells affixed to the coral toy with which children used formerly to be generally arrayed have been conjectured to have been attached for the same purpose [of protecting against the evil eye] as the ringing or rattling of them have been esteemed inimical to witches, sorcerers, &c. (p. 32)

The historical association of coral and bells with warding off of the evil eye suggests that, as in many other uses of coral, these practices are more fully comprehensible in their historical context.

Belief also continued in coral’s quasi-magical properties to take on the wearer’s characteristics, as Kozminsky (1922) reports that “[i]t is a fact that coral is affected by the health of the wearer” (p. 174). That this belief, expressed in several sixteenth century sources discussed above, continued unchanged until 1922 suggests that even some of the more implausible properties of coral were not rapidly or casually abandoned.

In fact, these beliefs and practices were long lasting, resilient to criticism, and endured even in the absence of empirical evidence or firm belief in efficacy. In ancient Rome, Pliny recorded that “Branches of coral, hung at the neck of infants, are thought to act as a preservative against danger” (Pliny, 1896, p. 70). Almost 1500 years later, Camillus Leonardus wrote that he had

…often experienced it myself, that it [coral] will prevent infants, just born, from falling into an epilepsy. Let there be put in the mouth of the Child, before it has tasted any Thing, half a scruple of the Powder of Red Coral, and let it be swallowed; for it is a wonderful preserver.” (Leonardus, 1750, p. 83-84)

Culpepper suggested coral as a treatment for numerous childhood ailments, including epilepsy, but also for babies who consumed corrupt milk, as a “strengthener” for babies,

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21 Kozminsky (1922) similarly records that “[l]ittle bells were also attached in the Middle Ages to children’s coral charms in order to ward off evil spirits, storms and pestilence, and scare away the Furies; this same belief exists in Japan, China and other countries” (p. 174).
to treat fevers and nightmares in children (both internally or as an amulet), and as a preventative against witchcraft (1762, p. 323, 257, 317, 315, 336). Napier reported at the end of the nineteenth century that “[c]oral beads…are still used in country districts to protect [babies] from an evil eye” (Napier, 1879, p. 36). Even where conscious belief no longer exists, traditions may endure. Thus:

Educated people give [coral to babies] from custom and not from superstition, but if an inquiry were held into the beliefs of nineteenth-century nursemaids (a stupendous undertaking, on which I do not propose to embark), I think it would be found that some at any rate held that the coral was in some mysterious way “good for the child.” (Pain, 1896, p. 862)

Nor are these beliefs confined to the distant past—Bromehead reported in 1947: “The value of coral to prevent convulsions in babies is not yet quite forgotten, though we do not encourage the swallowing of it.” (p. 81-82).

**Coral Medicine in the Non-Western World**

For Western scholars, exploring the role coral medicine played in non-Western medical traditions poses challenges, as few relevant historical records are written in English, and translations, particularly for obscure texts and non-Western languages are scarce. In no way should this brief discussion of coral medicine in India, China, and the Arab world be considered comprehensive. However, even English language sources suggest that coral was highly valued in the non-Western world, including for magico-medicinal purposes. Indeed, many English language authors drew on “exotic” medical traditions as evidence for the value of medical treatments, reporting both the kinds of use (“the Tamool practitioners prescribe it, when calcined, in cases of diabetes and bleeding piles. The Arabians place it among their astringents and cordials”) and the relative value

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22 As Culpepper observes “There are many superstitious things carried about against witchcraft; some hang amber and coral about the child’s neck, nor is it impossible that plants and gums should have power against Witchcraft” (1762, p. 336).
pearls and other precious stones have always been highly esteemed by the Hindoo physicians”) (Adams, 1846, p. 188; 474). In the West, exotic origins or authorities might be used to make a particular cure seem either more efficacious or more valuable (and costly).23

The numerous types of traditional Indian medicine (TIM) practiced today have found many uses for corals. As I have outlined, this interest and use is not at all new. The demand for precious corals from the Mediterranean in ancient India led Pliny to observe that

The berries of coral are no less esteemed by the men in India than are the pearls of that country by the females among us: their soothsayers, too, and diviners look upon coral as an amulet endowed with sacred properties, and a sure preservative against all dangers: hence it is that they equally value it as an ornament and as an object of devotion. (Pliny, 1857, p. 70)

Of course, it is impossible to argue that a “sure preservative against all dangers” does not also represent a powerful prophylactic medicine. Demand in India for Mediterranean corals, and the high prices they commanded there, has been used by some authors to explain the relative dearth of coral artifacts and jewelry from ancient Greece and Rome (Marzano, 2013, p. 163).24

Although corals were undoubtedly used in jewelry and amulets in India, they were also likely consumed as medicine (and still are).25 The ash form of corals, known as Pravala Bhasma, is used in Ayurvedic medicine to treat asthma, chronic bronchitis,

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23 For instance, the 1722 Pharmacopoeia officinalis noted of the Goa Stone, a medicinal object usually imported from India, that, “[t]he chief reasons that of our own Make is not so much in esteem, is because we…are more apt to admire what comes a great way” (Quincy, 1722, p. 530).
24 Similarly, Gibson reports that coral was once used “to decorate the helmets and weapons of the soldiers of Gaul, but when its value in India became known, most was traded in the east in exchange for pearls” (2015, p. 118).
25 It seems likely that at least some of the same beliefs about efficacy and color were also applied, as “Oriental mystics warn against the wearing of dull, dirty, or discolored specimens” (Kozminsky, 1922, p. 175).
tuberculosis, fever, urinary diseases, spermatorrhoea, gonorrhea, carbuncles, headache, giddiness and vertigo. Coral ash may also be used in preparations for treatment of cancers of the breast, lungs, stomach and uterus, and in treating anemia and jaundice. In the Siddha system of medicine, coral derivatives may treat loss of appetite, polyphagia, delirium, eye diseases, rickets, diabetes, skin diseases, ulcers, sepsis and leprosy—at least some of the illnesses coral is proposed to cure are similar to those uses for which it was employed in Europe (Gopal, Vijayakumara, Venkatesan, & Kathiroli, 2008).

Practitioners of traditional Chinese medicine use corals to prevent bleeding, relieve pain and stop convulsions, as well as to improve mental health (Bai, Chen, Chen, Lei, & Shi, 2011). These practices date at least to the Tang Dynasty (618-907) as the Tang Ben Cao (Tang Materia Medica) included red coral (Fu et al., 2016). Coral was also appreciated in China as a protective amulet around the twentieth century, as Kunz reports:

> Coral was used in Chinese amulets; diamond, ruby, emerald, pearl, coral—“an amulet containing these five substances is thought to combine the protecting influences of the different deities presiding over them, and is supposed to lengthen the wearer’s life. (1913, p. 40)

Many traditional practices and treatments are currently under scrutiny as a result of the increasing interest of the Chinese government in promoting research which will use the scientific method to test the assumptions and practices of Traditional Chinese Medicine (Qiu, 2007).²⁶

As discussed above, coral medicine in the Arab world dates to antiquity, and there was clear interchange among Greek, Roman, and Arabic-speaking medical practitioners.

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²⁶ At least one medicinal use of corals has been borne out by this type of research, as the bioactivity of black coral, when fashioned into cigarette holders, has been demonstrated to be potentially effective at reducing oxidative stress and bacterial infections resulting from smoke toxin exposure (Bai et al., 2011).
There is solid evidence beyond Maimoides and Al-Kindi that these practices continued. Al-Suyuti (d. 1505) included coral in his work on medicine based on the Koran and teachings of the prophet Muhammed, writing, “Almighty God has said that the best coral is the red coral. It is cold & dry. It acts powerfully on the heart, is good for palpitations, and is a carminative” (Elgood, 1962, p. 113).

**Modern Medicine and Corals**

Although skeptics had for thousands of years raised doubts about whether magical and medical practices associated with coral healing accomplished anything beneficent, these doubts did not eliminate belief in the protective quality of coral. In many parts of the world, traditional beliefs about coral’s medical or spiritual properties endure into the present. In the modern day Levant, many traditional pharmacological marketplaces still stock and sell coral for the treatment of eye ailments—as recommended by Al Kindi nearly 1200 years earlier (Lev, 2006).²⁷

In recent years, there has been significant interest in the ability of traditional practices to direct researchers to plants and animals likely to yield valuable compounds for pharmaceutical use. Marine invertebrates in particular have already demonstrated that they represent a rich source of potentially useful natural products ranging from anti-cancer agents to anti-fouling substances (Jensen, Harvell, Wirtz, & Fenical, 1996; Kim, Kim, Alker, & Harvell, 2000; Cooper, Hirabayashi, Strychar, & Sammarco, 2014). Many of these products are also likely to have significant monetary value.²⁸ Unfortunately, the

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²⁷ Medical traditions are often enduring: of 48 animal-derived products used medicinally in the Levant from the 10th to 18th centuries, only a few have been wholly abandoned, usually because of rarity or changing social norms (Lev, 2006).

²⁸ Even research which fails to identify compounds of pharmaceutical value may prove profitable. Pseudopterosins, which are extracted from the gorgonian coral *Pseudoterigorgia elisabethae*, have anti-inflammatory and analgesic properties. These extracts are now used as topical agents in an Estee Lauder skin care product and generate royalties of $3 to $4 million per year (Bruckner, 2002).
exploitation of sources of traditional medicine for drug development—in spite of the potential to help large numbers of people—has also created controversy and generated thorny ethical issues resulting from the intellectual property rights (or lack thereof) of the communities whose ecological knowledge is being exploited (Shiva, 2016; Greene et al., 2004; Timmermans, 1982).

Marine bioprospecting is still a relatively small industry, but coral reefs have demonstrated the potential to contribute significant new compounds to medicine. Although the development of new treatments through bioprospecting is limited by the speed with which samples can be collected and analyzed, the relatively low abundance and slow reproduction of some species of interest, and low yields of the compounds being analyzed, bioprospecting on coral reefs has already yielded promising compounds for enhancing human health (Bruckner, 2002). Hydroxyapatite (HA), produced by corals, can be used as a graft to facilitate bone regrowth (Suchanek & Yoshimura, 1998). Sarcophytols A and B, which were isolated from the soft coral Sarcopyton glaucum, inhibit tumor growth (Fujiki et al., 1989). Eleutherobin, a cytotoxic agent, prevents the reproduction of cancerous cells through the formation of long, rigid microtubules similar to those formed by the cancer drug Taxol (Long et al., 1998). Secosteroids, enzymes which corals use to combat disease, are being developed to treat inflammatory diseases like asthma and arthritis. However, they may have much broader applications, as they have been demonstrated to have anti-proliferative, anti-fouling, anti-viral and anti-microbial characteristics as well (Sica & Musumeci, 2004).

Scientifically validated biomedical research is far from the only modern use to which corals are put for their protective qualities or as medicine. The ways in which
Corals have been used medicinally throughout history may sometimes appear strange and even laughable to modern eyes. However, they are probably no more bizarre than the claims made by present day peddlers of “coral calcium” health supplements. These supplements have been a source of ongoing conflict between the Federal Trade Commission and makers, marketers and suppliers of coral calcium, particularly Robert Barefoot, the “doctor” who is the face of Coral Calcium Daily and Coral Calcium Supreme, and his partners. While this might seem like a fringe practice in the modern United States, the scale of their sales suggests that this industry could have a significant impact on coral reefs, which are already tremendously stressed globally by changes to the climate and chemical composition of the ocean (Baker, Glynn, & Riegl, 2008). Sales for this marketing organization, over as 18 month period, were valued at $54,034,395.00.

These supplements, which advertise that they are mined from (extinct) Okinawan coral reefs, cost substantially more than chemically identical lab-created calcium supplements. Advertising materials may claim that coral calcium is more “bio-available” or even “body-preferred”. As so many other people extolling the medicinal properties of coral before them, modern marketers rely on both a long history of use and on

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29 The extent to which these practices are harmful to living reefs is uncertain, as details on how many companies harvest coral for their supplements is not available. That said, data does suggest that the methods used (discussed further below) including dredging in the vicinity of reefs and near-shore mining, have potentially substantial impacts on water quality and coral morbidity and mortality (e.g., Dodge & Vaisnys, 1977; Pollock et al., 2014; Brown & Dunne, 1988; Dulvy, Stanwell-Smith, Darwall, & Horrill, 1995).


31 For an example that claims it is “bio-available” see http://www.coralcalcium-watchdog.com/facts.htm (visited 6 June 2017); “body-preferred” see https://swansoneurope.com/en/swanson-coral-calcium-complex.html (visited 6 June 2017); screenshots of both websites available in Appendix 1.
exoticism\textsuperscript{32} to help sell coral calcium supplements. In some cases, they throw back to aange of ancient beliefs, as in this case—the explanation of what coral can accomplish
recalls promises that coral tied to fruit trees might yield a more bountiful harvest:

Well, it [the medicinal properties of coral calcium] sort of was discovered by the
Japanese themselves about 800 years ago. It was obvious because the chickens,
when they pecked the coral reefs, would have twice as many eggs. The cows
licking it would have three times as much milk, and it was delicious milk,
delicious eggs...so they dug it up, put it on their crops, and they recorded a 400
percent increase in rice crops as soon as they started putting it on. So, they started
eating it. And it took a while before they realized what was happening because,
you see, all of a sudden, all diseases disappeared. People started living
incredible.\textsuperscript{33}

It goes on to claim that Spanish explorers came to Okinawa 500 years ago and brought
back ships full of coral sand to Spain, where it was renamed coral calcium and became
“the very first drug dispensed from a drugstore”.\textsuperscript{34} Although this description of coral’s
historic use in medicine is incorrect in many particulars, and grossly incomplete, it seems
clear that historical uses of coral for medicinal purposes may be applied unscrupulously
to support modern uses.

Moreover, these uses have not necessarily become any more scientifically
credible. The infomercial which was the primary tool for marketing this brand of coral
calcium further claimed that,

We’ve had people in a few weeks get out of wheelchairs, MS patients get out of
wheelchairs for—there are remarkable results. And, yes, we have people who are

\textsuperscript{32} This is also not a new technique, as the exotic origins of medicines have been used as evidence of value
and efficacy for centuries. In the early sixteenth century, Paracelsus decried the same impulse: “where do
you go looking for it [cures for disease]? Beyond the sea of the heathens? Oh, you simpletons, it lies before
your very houses and within the circular walls of your cities” (Weeks, 2008, p. 228). As mentioned above,
the 1722 \textit{Pharmacopoeia officinalis} noted of the Goa Stone, a medicinal object usually imported from
India, that, “[t]he chief reasons that of our own Make is not so much in esteem, is because we…are more
apt to admire what comes a great way” (Quincy, 1722, p. 530).

\textsuperscript{33} FTC Exhibit B (Transcript of Exhibit A videotape) June 10, 2003, p. 8. Available at
https://www.ftc.gov/enforcement/cases-proceedings/032-3064/trudeau-kevin-et-al.

\textsuperscript{34} FTC Exhibit B (Transcript of Exhibit A videotape) June 10, 2003, p. 9. Available at
https://www.ftc.gov/enforcement/cases-proceedings/032-3064/trudeau-kevin-et-al.
documented as terminal cancer patients that now say the oncologist says the cancer is gone away. I mean, it’s remarkable.\footnote{FTC Exhibit B (Transcript of Exhibit A videotape) June 10, 2003, p. 15. Available at https://www.ftc.gov/enforcement/cases-proceedings/032-3064/trudeau-kevin-et-al.}

This recalls many of the sweeping promises of miraculous cures associated with theriac during the Middle Ages; although not plague, the substituted modern diseases are similarly deadly and incurable. Of course, as the FTC observed, the claims made on behalf of coral calcium in this infomercial are “extrapolations, distortions, and sometimes, seemingly, utter fabrications”.\footnote{Opinion and Order, October 21, 2010, p. 18. Available at https://www.ftc.gov/enforcement/cases-proceedings/023-3138/direct-marketing-concepts-inc-et-al.} According to the infomercial,

> Over 200 degenerative diseases are caused by calcium deficiency. That includes cancer, heart disease, diabetes, Alzheimers', you name it. These diseases are caused by acidosis — acidification of the body — lack of minerals, especially calcium. When you start taking coral calcium, your body alkalizes and drives out the acid.\footnote{FTC Exhibit B (Transcript of Exhibit A videotape) June 10, 2003, p. 15. Available at https://www.ftc.gov/enforcement/cases-proceedings/032-3064/trudeau-kevin-et-al.}

This does not make sense, medically speaking, and runs afoul of US laws which prohibit marketing nutritional supplements—which are not tightly regulated or required to prove medical efficacy—as drugs intended to treat or prevent disease.\footnote{Simply put, the difference here is between marketing a supplement with the phrase “supports heart health” and using the phrase “prevents heart disease” or “cures heart disease”. The first would be within the law and the second two formulations would not.} As the FTC argued, these claims violated the law, given that a “statement that studies prove a product cures a certain disease, followed by the disclaimer that the statement is opinion and the product actually does not cure the disease, leaves an overall impression of nonsense, not clarity”.\footnote{Opinion and Order, October 21, 2010, p. 23. Available at https://www.ftc.gov/enforcement/cases-proceedings/023-3138/direct-marketing-concepts-inc-et-al.}
a “conspiracy by the traditional [scientific] medical community and the pharmaceutical industry to keep this information [e.g., coral calcium’s ability to cure cancer, MS] from the public”.40 This process of offering hope when other treatments have failed, however ill-founded, has been at the heart of (quasi-magical) coral treatments for millennia. These marketers promise that “with just three little capsules a day” patients will see “miraculous” results.41 The marketers go on to claim that,

Modern medicine has lost every war on every degenerative disease so badly, and the future looks dismal. There’s no hope at all with modern medicine because they’re looking for a white powder chemical.42 And here we have something that’s not manmade. God made coral and it works. It’s a magic mineral.43

This sentiment would have been entirely familiar to Lemnius, who wrote in the seventeenth century about the natural characteristics of cures which proceed from God—and to the many authorities, well-meaning or entirely profit driven, who from ancient times to the present, have made promises to the ill about the “magic” and “miraculous” healing properties of coral.

If this were merely a matter of ill consumers being preyed upon, it would largely be a matter for the Federal Trade Commission to regulate. However, the history of coral medicine, the present condition of global coral reefs, and the massive scale of the supplement industry create cause for conservation concern.44 Historically speaking,

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42 My sense of irony demands that I note here that, of course, the coral calcium being marketed by this infomercial is indeed white, a powder, and a chemical.
44 The dietary supplement industry is large and growing, estimated to reach $278 billion/year by 2024 (https://globenewswire.com/news-release/2016/07/18/856668/0/en/Dietary-Supplements-Market-Size-Is-Projected-To-Reach-278-02-Billion-By-2024-Demand-In-Food-Beverage-Sector-Grand-View-Research-Inc.html, accessed 10 June 2017). Moreover, one industry website reports that “many companies such as Procter and Gamble, Source Naturals, Nature's Bounty and Coral LLC have discovered the uniquely great
distinctions in medicinal value of coral have been drawn most often based on color, but also potentially based on freshness or style of preparation. Kunz reports that “to retain its power...[coral] must not have been worked, and in Italy only such pieces are valued for this purpose as have been freshly gathered from the sea or have been cast up by the sea on the shore” (1915, p. 69). Thus there is historical resonance to Robert Barefoot’s assertion in his infomercial that there are “high” and “low” grades of medicinal coral calcium:

The low grade is what they call the fossilized stuff that they dig right off the beaches. You know, it’s been there for millions of years. And rain and wind have weathered it and washed out a lot of the nutrients...when they take it freshly from the ocean, it’s called marine coral. That has 12 percent magnesium and it’s loaded with all the other nutrients. The Japanese sell it for three, four times as much money as the low grade stuff.45

Before conservationists dismiss this resonance as coincidence, or argue that it has little functional effect beyond as a marketing tool, it is worth mentioning further that there is at least one company currently marketing itself as selling “living and vibrant” coral supplements that are “live harvested”, which their marketing materials claim “keeps its minerals intact”, unlike “dead and degraded” Okinawan coral calcium.46 This potential preference for fresher coral calcium suggests at least the possibility that the coral calcium industry may pose a threat to living coral reefs. Given the current progress of marine bioprospecting with corals and other invertebrates, there also remains the risk that

health benefits of coral minerals. All of these companies have managed to use coral in different ways, including in agriculture, cosmetics, sports, water enhancement, and more”. This suggests that the market for coral “wellness” products is not likely to be limited solely to the marketing of nutritional supplements in pill or powder form (https://coralcalcium.com/coral-llc-about-us/, accessed 10 June 2017).
scientific discoveries of potential medicinal compounds will be advertised and applied in non-scientific ways to further the marketing and influence of quack medicine.  

The current coral calcium supplement industry has taken pains to emphasize the extent to which they engage in environmentally friendly practices. Current marketing materials for the “Barefoot” line of products describe them as “ecologically harvested marine-grade coral from Okinawa”. Barefoot marketing further reassures the environmentally-minded consumer that their product “is meticulously accumulated from the bottom of the ocean where coral had broken off the reefs long ago. We do not in any way harm live coral or the reefs”. Another coral calcium company describes itself as using “ecologically safe” harvesting practices, and providing “above-sea coral”. The sellers of the Brazilian “live” coral supplements describe themselves as “environment friendly”, and say that their corals are “harvested without harming the delicate coral reefs”. In a rather baffling description, a European seller reports that “[b]ecause we take great care of the environment, our coral calcium has been derived explicitly from sources in the upper layers of the sea, so as to avoid affecting and damaging the natural coral reefs”. Clearly, there is a sense within the industry that downplaying the environmental impact of coral calcium supplements helps to market their products; however, the limited

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47 The example of shark cartilage is instructive here, as in the 1970s an academic paper suggested that chemicals extracted from shark cartilage might play a role in combatting tumor growth (Langer, Brem, Falterman, Klein, & Folkman, 1976). There is no medical basis for these findings being interpreted to suggest that consuming shark cartilage orally might help combat cancer, however, following media coverage of this discovery many desperate patients began taking shark cartilage supplements, which became so well-known as an alternative therapy that in the early 1990s as many as 80% of patients were asking their oncologists about the efficacy of supplementing cancer treatment with shark cartilage (Loprinzi et al., 2005).


regulation of the dietary supplement industry in the United States means claims about how and where these products are harvested are nearly impossible to validate.

The case against Barefoot Calcium was adjudicated nearly a decade ago, and substantial restitution was paid by those who engaged in misleading marketing. However, it does not appear that this precedent has meaningfully altered the landscape of advertising for these products, or even prevented Barefoot himself from continuing to sell them. In a 2013 interview, Bob Barefoot says that he is currently living in Costa Rica, because “the FDA and IRS want to put me in jail for telling people that they can cure themselves”; in explaining the negative press he has received, he claims that “the FDA, AMA and the drug industry pay enormous amounts of money to people who will write negative comments”. There is a clear implication that corporate pharmaceutical interests are trying to silence him to prevent knowledge of his “cures” for cancer and a range of other diseases from spreading. Rather than recognizing that these treatments are dismissed by nutritionists, doctors, and dieticians because they are not based in science, attempts to suppress this sort of quackery may actually be perceived by some as proof of efficacy. As of April 3, 2017, there are 410,000 google search results for “buy

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53 In case any doubt remained as to Robert Barefoot’s perspective on this issues, in 2005 he self-published a book entitled The Disease Conspiracy: The FDA Suppression of Cures.
54 At the conclusion of the interview, the interviewer offers a “Final note” which includes the following: “What shocked me the most though was the fact that Bob has been forced to leave the country he loves and move to Costa Rica, all because the FDA has a vendetta against him. I'm sorry to say folks that our freedom of speech and way of life as we know it is slowly being taken away from us. Big government and big business don't like it when someone rocks their boat. The fact that the FDA tries to throw someone in jail because they talk about the benefits of natural supplements, yet at the same time they allow drug companies to basically do whatever they like and get away with murder (yes I literally mean "murder"[...]). Personally, I commend people like Bob Barefoot, Mike Adams, Alex Jones and others who are willing to stand up to these thugs. Please give them your support so that our way of life and free-dom to express ourselves and speak our minds remains exactly that... free!” Another website advertising coral calcium expressed similar sentiments in response to a warning letter from the FTC: “Unfortunately, because of a recent letter received from the FTC, consumer testimonials are not allowed to be shared. It seems the FTC's
coral calcium” and on the first page of results, more than 50% of websites advertising products (8 of 15 sites) were for “Barefoot” coral calcium.

Recent bioprospecting for compounds of potential pharmaceutical value on coral reefs has begun to offer tremendous promise for drug development, but the history of the human relationship with coral medicine has more complex lessons for conservationists. Today’s consumers are no more immune to the promise of a “miraculous” medical fix than our forebears were, and there is the potential for the coral supplementation industry to expand further and in more ecologically damaging ways. While the knowledge about corals accumulated over centuries may guide us towards future medicinal uses, humans have sought, and are still seeking, more than potentially healing chemistry from our reefs—throughout history, we have turned to corals in search of protection, magic, and miracles. Conservationists ignore the power and emotional resonance of these traditions and emotions at the peril of surviving coral reefs.55

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55 Or they may ultimately find themselves, like Dr. John Renner, a member of the American Cancer Society’s Subcommittee on Questionable Methods, struggling to resist an already firmly established practice. According to a clearly frustrated and angry Renner, “[t]he only cure for [the myth shark cartilage cures cancer] is to spread the rumor that cartilage from the noses of quacks is anti-carcinogenic” (Mathews, 1993, p. 1191).
Chapter 5:

Newspaper Reporting on Shark Attacks in South Africa 1850-2000
Background

Since “Jaws” became the world’s first summer blockbuster in 1975, shark scientists and conservationists have been concerned about the impacts of the film on public perceptions of sharks. Research on human-shark relations has often mentioned the importance of the “Jaws Effect” in shaping public responses to sharks and shark attacks.\(^5^6\)

There are functionally two different ways of conceiving of this effect: as composed of facts that people believe about sharks (and shark attacks) as a result of “Jaws,” or of emotions or perceptions fueled by the movie’s narrative. Neff (2015) defines the “Jaws Effect” as three separate nested factual beliefs: that shark attacks are intentional (e.g., that there are “rogue sharks” that want to attack humans), that shark attacks are generally fatal, and that governments must act to respond to or prevent them (by killing the shark responsible). Other authors have used the same term to refer more generally to negative public perceptions and fears of sharks that may have been stoked by “Jaws” and subsequent movies about shark attack.

Human attitudes towards sharks have historically acted as a barrier to shark conservation, and sharks are perceived by some people as man-eating monsters (Dobson, 2006). Early research into sharks focused almost exclusively on limiting risks of shark attack for bathers or fishermen (Papson, 1992). This anthropocentric emphasis has continued to the present day, as current scientific research on sharks often focuses on the ways in which shark populations can be controlled or managed to benefit humans, either

\(^{56}\) The practice of describing encounters between humans and sharks as “attacks” is somewhat contested in the shark research world (e.g., Neff & Huetter, 2013). Without question, many shark bites are investigatory or accidental and not aggressive in nature. However, given that this chapter is concerned primarily with public discourse, for clarity I have opted to use the same terminology used by newspapers and victims to describe these events throughout.
in terms of generating fishery or tourism revenue or minimizing threats to human safety (Papson, 2002; Philpott, 2002).

Sharks are not the only animals facing this challenge: many apex predators suffer from negative public images and are reflected negatively in popular culture (Driscoll, 1995; Woods, 2000; Thompson & Mintzes, 2002). Representations of predators in the media have the power to influence outcomes of wildlife and conservation policies (Muter, Gore, & Riley, 2009; Jacobson, Langin, Carlton, & Kaid, 2012). Media coverage of sharks focused on shark attacks presents particular challenges, serving to amplify perceptions of risk through sensational headlines and photographs (Philpott, 2002; Peschak, 2006). Negative public attitudes towards potentially dangerous wildlife, amplified by media coverage of human-wildlife conflict, have the potential to limit conservation efforts and affect the status of populations (Newhouse, 1990; Kellert, Black, Rush, & Bath, 1996).

Studies have shown that media representations of sharks impact the success of shark management and conservation measures (Muter, Gore, Gledhill, Lamont, Huveneers, 2013; Ferguson, 2006). It is not yet clear the extent to which changes in media representations of sharks have occurred or are occurring; however, such changes may have broad and meaningful impacts on the conservation of shark species (Simpfendorfer, Heupel, White, & Dulvy, 2011). This chapter utilizes content analysis to explore changes to descriptions and framing of shark attacks, including the potential presence of a “Jaws” effect, in two newspapers based in Cape Town, South Africa over a long period of time (1850-2000). Factual accounts of the attacks are compared to

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57 This is part of a larger pattern of reporting on wildlife, as wildlife-related media coverage often highlights low-incidence, high-consequence events such as harm or mortality to humans (Corbett, 1995; Gore, Siemer, Scheufele, & Decker, 2005).
ecological and biological information and human demographic and behavioral shifts to explore how these trends both reflect and determine cultural discourse about sharks in South Africa. The chapter also assesses how reliable these media accounts of shark attacks are as a form of historical datum. Shifts in cultural and political responses to attacks are tracked over time, and placed in the context of contemporary changes in popular discourse.

**Sharks and Beaches**

A barrier to protecting shark populations worldwide is the growing economic importance of beach tourism. International travel and tourism, driven primarily by beach tourism, is worth $5.64 trillion to the global economy—a number larger than the GDP of all individual countries other than the United States (Houston, 2008). The prospect of sharks at popular tourist beaches can cause dramatic harm to cities and countries economically reliant on beach tourism. This, in turn, can serve to incentivize the extirpation of local shark populations near tourist beaches. Because popular tourist beaches are often located in sheltered nearshore waters, these areas may also represent critical habitat for sharks. This proved to be the case in some areas of KwaZulu Natal, where thousands of newborn Dusky sharks (*Carcharhinus obscurus*) were caught in bather protection nets until the area was abandoned as a nursery ground (Wallett, 1978).

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58 Following the series of attacks near Sharm-el-Sheik on the Red Sea, Egyptian government officials speculated that the spate of incidents was masterminded by Israel’s Mossad and that the sharks involved had either been trained to attack or were somehow being mind-controlled remotely by satellite tags. Although this seems highly unlikely, the destructive potential of these incidents is so great in regions heavily reliant on beach tourism that this would represent an effective economic attack were it technologically or behaviorally feasible (http://blogs.discovermagazine.com/discoblog/2010/12/13/shark-attack-in-egypt-must-be-the-work-of-israeli-agents/#.WdYyp2hSxPY).

59 Surfing beaches, on the other hand, are often located near areas of upwelling, where water movement produces both important nutrient exchange leading to biological richness (and sources of food for fish and the sharks which prey on them) and surfing waves.
Perhaps the most famous string of encounters between beach-goers and sharks took place off the coast of New Jersey in 1916. These attacks were the basis for the novel *Jaws* and exemplify the responses of coastal communities when their primary economic driver (beach tourism) is threatened. These attacks led to the building of steel “bathing cages” to protect swimmers, patrols by armed men in motor boats, the use of nets and dynamite to kill or frighten sharks, and rewards offered for sharks caught or killed (Capuzzo, 2002). The attacks are estimated to have cost resort and hotel owners approximately $250,000 in lost revenue—or approximately $5 million in 2011 dollars—and led to a temporary decline in beach use of as much as 75 percent in some areas (Allen, 2001).

Although these protective measures may seem extreme, similar responses occurred at other times and in other locations in response to shark attacks. A string of attacks on swimmers and snorkelers off the coast of Egypt near the resort town of Sharm el-Sheik in 2010 was met with beach and diving closures, a hunt for sharks in which sharks likely unrelated to the attacks were killed, and the temporary introduction of new “watch stations” and continuous boat patrols. In the aftermath of the attacks, the beaches were “deserted”—even of sunbathers—and tourists interviewed suggested that they would never return to the area or feel comfortable in the ocean again.⁶⁰ Beach tourism in the Red Sea region was Egypt’s largest foreign currency earner, bringing in as much as a reported 66% of the US$12.3 billion dollars per year tourists spend visiting Egypt.⁶¹

It is clear that the stakes involved in beach tourism are large and the potential economic harm inflicted by shark attack may prove to be enormous. Shark control

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⁶¹ Data from the CIA World Factbook, accessed November 21, 2011.
measures in KwaZulu Natal may be expensive—but beach tourism contributes approximately $1 billion per year to the local economy (Cliff & Dudley, 2011). Control efforts rely primarily on the use of beach nets intended not to act as exclusionary barriers, but to fish out local shark populations to levels at which sharks are sufficiently rare that they would be unlikely to pose a threat to beach-goers. Once large-scale shark protection measures are introduced, it is nearly impossible to remove them, given the pressures from industry and local government to protect tourism revenues (Dudley, 1995).

Incentives to reduce shark populations are likely to increase over the long term, despite increases over the last several decades in the popularity of shark diving tourism. In the Maldives, where tourist development was predicated on pristine marine environments and shark tourism, the relative importance of the dive and ecotourism industries has declined in recent years, particularly as more up-market beach resorts have opened. Only an estimated 15% of tourists now visit the Maldives primarily for diving, a significant decline from previous rates (Anderson, Adam, Kitchen-Wheeler, & Stevens, 2011). Dive tourists may generate incentives to conserve marine species; however, in the case of sharks these incentives are likely to be overbalanced by the negative potential of sharks to interfere with beach tourism and risks of associated liability (see chapter six). The continuing growth in demand for beach tourism further suggests that many beaches in a fairly undeveloped state will increasingly be exploited for tourism. There is ample evidence that beach crowding creates disutility for users, and that current recreational beaches are limited in their ability to absorb increasing numbers of beach tourists (Pompe & Rinehart, 1999). While Agardy (1993) argues that resort development may concentrate non-environmentally minded beach users at ‘megasites’ including the beaches of Cancun,
Miami, and the Cote d’Azur, growing populations and demand will undoubtedly necessitate the development of further similar locations, creating additional potential conflicts with shark populations.

**History of Shark Attack in South Africa**

In late 1957 and early 1958, the eastern coast of South Africa around the tourist resort of Durban endured one of the most severe spates of shark attacks on record. This series of attacks, during what became known as “Black December,” resulted in five fatalities between Christmas 1957 and Easter 1958. Occurring during the busy holiday season, these attacks were especially economically destructive, as tourists “began leaving their hotels, no longer prepared to risk their lives in the sea…before long thousands of holidaymakers departed in a mass migration, leaving hotels vacant for the remainder of the holiday season” (Wallett, 1978, p. 55). Hysteria reached such a pitch that the South African Navy minesweeper *Pretoria* was commissioned to drop depth charges and hand grenades into the water off South Coast beaches in an attempt to kill sharks. At the time, the costs of almost any shark-control program were “considered to be small in relation to the benefit which is derived by the City of Durban and its numerous visitors” (Davies, 1964, p. 87). This series of attacks drove the creation of a shark control program to protect bathers by removing shark populations, which continues to the present day. The attendant precipitous decline in shark populations has successfully reduced attack rates; however, there are growing concerns among the public about the ecological

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62 Unsurprisingly, this was not an effective approach to managing shark populations, as it primarily succeeded in killing large numbers of fish, which likely served as a shark attractant. *Cape Argus*, December 30, 1957, pg 1.

63 For some sense of how destructive this approach has been to local shark populations, see Wallett (1978, p. 47). As he reports, in 1952, Durban’s shark nets caught 552 sharks, or an average of two per day. In 1962, the same nets caught 107 sharks, or 0.3 sharks per day. A decade later, that number had fallen even farther, to 85 sharks per year (0.2 sharks per day).
impacts of this approach (Dudley & Cliff, 1993; see also the ongoing resistance to similar bather protection strategies in Western Australia, e.g., Gibbs & Warren, 2015).

There is a clear geographical difference in the treatment of attacks and attack risks between the Eastern (Port Elizabeth area) and Western Capes of South Africa, and between the capes and KwaZulu Natal, particularly around Durban, to the north (Figure 5.1). In spite of several high profile shark attacks, there has never been much support for the idea of shark netting in the Cape. Colder waters mean that swimmers and surfers spend less time exposed to risk, while the topography of the Western Cape makes cliff-side shark spotting programs possible. The different approaches taken by local governments may result at least in part from a different perspective towards the risks of attack; however, the Western Cape has also never had a spate of serious incidents in a short amount of time comparable to those which led to the adoption of shark control measures in KwaZulu Natal, and is less reliant on mass beach tourism as a primary economic driver (Dudley & Cliff, 1993).

Of course, non-lethal means of shark protection can also prove very expensive to operate. Spotter planes have been used intermittently throughout the country in an attempt to protect swimmers from sharks, but this approach is relatively ineffective and cost prohibitive. The introduction of cliff-side shark spotting as a method for preventing human/great white encounters in the Cape Town area has been met with acclaim by both local governments and conservation organizations. Shark Spotters watch over four beaches daily, and an additional two beaches during weekends, public holidays and school holidays. They report approximately 119 shark sightings per year.\textsuperscript{64} Given the

\textsuperscript{64} Unless otherwise referenced, all data on Shark Spotters comes from the program’s official website http://sharkspotters.org.za/, accessed November 3, 2011.
history of shark attack in the Western Cape—less than one (0.42) attack per year since 1905—the vast majority of sighted sharks pose no threat to beach goers.\textsuperscript{65}

\textbf{Methods}

Media research has long established the ability of mass media, including newspapers, to reflect popular views and opinions (Katz & Lazarsfeld, 1955; Jensen, 2003). Content analysis is an objective and systemic method for quantifying the ways issues are discussed in the media, providing valuable information about public views and perceptions (Kerlinger, 2000; Wimmer & Dominick, 2003). Content analysis is regularly applied to issues of concern to conservationists as a result of its ability to provide historical insight into complex environmental issues (Muter et al., 2009; Houston, 2011).

\textsuperscript{65} Data drawn from the International Shark Attack File, accessed November 15, 2011.
Bruskotter, & Fan, 2010); it is perhaps particularly appropriate for use related to sharks, given their status as mythic villains in popular culture.

For this paper, a comprehensive list of shark attacks was created for South Africa, drawn in part from data from the International Shark Attack File, but also using numerous printed sources including attack listings found in governmental records and Wallett (1978). Ultimately, 180 discrete “attacks” were identified from 1862 through 2000, ranging in severity from immediately fatal to those resulting in no injury to humans. Records for attacks prior to 1940 must be considered incomplete at best; however, there are adequate articles available to draw a suggestive picture of shifts in shark attacks and human perceptions of sharks over time. Attack dates were used to isolate microfilm records in the South African National Archives for the Cape Times and the Cape Argus, daily newspapers based in Cape Town, South Africa. Both morning and evening editions of each paper were scrutinized for attack coverage for seven days following attack dates, and all articles were labeled with their date and location within the paper and were reproduced by mimeograph.

Each article was then coded for a variety of information about the attacks themselves and how they were being reported. Some of these categories were used to gather factual data about attacks, including:

- Seasonal patterns in attack frequency
- Species of shark identified as responsible for attack
- Estimated size of attacking shark
- Victim age, race, and gender
- Victim activity at time of attack
- Persistence of attack
- Severity of injuries

In a randomized test of 20 articles, re-coding produced >90% agreement with previously performed coding, suggesting that the method of categorization is fairly robust.

This research also analyzed what information newspapers emphasized over time in reporting on shark attacks. This approach allows for analysis of a reasonably large article sample size (n=231 articles written about 180 discrete events) so that changing standards of what information is considered most relevant can be explored over time.

Information collected included:

- Total word count for articles
- Reported explanation for why attack took place (and explanation word count)
- Community response to attack (and community response word count)
- Victim responses to attack (and victim response word count)
- Language used in article titles

Although these categories are slightly more subjective than those providing simple factual data about the events being reported, recoding of 20 randomized articles still produced agreement >90%, suggesting that these coding categories can be applied in a standardized and replicable way.

**Results and Discussion**

**Factual Descriptions and Events**

Over time, newspaper coverage of human-shark interactions can reveal shifts in the actual events surrounding attacks and regarding the information reporters felt should be included in news coverage. This information also provides the opportunity to broadly
consider reporting accuracy in weighing the details of events as they are memorialized in the press (which for many of these attacks likely represents the best available historical data).

Approximately 45 percent of articles identified a species believed responsible for an attack. Sharks can be challenging to identify to the species level for non-experts, and common names may refer to more than one species or be misused, further confusing the issue. However, it seems clear that both eyewitnesses and reporters tend to identify charismatic and recognizable species as probable attackers more often than these species are likely actually responsible for attacks (see Figure 5.2). Fifty percent of articles identifying an attacking shark claimed that the attacker was a great white, though
behaviorally many of these attacks were more characteristic of other species. Only three species of shark are generally considered to pose a serious threat to humans: the tiger shark (*Galeocerdo cuvier*), bull shark (*Carcharhinus leucas*) and great white shark (*Carcharodon carcharias*) (West, 2011). Data from the International Shark Attack File suggests that these three species alone are responsible for 84.8% of recorded fatal attacks on humans, although combined they represent only 68% of total reported attacking species including non-lethal encounters. Newspaper coverage likely places too much responsibility on great whites for these attacks and too little responsibility on the bull and the tiger shark. It is also worth noting that the distinctive, fearsome-looking but docile ragged tooth shark (*Carcharias taurus*)—here held responsible for 13% of attacks—is unlikely to be the responsible species in at least some of these attacks, although they are known to bite when harassed. These findings suggests that even in cases in which sharks have distinctive appearances, habitat preferences or patterns of attack, both bystanders and reporters may be most likely to place responsibility on the few species with which they feel most familiar.

Witnesses to attacks and victims encounter similar difficulties when asked to characterize the size of attacking sharks. When using qualitative descriptions, people overwhelmingly identified attacking sharks as being large—in fact, only eleven percent of those characterizing the size of a shark said that it was “medium-sized,” “not very big” or “small”. Witnesses appear to have run into similar difficulties when providing data

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66 By which I mean that the conditions of many attacks (murky water, low salinity, high water temperatures) represent favorable conditions for other large predatory sharks, including tiger and bull sharks, but are usually not preferred by great whites (Compagno, Dando, & Fowler, 2005).

67 This species is so unlikely to be responsible for serious attacks on humans that they are commonly kept in public aquaria, as they are easy and safe for divers to work with when cleaning tanks or administering medical care (Compagno et al., 2005).
estimating the actual quantitative size of these sharks, they appear to have run into similar difficulties (Figure 5.3 (a)). Based on witness estimates (though it seems safe to assume that those trying to estimate the size of a shark attacking a human may overestimate), the average attacking shark is approximately 3 meters (roughly 10 feet) in length (Figure 5.3 (b)). Not only does this number seem improbably high across a range of species, but even if this were an “average” sized shark, a ten foot shark seems unlikely to be considered “average” by eyewitnesses who have a limited frame of reference for interpreting shark size.\textsuperscript{68} This data suggests that attack attributions relying on non-expert qualitative descriptions of shark size or appearance to identify species responsible for attacks may frequently be unreliable.

\textsuperscript{68} For reference, bull sharks are considered mature at approximately 1.6 meters, and reach a maximum length of 3.4 meters. Tiger sharks are considered mature at 2.2 meters, and reach a maximum size of 5.5 m. A great white is mature at 3.5 meters, and although individuals as large as 6 meters have been recorded, adult great whites—the largest predatory shark in the sea—are typically between 4 and 5 meters. This should provide some perspective on how improbable it is that the size distribution proposed by witness accurately reflects the sizes of attacking sharks. Size and maturity data drawn from Compagno et al., 2005.
The victims of shark attack in South African waters are overwhelmingly male (94% of articles), white (96% of articles), and young (mean age 23.25; median age 21) (Figure 5.4). The preponderance of reports on these victims is probably related not to cultural prejudice against women or minorities, but to risk factors and likelihood of attack.\footnote{Which isn’t to say that prejudice does not exist in this context: the mean word count for attack articles is 292; however, attacks on women, perhaps by virtue of their relative scarcity, merit more attention, averaging 350 words. People of color, on the other hand, tend to have a lower level of coverage when attacked, averaging only 162 words per article.} Historically, young white relatively affluent males make up the largest percentage of those participating in recreational activities at beaches, particularly those activities like surfing requiring long stints in the water (and greater exposure to shark attack risk). They therefore assume higher attack risks than low income people who have little time for beach recreation, people of color who are likely to have been historically excluded from these public spaces, and women, who make up a smaller portion of the surfing population (Stedman, 1997; Booth, 2001).

The word count dedicated to discussing who the victim was varied depending on where the victim was from ($F(2) = 4.62, p < 0.05$). Although newspaper coverage does not significantly prioritize “local” victims of attack ($M = 33.45, SE = 4.85$) over non-local

![Figure 5.4. Number of articles about shark attacks in South African waters 1850-2000 by age of victim. Articles containing victim age information n= 196.](image-url)
South Africans ($M = 30.87, SE = 6.55$), it seems clear that international tourists injured or killed by sharks while in South Africa were the subject of a higher level of scrutiny and interest ($M = 68.13, SE = 11.10$). While the reasons for such increased coverage are unclear, it seems likely that South Africa, particularly during apartheid, had reasons to be concerned with how it was viewed internationally and was motivated to attract international tourists.

Shark attack risk is obviously correlated with the amount of time an individual spends in the water. Therefore, activities requiring long periods of time in the water (like surfing, body-surfing or spearfishing) or those in which many people participate (such as swimming), are most likely to result in shark encounters (Figure 5.5). Activities likely to take place in clear water and afford sharks a good view of humans (e.g., diving) are relatively unlikely (4%) to result in attacks in spite of the growing popularity of these activities, including diving specifically to see sharks. Thirty-four percent of attack articles dealt with attacks in which victims were swimming when attacked, while 35% dealt with surfers being attacked. Although spearfishing accounts for 18% of human-shark interaction, these attacks, which are often the result of divers tethering dead fish to their waists or their attached dive buoys, should not be considered to be unprovoked.\footnote{Seventeen percent of all attacks covered were categorized as “provoked” based on the presence of dead fish in the water (for spearfishermen) or stupid and irresponsible behavior around sharks—as, for example,}

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{figure5_5}
\caption{Reported activities of shark attack victims immediately prior to attack. Articles containing details of victim activity n=225.}
\end{figure}
Attack rates are also seasonal, tending to cluster around the summer months and during holidays when the number of people in the water increases (Figure 5.6). Rates of reporting on attacks climb dramatically during the summer (in the Southern hemisphere, November-February) as warmer water increases shark activity and attracts larger crowds of beach-goers. There is another small spike in attack rates in April, around the Easter holiday, and in July, when students are on vacation from school. Though this quantified shark attack news coverage and individual attacks may receive coverage in multiple articles, the timing of these spikes further supports a direct correlation between the number of water users and heightened societal risk that a shark attack will take place.

Figure 5.6 Distribution of shark attack coverage by month. Articles identifying attack month n=231.

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the thirteen-year-old boy who attempted to swing a live shark around his head by the tail (Cape Argus, January 19, 1938).

71 Because most sharks are ectothermic, their metabolic rate is tied directly to the temperature of their environment. Therefore, sharks require more calories and are more active in summer and under warmer conditions generally, as their body temperatures are higher (Compagno et al., 2005).
Although it seems that surfers and swimmers are at similar risk of attack, it is worth noting that swimmers dramatically outnumber surfers, and so while they represent a similar percentages of attack victims, the lifetime risk of attack is much higher for habitual surfers than for casual swimmers.\textsuperscript{72} Further, coverage of attacks on swimmers has actually declined as surfing has risen in popularity (Figure 5.7). The presence of greater numbers of humans at areas of upwelling where sharks preferentially hunt (areas which also, of course, produce good waves for surfers) may actually lead to fewer encounters between inshore swimmers and sharks.\textsuperscript{73}

The reported severity of attacks by sharks upon humans has shifted over time. During the late 1970s many beaches were stocked with “shark packs”—specialized first aid kits—and lifesavers were provided with training on how to best medically assist

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure5.7.png}
\caption{Coverage of attack on swimmers (blue) and surfers (red) in South Africa 1850-1999. Articles containing details of victim activity n=225.}
\end{figure}

\textsuperscript{72} This is borne out by the relative frequency with which serious surfers and “lifesavers”—the preferred term for volunteer or professional lifeguards in South Africa—are victims of shark attack.

\textsuperscript{73} The precipitous decline in attacks on swimmers is also undoubtedly associated with the introduction of beach nets in KwaZulu Natal in 1952, and attendant declines in local shark populations. Few netted beaches accommodate surfers, and conditions which make for good surf breaks are typically not conducive to netting. Thus the rise in popularity of surfing and the increasing time spent in the water by surfers is not the only variable affecting these shifts in attack risk.
victims of shark attack (Wallett, 1978). Protocols were created, which meant that victims of attacks were likely to lose less blood and go into shock less frequently. Although overall shark attacks have not necessarily declined, some characteristics of the injuries suffered have changed. Since the introduction of shark packs and lifesaver shark training, there has been a decline in injuries categorized as “severe” (usually resulting from blood loss and shock) and an attendant uptick in injuries categorized as “moderate,” as attack victims receive more immediate and appropriate treatment for their injuries (Figure 5.8).

Data from these articles suggests that few of these attacks are sustained and that it is highly uncommon for any significant amount of human flesh to be reported consumed by an attacking shark. The vast majority of sharks which attack humans are content to depart after one (likely accidental or investigatory) bite. In 63% of reported attacks,

![Figure 5.8. Coverage characterizing attacks as “moderate,” “severe,” and “fatal” 1850-1999. Articles providing sufficient data to meaningful evaluate injury severity, n=222.](image)

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74 There are a few appallingly memorable exceptions to this rule. On April 11, 1971 Theo Klein, a German tourist, was torn apart and partially consumed by multiple sharks, most likely bull sharks (Cape Times, April 14, 1971 pg. 7) As a general proposition, even victims who are fatally mauled are not consumed. Although an attacking shark amputated surfer Mark Penches’ right leg at the thigh, severing the artery and resulting in his death, both his corpse and the leg later washed up on shore (Cape Times, July 23, 1997 pg. 5)
sharks departed voluntarily after this single bite. In 15% of attacks, sharks bit or mouthed victims more than once, but still departed without requiring intervention from bystanders to frighten them away. Twelve percent of attacking sharks exhibited a high degree of persistence, with sharks remaining in the area until they were frightened away by a concerted effort, and 10% of attacking sharks remained nearby and in some cases continued to attack even in the presence of rescuers or resistance from victims. While this data certainly does not support the contention that people are a desirable prey item for sharks, these findings are also not completely in keeping with modern characterizations by some conservation groups or scientists, which suggest that shark bites are almost exclusively investigatory.  

Subjective Frames and Responses

There are indications of some shift in South African public responses to shark attacks. The timeline below (Figure 5.9) helps to visualize the changes in how communities responded to shark attacks and what they perceived as the drivers of attacks. It demonstrates that over the last hundred years discourse about sharks and shark attack has become increasingly nuanced. Early responses to shark attacks on humans often involved

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More detailed information on species involved in attacks would be helpful in evaluating persistence as a trait in attacking sharks. However, in several attacks in which high persistence behavior was exhibited by sharks, witnesses sighted multiple sharks in the area. Conspecific competition and aggression may well have played a role in at least some proportion of these highly persistent attacks, including the attack on tourist Theo Klein discussed in footnote 64.
<table>
<thead>
<tr>
<th>Decade</th>
<th>Responses to attack</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1905-1914</td>
<td>Shark hunt</td>
<td>Harassed by human</td>
</tr>
<tr>
<td></td>
<td>Warning to swimmers</td>
<td>Attracted by fishery</td>
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<td></td>
<td></td>
<td>Territorial</td>
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<td>1915-1924</td>
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<tr>
<td>1925-1934</td>
<td>Attempt to kill responsible shark</td>
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<tr>
<td></td>
<td>Beach closures</td>
<td></td>
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<tr>
<td>1935-1944</td>
<td>Shark hunt</td>
<td>Harassed by human</td>
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<tr>
<td>1945-1954</td>
<td></td>
<td>Attracted by fish school</td>
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<tr>
<td></td>
<td></td>
<td>Harassed by human</td>
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<td></td>
<td></td>
<td>Excited by spearing</td>
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<tr>
<td>1955-1964</td>
<td>Shark hunt</td>
<td>Harassed by human</td>
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<tr>
<td></td>
<td>Anti-shark fund started</td>
<td>Excited by spearing</td>
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<td></td>
<td>Beach closures</td>
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<td></td>
<td>Mouth of lagoon sandbagged</td>
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<td></td>
<td>Shark nets erected</td>
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<td></td>
<td>Sharks attacked with depth charges</td>
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<tr>
<td></td>
<td>Government help requested</td>
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<td></td>
<td>Aerial Patrols</td>
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<td></td>
<td>Armed constable stationed at beach</td>
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<tr>
<td>1965-1974</td>
<td>Aerial and marine patrols</td>
<td>Harassed by human</td>
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<tr>
<td></td>
<td>Shark “traps”</td>
<td>Excited by spearing</td>
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<tr>
<td></td>
<td>Shark hunt</td>
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<td></td>
<td>Beach closures</td>
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<tr>
<td>1975-1984</td>
<td>Marine patrols</td>
<td>Excited by spearing</td>
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<tr>
<td></td>
<td>Introduction of “shark pack”</td>
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<td></td>
<td>Warning to swimmers</td>
<td>Brought by sardine run</td>
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<td></td>
<td>Beach closures</td>
<td>Attracted by sewage outfall</td>
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<td></td>
<td>Call for investigation of “shark menace”</td>
<td>Aﬀected by reduced fish</td>
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<td></td>
<td>Skindivers warned not to hunt shark</td>
<td>populations</td>
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<td></td>
<td></td>
<td>Attracted by dead whale</td>
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<tr>
<td>1985-1994</td>
<td>Aerial patrols</td>
<td>Curiosity</td>
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<td></td>
<td>Beach closures</td>
<td>Scent of fresh water</td>
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<td></td>
<td>Lifesavers “on alert”</td>
<td>Murky water</td>
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<td></td>
<td>Warning to swimmers</td>
<td>Warm water</td>
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<td></td>
<td>Beach closures</td>
<td>Feeding frenzy</td>
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<td></td>
<td>Mayor publically denies a “shark hunt”</td>
<td>Attracted by fish</td>
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<tr>
<td></td>
<td></td>
<td>Mistook human for seal</td>
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<tr>
<td></td>
<td></td>
<td>Whales in area</td>
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<tr>
<td></td>
<td></td>
<td>Seals in area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brought by Sardine run</td>
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<tr>
<td></td>
<td></td>
<td>Proximity to river mouth</td>
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<tr>
<td></td>
<td></td>
<td>Squid fishery/”Chokka industry”</td>
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<tr>
<td></td>
<td></td>
<td>Ecotourism industry</td>
</tr>
</tbody>
</table>

Figure 5.9. Timeline of responses and explanations of attacks. Each category is listed once if it appeared during the respective time period. Red text denotes approaches which intend to manage risk of attack by lethal control of shark populations, orange text denotes proposed behaviors which may include killing sharks, and green text denotes approaches that involve changing human behavior in order to minimize risk of attack.
acts of “vengeance” as sharks—ideally the responsible shark, but often merely a symbolic stand-in—were hunted down and killed. However, in the mid-1970s a shift away from this paradigm began, and local responses to shark attacks increasingly relied on altering human behavior and risk through warnings, beach closures and improved treatment for victims.76

Similarly, early efforts to understand shark behavior and to assess factors contributing to attack risk focused largely on simplistic explanations (i.e., the shark was attracted by blood). Particularly since the mid-1980s, attempts to understand the causes of shark attacks have reflected our increased understanding of shark behavior and ecological principles. Perhaps most promisingly, media discourse has begun to reflect the potential for humans to indirectly influence attack risks through individual behavior (i.e., deciding not to swim in an area where sharks are feeding) or systemic changes to ecosystems (i.e., recognizing that human-caused declines in prey items may increase risks). Later articles also increasingly emphasize the rarity of attacks and the vanishingly small risk sharks represent to humans.77

In keeping with these shifts, newspaper coverage of shark attacks has grown lengthier as it has increased in complexity (Figure 5.10). Early articles averaged less than 100 words, while by 2000 the average article was three times longer. While the overall trend is gradually positive, there is a dramatic spike in coverage length in the late 1950s/early 1960s which can likely be attributed to the media frenzy surrounding the events of “Black December,” which received an unprecedented degree of coverage.

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76 Of course, this does not really include beach netting. However, public awareness of exactly how beach netting works and what effect it has is somewhat limited, and there is evidence that support for lethal approaches to risk mitigation may be waning (e.g., Gibbs & Warren, 2015).
77 In the early 1990s the rarity of shark attack became a particular focus of media coverage, and was mentioned in 62% of articles published between 1994 and 2000.
Finally, it is possible to visually explore changes in language used to discuss sharks and shark attacks (Figure 5.11). Word cloud visualization was used to examine the relative importance of concepts and frames across time periods. While not a replacement for more in-depth content analysis, word clouds have been used in research as a means of exploring patterns and creating visually rich summaries of qualitative data (Cidell, 2010; McNaught & Lam, 2010). The word cloud generator Tagcrowd.com was chosen as it allows the user to exclude common English words (e.g., “a”, “the”), group similar words (e.g., “learn”, “learns”, and “learned”), and to exclude specific words from analysis. The word “shark” and related words (sharks) were excluded from analysis, as shark was de facto the most common word in any era. The 30 most common words within each group of titles is presented in each timeframe. Timeframe selection was determined based on multiple factors. Early periods were made relatively larger to contain appropriate numbers of articles, after which time period, ten years was selected in a way that would allow for comparisons of frames immediately before, and after the release of Jaws (1975).
A shift in how people framed and understood these events is also visible, qualitatively, within the articles themselves. Beginning in the early 1960s, some articles about attacks provide perspective about the experiences of victims. Most of the early opinions given about sharks are decidedly negative: or “I don’t think I’ll be going to the beach again soon”.\(^{78}\) However, there were also a number of victims who expressed more positive attitudes about sharks, many of them noting that the ocean is the “shark’s domain: if you want to play in it, take whatever comes your way,” and reporting that there was “no malice…[sharks] have a definite place in our environmental chain”.\(^{79}\)

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\(^{78}\) Quote drawn from Cape Times February 8, 1962, pg. 1.

Several victims also expressed opposition to hunting or culling sharks, insisting that “it’s totally unnecessary to kill sharks to protect humans”. This is a dramatic shift from earlier media representations in which a shark could be referred to as a “monster” (3 times), a “brute,” a “man-eater,” and an “enemy” all in the course of one article.

**Conclusion**

Understanding the facts of shark attack in South Africa is important for mitigating both the harm which attacks can do to families and communities and the damage which can be caused by ill-considered human responses. Knowing who is being attacked, what victims are doing when attacks occur and how environmental factors may impact the likelihood of encounters between humans and sharks is an important first step in managing future risk. Being aware of which sharks are blamed for these attacks (and having some sense of whether this blame is misplaced) can provide valuable information about what people actually know—or think they know—about sharks, while creating potential avenues for education. Perhaps most importantly, exploring the reasons people believe attacks occur and the ways in which they respond is a powerful tool for parsing the human-shark relationship, both in a particular moment and for the purpose of understanding the ways it has changed over time.

Evidence from these articles, though not conclusive, does not support the contention that the release of “Jaws” was a crucial moment in determining future human-shark relations. Many of the beliefs categorized as the “Jaws Effect” can be seen in the

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81 *Cape Argus*, February 11, 1887, pg. 3.
82 Even those with little interest in sharks and shark conservation are likely to be distressed by the capture in shark nets of endangered leatherback turtles (*Dermochelys coriacea*), indo-pacific humpback dolphins (*Sousa chinensis*), dugongs (*Dugong Dugon*), and humpback whale calves (*Megaptera novaeangliae*) (Dudley & Cliff, 1993).
historical record much earlier than the release of “Jaws”, and in fact appear to have already been declining in frequency in the decade before the movie was released.

Although “Jaws” is mentioned fairly regularly in articles covering shark attacks, and one victim was bitten while acting out a scene from the movie, these mentions do not seem to have translated to changes in how shark attacks were framed or talked about by reporters and editors. There is no increase in support for responses to attacks which involve killing sharks (the most vociferous of which occurred in the 1950s, well before the release of the movie) and there is an ongoing increase in support for solutions which involve changing human behavior to reduce risks. Similarly, there is no detectable increase in fear of or hostility towards sharks based on words used in headlines, and explanations for why attacks occurred continued to increase in ecological sophistication. Both before and after “Jaws” was released, we see many more victims of shark attack talking about the right of sharks to exist and the risks they assumed when they chose to engage in ocean-based recreation, a change in perception that clearly originated in the 1960s. While none of this proves that “Jaws” didn’t affect the way people think about sharks—it certainly did—it does suggest that it may not be the only, or even the most important, factor shaping these attitudes and beliefs.

These changes correlate far more closely with the global environmental movement in the 1960s than with the release of any single movie. There is a long history of slowly shifting attitudes and representations of shark attack which can be identified as far back as the late 1950s and early 1960s. While progress is slow and fitful, and entrenched cultural attitudes are lasting, the current shift towards shark conservation is the product of decades of almost undetectable movement which was most likely tied to
the rise in environmental awareness in this period. In this case, historical data from newspaper coverage can help challenge an entrenched narrative—that “Jaws” is the most useful frame for understanding the human-shark relationship—in ways which suggest alternative conservation approaches. While there has been a boom in the amount of conservation attention paid to sharks, and NGOs devoted to shark protection have proliferated since the 1990s, this finding also suggests that those working to improve attitudes towards the environment—and environmental literacy more broadly—are likely able to impact perceptions of, and feelings about, even species that are historically disliked or misunderstood.
Chapter 6:

Legal Bans of Shark Provisioning Tourism in Florida and Hawaii, USA
In recent years, a number of researchers have suggested that shark-based ecotourism can play an important role in advancing legal protections for sharks and other vulnerable species of elasmobranch. It has been argued that shark ecotourism can create economic incentives that encourage governments and individuals to protect sharks from anthropogenic threats including overfishing, finning, and indiscriminate use of longlines (Gallagher & Hammerschlag, 2010; Vianna, Meekan, Pannell, Marsh, & Meeuwig, 2010). In spite of concerns about the potential effects of feeding sharks on both public safety and animal health, studies attempting to assess the effects of shark-based tourism on shark behavior and wellbeing are equivocal. Most report some behavioral changes in participating sharks, but the significance and severity of these changes is the subject of intense and ongoing debate (Laroche, Kock, Dill, & Oosthuizen, 2007; Clua, Buray, Legendre, Mourier, & Planes, 2011; Brunnschweiler & Barnett, 2013).

Despite a lack of clear evidence that shark tourism creates a hazard for participants or the general public, the economic benefits associated with shark ecotourism still appear to be too small to secure the future of shark species—or even of shark ecotourism as a commercial activity—and fail to take into account the potential opportunity costs associated with increases (or perceived increases) in shark attack risk due to such activities. In response to concerns over the marine conservation impacts of shark feeding, as well as the health and safety of human beings who come into contact with sharks attracted by feeding activities, some state and local governments have instituted, or have considered instituting, legal bans on commercial shark feeding. These concerns are undoubtedly related not just to possible safety risks, but also to the
concomitant potential tort liability for governmental entities managing the waters in which humans and sharks may interact.

This chapter investigates the interlocking legal, economic, and conservation issues surrounding the implementation of such regulation. In the first section, we provide an overview of shark ecotourism and legal risks which may arise for the state as a result. This section discusses legal and economic reasons that the implementation of bans on shark tourism by US states was predictable (and, perhaps, inevitable). The second section provides an exploration of two case studies based on introductions of shark feeding bans. The first case study, in Florida, traces the failure of a small but relatively organized and well-funded local shark tourism industry to avoid being regulated out of legal existence. This case study demonstrates the potential for lengthy and contentious debates both in and out of court to which such regulations may lead. The second case study, in Hawaii, demonstrates some of the difficulties associated with effectively enforcing such a ban once it becomes law.

**Methods**

This paper is based on legal research into the risks shark tourism might pose to states, utilizing legal databases including Lexis-Nexis® and HeinOnline. For in-depth information on the Florida ban, the Florida Fish and Wildlife Conservation Commission provided hundreds of pages of minutes, memoranda and other primary source documents in response to our requests, related to the policy and legal issues around shark tourism. Additional historical information was gathered from news coverage of these events in both Florida and Hawaii.
Shark Feeding Tourism and Economic Valuation

Estimates suggest that marine and ecotourism are an important and growing part of the global tourism economy, with nature based “ecotourism” activities worth an estimated US$10 to US$17.5 billion per year worldwide (Fennell, 1999; Orams, 1999). In a marine context, it has been suggested that ecotourism may serve to generate funds for research and conservation, raise the profile of targeted habitats or species, and create economic rationales for conservationist policies (Garrod & Wilson, 2003; Tisdell & Wilson, 2001). Non-governmental organizations increasingly view such tourism as both a conservation and “pro-poor” development strategy (Ashley & Roe, 2002). While the values associated with shark tourism are relatively modest in comparison to ecotourism globally, at an estimated $314 million per year, they are still significant enough to support an estimated 10,000 jobs globally (Cisneros-Montemayor, Barnes-Mauthe, Al-Abdulrazzak, Navarro-Holm, & Sumaila, 2013).

There are significant debates about the usefulness of economic measures in calculating the “value” of a species. This is in part a practical matter—for example, published analyses of the economic value of sharks—for consumption or tourism—often fail to account for the value people may place on the mere existence of sharks, or the ecological contributions sharks make to maintaining healthy ocean ecosystems, both of which may constitute a meaningful portion of the total estimated value of a species (Bandara & Tisdell, 2003).

Other authors have taken issue with the very idea of using economic valuation as a conservation tool, suggesting the ethical and moral arguments for conservation are weakened when economic rationalism is emphasized as a motive to conserve nature.
(Krüger, 2005; McCauley, 2006; Isaacs, 2000). The reality that many tourist uses of species and areas are harmful to wildlife or ecosystems, or are incompatible with other uses or mutually exclusive, further complicates estimates of value, given that (for example) shark tourism and beach tourism may have difficulty operating in the same areas (Garrod & Wilson, 2003). There is also considerable doubt about the impact of these activities on the attitudes and behaviors of participants, with some authors arguing that tourism experiences can lead to pro-environmental behaviors, while others are more skeptical that these experiences create lasting attitudinal or behavioral changes in most participants (Tisdell & Wilson, 2002; Smith et al., 2011). As discussed in chapter two, potential impacts would presumably be closely linked to the educational content and quality of the tourism experience, which will also inevitably vary, based both on operator resources and customer preferences (Ryan et al., 2000; Ballantyne et al., 2009).

There is a good deal of contention about the impacts of shark feeding tourism on both humans and sharks. Those who feel that it can meaningfully contribute to conservation point to a dearth of evidence that shark feeding causes serious, harmful ecological impacts, highlight the role of economic valuation as a tool for encouraging governments to protect sharks, and report, anecdotally, that direct experiences with sharks can change people’s views about them. Those who are less sanguine observe that a lack of proof of harm does not necessarily represent a lack of harm, and that the public relations gains of sharks as a result of tourism are speculative. In this data-limited setting, debates are more likely to be based on emotions or opinion than on available facts, and in the absence of scientific consensus, policy makers are likely to act based on local or regional political and legal realities.
Legal Aspects of Shark Feeding

The risk of unprovoked shark attack is low: in 2016 only 84 cases were reported worldwide, out of 154 attacks total. Yet, many governmental agencies may be unwilling to tolerate even this low risk, particularly in areas that are comparative “hotspots” for shark attack incidents. For example, in 2016, 62.5% of unprovoked shark attacks in the United States occurred in Florida, with 15 out of 35 bites occurring in Volusia County alone. Furthermore, even where risk of attack is low, governments reliant on tourism dollars may want to avoid making public the presence of sharks in the area, and possible resulting perceptions of beaches as unsafe. Finally, although this is contested, some recent research suggests a modest increase in unprovoked shark bites in recent decades, which is not fully explained by increases in human or shark populations (McPhee, 2014; for a contrasting view, Ferretti, Jorgensen, Chapple, De Leo, & Micheli, 2015).

While a full discussion of the relevant legal issues would take up multiple volumes, the two primary legal issues implicated are: (1) the liability of governmental entities for shark injuries, the potential risks of which might give rise to a ban on shark provisioning tourism; and (2) jurisdictional issues relating to the ability of a specific governmental entity to implement and enforce such a ban.

Governmental Liability for Shark Attacks

Governmental entities at the federal, state, and local level may face potential liability for animal attacks that occur in areas over which they have control, though

83 “Unprovoked” attacks are defined as “incidents where an attack on a live human by a shark occurs in its natural habitat without human provocation of the shark”. These are distinguished from attacks where the victim provoked the shark in some manner, such as divers grabbing a shark, anglers attempting to remove a fishing hook from a shark’s mouth, or divers feeding sharks or spearfishing near them.
whether liability attaches depends on the specific factual circumstances surrounding a
given attack. Such liability would typically take the form of an action for negligence,
which occurs with the existence (and violation of) a legal duty to use care, proximately
causing injury to another (see 57A Am Jur 2d Negligence § 5). Landowners generally are
liable for negligence for failing to maintain their premises in a safe condition, though the
exact duty may differ in some jurisdictions based on the status of the person coming onto
the land. In most cases, however, there is at minimum a duty to warn of dangerous
conditions if such conditions are known.

In the American civil court system there are two primary hurdles a defendant
must pass to successfully sue the state for damages arising from a shark attack in state-
controlled areas. First is the doctrine of sovereign immunity, codified in both federal law
as well as individual state laws in various forms, which immunizes the “sovereign” –
whether federal, state, tribal, or local government – from being sued without its consent,
even if liability could be established (Florey, 2008). Absolute immunity against any court
action existed at the federal level until 1887, when Congress authorized contract actions;
subsequently, in 1946 Congress passed the Federal Tort Claims Act that waived
immunity for certain claims arising from actions taken by government employees in the
scope of their employment (Cole & Marzen, 2013). Most state governments have since
followed suit, implementing their own waiver of sovereign immunity, though the exact
format differs from state to state. The different statutory and common-law mechanisms
governing sovereign immunity at the federal, state, and local levels are complex and a
full discussion would go well beyond the scope of this chapter.85 However, both at the

85 For a history (and criticism) of sovereign immunity in the United States, see Chemerinsky, 2001. For an
overview and discussion of state sovereign immunity statutes, see Cole & Marzen, 2013.
federal and state level, either the statutes or the courts have generally restricted such
waivers to “operational” functions as opposed to “planning,” or “discretionary” functions,
to avoid allowing courts to “second guess policy decisions that are more properly made
by the legislature . . .” (Florey, 2008). To put it plainly, governmental entities are given
discretion to decide how things are to be done at a policy level without oversight by the
courts. Once they have made a policy decision, however, they can be held responsible by
the courts for negligently implementing that policy. In theory, this provides absolute
protection of policy decisions; however, in practice the boundary between “operational”
and “planning” has been frequently blurry and uncertain.

Second, even where sovereign immunity has been waived and the governmental
actor faces the same judicial determination of liability as any other landowner, under
Anglo-American common law principles, liability generally does not attach to any
landowner for unforeseen attacks by wild animals under the doctrine of ferae naturae,
which holds that a landowner cannot be held liable for the act of a wild animal, provided
the landowner cannot be considered to own or intentionally harbor the animal and did not
introduce the non-native wild animal to the area.86 However, even if the doctrine protects
the landowner from liability for the actions of the animal, the landowner still may be
liable for a more generalized failure to maintain the property free of dangerous conditions
(or failure to warn visitors of those conditions).87

The only United States case found to address liability for shark attacks
specifically is *Wamser v. City of St. Petersburg* 339 So. 2d 244 (Fla. Dist. Ct. App. 1976)
[hereinafter *Wamser*]. On August 3, 1969, a 13-year-old boy named Robert Wamser was

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87 See, e.g., Restatement of Torts (Third) § 12
bitten on the foot and leg by a shark four feet in length while he was swimming about 25 feet from shore on a public beach in Saint Petersburg, Florida, near a lifeguard station. Subsequently, the Wamser family filed suit against the City of Saint Petersburg for failing to adequately warn them about the risk of shark attack on city beaches. Although there had been no previous recorded attacks at this beach, the Wamser family presented affidavits claiming that both shore patrol boats and local fishermen were aware that sharks sometimes approached beaches closely there. However, lifeguards and beach managers had no knowledge of a potential shark threat and were not aware of previous shark sightings, except for having investigated a few reports that turned out to be bottlenose dolphins. In *Wamser*, the Court of Appeals ruled that the city was under no obligation to seek out information on a threat with no history of occurrence in that locale.

The Court raised the *ferae naturae* doctrine, holding that

> The rule is that generally the law does not require the owner or possessor of land to anticipate the presence of or guard an invitee against harm from animals *ferae naturae* unless such owner or possessor has reduced the animals to possession, harbors such animals, or has introduced onto his premises wild animals not indigenous to the locality.

This decision has since been viewed as providing significant protection against liability related to shark attack for municipalities maintaining public beaches—provided that they post warnings on beaches where a risk of attack is known to exist. However, the *Wamser* court did not address sovereign immunity because it did not apply at the time; while the Florida Constitution established absolute sovereign immunity for the state and its political subdivisions, the Florida Supreme Court had allowed recovery against municipal corporations without distinguishing between operational and planning functions. This
would be changed by the sovereign immunity waiver statute\(^\text{88}\) in 1975, which expressly protected municipalities through sovereign immunity (except, of course, where it was waived) and instituted the operational/planning distinction.

Despite sovereign immunity and the *ferae naturae* doctrine, shark feeding ecotourism could impose liability on both state and local governments that did not take steps to protect or warn the public. There are several cases involving incidents outside the United States where liability was acknowledged in somewhat similar circumstances. A resort in Acapulco was successfully sued after a shark attack for failing to warn guests that hotel garbage was discharged into the ocean, potentially attracting sharks and conditioning them to feed in that area.\(^\text{89}\) Similarly, following an attack in which a New York man lost his leg while vacationing in Grand Bahama, the victim sued on the grounds that the resort had failed to warn him of shark feeds taking place a mile offshore, contending that he would not have gone swimming in the ocean had he been aware of this activity. This case resulted in a sealed settlement agreement. In consequence, the details of the settlement are not public; however, the victim had previously said he would consider settling the case for between $3 and $6 million.\(^\text{90}\) Although both of these cases entailed lawsuits against private entities, not states, they emphasize the extent to which knowledge of shark feeding and associated risks can potentially create significant liability, and point to the reasons (financial and practical) that may lead to settlements even in cases a plaintiff would not be likely to win.


\(^{89}\) This was in some ways an important test case; as lawyer Harry Lipsig acknowledged, people initially thought he was “mad”, and a common initial response was “who are you going to sue? The shark?” (*New York Magazine*, “Samurai Lawyer”, April 5, 1982, p. 38).

Cases involving activity that attracts other potentially dangerous animals may also provide insight into governmental liability for shark attacks. For example, several courts have addressed the issue of liability over bear attacks, including situations somewhat analogous to feeding activities, in terms of both the *ferae naturae* doctrine and sovereign immunity. For example, the Supreme Court of Alaska’s decision in *Carlson v. State* provides an analysis of both sovereign immunity as well as the doctrine of *ferae naturae* in regards to an animal attack. In that case the appellant was attacked by a bear that had been attracted by overflowing drums of litter on a state roadside turnout. While the state had generally stopped arranging for trash collection from roadside turnouts on October 1 of each year, there appeared to be no written policy governing such collection. The victim sued the state, alleging that it had negligently failed to collect the trash or warn the public about bears in the area attracted to the trash, but the trial court granted summary judgment to the state, holding that the decision to halt trash collection on October 1 was a discretionary act protected by sovereign immunity.

The Supreme Court of Alaska overturned that ruling, finding that while the decision not to maintain highway turnouts in the winter might be a policy decision immune from liability, decisions about how exactly to cease trash pick-up were operational in nature, and liability could attach under Alaska’s codified waiver of sovereign immunity. The court then addressed whether the judgment (if not its reasoning) could still be upheld under the alternate grounds that even if sovereign immunity did not attach, the state was not liable for negligence. The court rejected the state’s argument that

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92 In both state and Federal courts, parties may be granted summary judgment on some or all issues raised without a full trial if they can show that there is no genuine dispute as to material facts, and the sole determination to be made is an interpretation of the law.
liability did not exist under the doctrine of _ferae naturae_, finding that the appellant alleged liability not because the state was in possession or control of the bear, but rather because the state knew a dangerous condition existed but failed to either correct it or to warn people of the danger. The court then sent the issue back to the trial court for disposition under those guidelines.⁹³

Similarly, liability for shark attacks against federal, state, or local governments would depend on the specific facts of the incident. Failure to implement a feeding ban at a policy level (such as through legislation or formal administrative rules) would likely be considered a discretionary function firmly within the purview of the other branches of government and thus immune from suit. However, where a plaintiff could convince a court that failure to prevent a shark attack arose from a negligent action taken in the implementation of an otherwise protected policy decision, the governmental unit might not be immune from suit.

Even where a governmental unit reasonably believes itself to be protected under sovereign immunity, or exercises great care, the cost of defending itself against an unsuccessful suit may still be high. For smaller municipalities especially, the cost of losing a wrongful death suit might lead to millions of dollars in damages that it does not have available, particularly in jurisdictions where waiver of sovereign immunity has not been coupled with a damages cap or a prohibition on punitive damages. Furthermore, shark feeding bans may represent a more desirable option than posting signs warning about potential shark activity—which, from the state’s perspective, might be a legally prudent move, but in many locations would be economically unfeasible if it kept away tourists.

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⁹³ _Carlson_, 598 P.2d, _supra_ n. 91.
Jurisdictional Issues

Once a governmental unit has decided to implement a ban or limit on shark feeding, the next step is for that unit to determine the extent to which it has the authority to pass such a ban, and the manner in which best to do it. Such regulation of coastal waters and activities is complicated by overlapping jurisdictions on the part of federal, state, and municipal governments and agencies. The federal government has broad authority to enact and enforce laws and regulations governing use of coastal resources through Article I, section 8, clause 3 of the United States Constitution, which grants Congress the power “[t]o regulate Commerce . . . among the several States.” The Supreme Court has held on numerous occasions that this grants the federal government ultimate authority over navigable waters; for example, in *Gilman v. Philadelphia,* it held that “[t]he power to regulate commerce comprehends the control for that purpose . . . all the navigable waters of the United States . . . they are the public property of the nation. . .” At the present time, it has instituted no direct federal ban on shark feeding, although one was introduced by Florida Senator Bill Nelson as part of the federal “Access for Sportfishing Act of 2016”. Section 3 of the bill (S. 3099), contains the following provision:

It is unlawful for any person—
(1) to engage in shark feeding; or
(2) to operate a vessel for the purpose of carrying a passenger for hire to any site to engage in shark feeding or to observe shark feeding…

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94 Congress’ power to regulate coastal areas may also arise under other, albeit more narrow, Constitutional provisions, such as its authority to pass laws regulating customs and tariffs, naval forces, and treaties, and to “define and punish . . . Felonies committed on the high Seas.” See US Const. art. I, sec. 8.
95 70 US (3 Wall.) 713, 725 (1866).
…The term ‘shark feeding’ means the introduction of food or any other substance into the water to feed or attract sharks for any purpose other than to harvest sharks.\footnote{As elsewhere, this law framed the feeding of sharks for the purpose of “harvesting” them is an acceptable behavior, while feeding them for viewing or recreational purposes would have become a federal offense.}

Should such a ban ultimately pass, it would preempt any state- or local-level bans through the Supremacy Clause of the US Constitution (US Const., art. VI, sec. 2).

For state and local governments and agencies, jurisdictional boundaries can prevent regulation or enforcement of feeding bans; such limitations became issues in both of the case studies discussed below. The federal Submerged Lands Act of 1953\footnote{43 U.S.C. §§1301-1315 (2002).} gave states title to both land underlying navigable waters as well as the natural resources (including specifically marine life) to a distance of no more than three geographical miles (or, for Gulf Coast waters, three leagues or nine miles). This may require more creative approaches of indirect regulation, such as refusing to grant commercial licenses to dive operators who feed sharks, even if the feeding is outside the boundaries controlled by local or state governments.

In the absence of federal action, Congress has allowed the states to institute their own coastal regulation (except, of course, where such regulation would conflict with existing federal law). Indeed, the Coastal Zone Management Act of 1972\footnote{16 U.S.C. §§ 1451–1464, Chapter 33 (1972).} put in place a shared management framework for coastal areas that explicitly allowed and encouraged state and local management activities to protect marine resources. Furthermore, where Congress has not either explicitly or implicitly preempted an area from state regulation, individual states also have broad police powers to regulate the general welfare of their inhabitants, which includes protecting their environment and the safety and health of
persons. In turn, state governments frequently delegate these powers to both state agencies and local municipal governments, though the extent to which such powers can be delegated, exercised, or withdrawn differ from state to state, as do how narrowly or broadly state courts will interpret powers so delegated (Zimmerman, 1995, p. 4-10). Just as federal law can pre-empt state law, state law can pre-empt conflicting local government laws and regulations.

Authority at the state or local level is dependent on the states’ constitutional or statutory provisions governing the delegation of power. The justification behind a shark feeding ban may also be relevant to that determination; in a jurisdiction where the state government retains strong control over environmental regulation, but delegates police powers concerning safety more liberally, a feeding ban created purely for the purpose of protecting sharks might be found to be outside a municipality’s power to enact, while a feeding ban intended to protect the safety of beachgoers might not be. Furthermore, counties and municipalities within the same state may have differing levels of police power depending on the legislative history of that state (Vaubel, 1993). For example, counties in Florida that have adopted what are called home rule charters (in essence, county-level constitutions), have greater local authority than those counties that have not. Similarly, while the state may delegate some rulemaking powers to administrative agencies (for example, state agencies regulating environmental matters), the scope of such powers are usually narrowly construed by courts; an agency cannot take actions unless it has been clearly given the authority to do so (Freyfogle & Goble, 2009, at 139-140).
Case Study 1: Florida

In 2000 and 2001, the Florida Fish and Wildlife Conservation Commission (FWC) became embroiled in a debate about whether or not they should ban the feeding of sharks in state waters. Although the term used to describe the practice they intended to regulate varied—the February 2001 meeting was overwhelmingly about “shark” or “predator” feeding, while the September 2001 meeting talked primarily about “fish feeding” (sharks are of course cartilaginous fish, but in the minutes they are sometimes still identified separately, i.e., “fish and shark feeding”)—ultimately the Commission seems to have settled on the more general “marine life feeding.”

It seems clear, however, that regardless of terminology, the real target of the ban was unequivocally shark feeding. The role of a proposed ban in protecting “human safety” was consistently an important theme in FWC meetings—one that would hardly seem necessary if the purpose of banning marine life feeding were the avoidance of aggressive or unnatural behaviors in small reef fish incapable of causing meaningful harm to humans. In total, 93 percent of the mentions in FWC meeting minutes of animals/categories associated with the ban can be applied to sharks (Sharks (55%), Fish (25%), “Predator” (13%) (Figure 6.1).
Although the shark feeding debate would be revisited by the Commission over years of meetings, and Commissioners and staff would listen to many hours of public debate on the topic and receive thousands of letters in support of and opposition to a ban, the passage of a ban on feeding sharks in Florida waters was nearly inevitable. Florida case law created a specter of state and local liability should the Commission fail to act; while any action which was stringent enough to provide reasonable liability protection would likely be unacceptable to the dive industry.\textsuperscript{99} It seems as though the core of this debate was not truly about what was good for sharks, marine resource users or marine ecosystems—even if the end results achieved those goals—but about what best protected state and local governments from potential liability associated with shark attacks.

\textsuperscript{99} Minutes, FWC Meeting Sep. 6-8.
Florida Legal Precedents for Liability Associated with Shark Attack

As discussed above, *Wamser* suggests that where a governmental unit is aware of the presence of sharks, failure to take action might lead to liability. While the *Wamser* court found lack of knowledge of sharks in the area protected the city in that case, it also suggested that where the governmental unit was aware of the presence of sharks, it might be liable for failing to warn the public or take other steps to reduce the risk of danger.

Another Florida case, *Florida Department of Natural Resources v. Juan A. Garcia, Jr.* 753 So. 2d 72 (Fla. 2000) [hereinafter *Garcia*], provides an example of the potential issues facing policymakers in Florida when managing (and regulating) coastal recreational areas. In that case the appellee was injured when he dove and struck his head on debris remaining in the water following the demolition of a South Beach pier, rendering him a quadriplegic. The trial court found in favor of the state on summary judgment, finding that the state had no duty of care to swimmers since it had not publicly designated the beach as a swimming area, and in any event the state had delegated any duty to maintain the area to the city of Miami Beach. The Third District Court of Appeals overturned that ruling, finding that a non-delegable duty of care extended to a “body of water . . . held out to be a public swimming area and/or commonly used by the public as a swimming area.” (*Id.*, at 1159). The Florida Supreme Court affirmed, confirming that

…a government entity operating a public swimming area will have the same operational-level duty to invitees as a private landowner—the duty to keep the premises in a reasonably safe condition and to warn the public of any dangerous conditions of which it knew or should have known.

The Florida Supreme Court rejected the state’s argument that a formal designation as a public swimming area was necessary before the duty to maintain the swimming area arose, though it disagreed with the Third District that mere “common[] use” of an area for
swimming created the duty, instead requiring the government entity to either represent to
the public it was a swimming area or let the public believe it to be one. Under the logic
employed by the Florida Supreme Court in this case, it seems that the state could be held
liable for a shark bite which took place near an area in which shark feeding ecotourism
was conducted, assuming the state knew of the conduct of such feeds and was aware they
could theoretically create risks for beach users. Moreover, Garcia demonstrates that such
liability would not necessarily be restricted to occurrences at public beaches formally set
aside for swimming, but also could extend to areas that the governmental entity either
explicitly or implicitly (for example, by providing public beach access) holds out as a
place for the public to swim.

**History of the Florida Ban**

The debate over shark feeding at the initial meetings of the FWC was highly
contentious, and was often framed as a question of the “rights” of divers or the “safety”
of other marine resource users, with both pro- and anti- ban activists making claims about
the malfeasance of their opponents. Ban advocates claimed that shark feeding was strictly
a commercial venture performed without concern for the potential harms being done to
animals, while ban opponents claimed they were interested in educating the public and
that ban advocates were trying to prey on public fears of shark attack to their own ends.
One dive operator, Jeff Torode, claimed his former friend David Earp (a commercial
lobster diver, and a leader of the pro-ban Marine Safety Group) had gotten involved in
the debate in an effort to prevent the (dive industry-backed) creation of marine protected
areas in locations where feeds took place, which would then be off-limits to commercial and recreational fishing.\textsuperscript{100}

A fact-finding workshop on the issue of predator feeding took place on October 29, 1999. The FWC staff recommendations associated with this workshop note that the public controversy over the practice had “surfaced at the same time as dive tour operators and conservation groups began to advocate setting aside areas in Broward County as marine, ‘no take’, reserves.” These proposed reserves met with opposition from spear fishing, recreational, and commercial fishing interests who felt that it favored divers over other marine resource users. The report further observed: “[s]taff believes that, in part, the organized opposition to fish feeding dives has its roots in the controversy over marine reserves”; however, in spite of “linkage between these two issues [shark feeding and the creation of marine reserves]” FWC staff recommended that the Commission “consider the policy implications of continuing, prohibiting, or regulating dive feeding excursions” solely on the basis of questions around feeding practices.\textsuperscript{101}

Against this highly charged backdrop, during meetings occurring from February 2-4, 2000, FWC Commissioners voted to have its staff draft a rule to ban feeding of marine life in state waters. Discussion focused largely on the risks or potential risks to human safety that might result from these practices, and on the question of whether shark feeding was likely to make predators more aggressive towards humans. This decision was


\textsuperscript{101} FWC Commission Background Briefing Memorandum, January 7, 2000.
later reconsidered following lobbying by the dive industry, and Commissioners sought other potential solutions.  

At the next meeting of the FWC, the Commissioners were unable to reach consensus on moving forward with a ban, due to a “lack of scientific data to demonstrate human safety is a factor to consider in fish feeding, or whether the practice is detrimental to fish”. A motion was passed to suspend the rule-making process to allow pro- and anti-ban activists to work together to create industry guidelines to be considered at the May 2001 FWC meeting.

Local Action

At this point, largely as a result of the activities of pro-ban activists in the Marine Safety Group, many municipalities in South Florida began to consider the question of shark feeding dives, potential liability, and whether their police powers and ability to pass ordinances to protect public safety might allow them to regulate or ban the practice in local waters. Florida’s Municipal Home Rule Powers Act grants municipalities broad police powers where state and county law does not pre-empt them, see Fla. Stat. Section 166.021 et seq., and Florida courts have recognized this can extend to regulating marine resources. In State v. Leavins, 599 So. 2d 1326, 1336 (Fla. Dist. Ct. App. 1992), a state appeals court held that “[t]he protection of valuable marine resources is a valid, and indeed inescapable, exercise of the state’s police power.” Similarly, in Moviematic Ind. Corp. v. Bd. Of County Comm’rs of Metro. Dade County, 449 So. 2d 667, 669 (Fla. Dist. Ct. App. 1977), the Florida Third District Court of Appeals concluded that “preservation of the ecological balance of a particular area is a valid exercise of the police power as it

102 Minutes FWC Meeting Sep. 6-8, 2000.
103 Minutes FWC Meeting Sep. 6-8, 2000.
relates to the general welfare,” upholding a county zoning decision instituting a building moratorium in a certain area. Therefore, in the absence of other action, municipalities could be justified in regulating the practice of marine feeding using police powers.

On February 11, 2001, the City of Deerfield Beach passed an ordinance “prohibiting the feeding of marine wildlife in proximity to the public beach.” On March 8, the Town of Hillsboro Beach followed suit, making it “unlawful” for any person to “feed marine wildlife within 1500 feet of the mean high tide water line adjacent to the shoreline in the Town of Hillsboro Beach,” or for “the owner or operator of any vessel to permit or assist any passenger on that vessel in the feeding of marine wildlife” within the same limit. However, this rule also specified:

Nothing in this section shall be construed to prohibit the use of bait or chum in the course of any lawful fishing activity or harvesting of marine wildlife pursuant to all applicable state and federal regulations.

This exemption of fishing practices, which will also be seen in many other rules and laws addressing the question of shark feeding, was necessary for the purpose of an ordinance, as the State of Florida preempts local regulation of fishing, limiting local power in this matter. The fact that more stringent regulation of shark fishing in Florida was not considered at this time and that there was minimal discussion of shark population trends suggests that the central basis of concern was not potential impacts on the ecological or biological health of shark populations, but was focused in large measure on the safety risks and liability potentially imposed by shark feeding ecotourism.

Other municipalities which did not take the step of banning or regulating the practice sought alternate methods for minimizing liability risk by making their concerns

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105 Hillsboro Beach Town Minutes, March 8, 2001.
about shark feeding known. The Lighthouse Point City Commission, uncertain whether it had the legal authority to ban shark feeding, opted instead to consider creating an ordinance refusing to grant an occupational license to any dive operator using city waterways or docks who wished to conduct shark feeding.\textsuperscript{106} The City of Delray Beach did not act to regulate the practice itself, but wrote to the FWC asking that the FWC “prohibit or appropriately regulate” feeding of marine life, and making explicit the basis of their concern:

While we understand that dive tour operators bring a certain number of tourists into our state and our area, certainly many times more tourists come to enjoy our beaches. Anything that might create the perception that our beaches are unsafe is surely to be avoided at all costs.\textsuperscript{107}

The City of Fort Lauderdale would later take a similar approach to the problem, passing a resolution urging the FWC to “enact an administrative rule prohibiting the feeding of sharks and other marine life” (Fort Lauderdale Res. No. 01-172).

\textbf{Industry’s Proposed Self-Regulation}

In May of 2001, the Global Interactive Marine Experiences Council (GIMEC)—an organization made up of both feeding dive operators and large industry players like the Dive Equipment and Marketing Association (DEMA)—presented their proposed guidelines to the Commission. Although these guidelines were supposed to be created in consultation with those in opposition to marine feeding, FWC minutes note that “[c]oordinated consultation with and involvement of all the principle [sic] parties were largely unsuccessful”\textsuperscript{108} Some of these industry drafted guidelines were viewed as


\textsuperscript{107} Letter to FWC from David Schmidt, May 13, 2001.

\textsuperscript{108} Minutes, FWC Meeting, May 2001.
acceptable by the Commission—for example, the training to be provided to staff running feeding dives, or the methodology proposed for reporting and tracking injuries associated with shark feeding dives. However, there remained several significant areas of contention, most notably questions about:

1. Conflicts with other [marine resource] users
2. Minimum distance from swimming beaches
3. List of feeding locations and suggested feeding zones
4. Species allowed to be fed or species prohibited from feeding
5. Hand-feeding or other feeding that associated food directly with humans

The Commissioners asked their staff to expand or alter the proposed GIMEC guidelines to address these additional concerns. The Commissioners also raised the possibility of limiting entry to the industry to control the number of operators offering marine feeding experiences, perhaps through a permitting system. The Commissioners were told by the General Counsel to the FWC that a rule limiting entry would not be strictly resource based (e.g., would regulate industry, rather than the behavior of industry in relation to wildlife) and thus might not fall within their mandate to regulate wildlife.109

Staff of the Department of Marine Fisheries drafted revised guidelines addressing the areas which the commission felt were unsatisfactorily addressed by the GIMEC proposal. Their proposals included:

1. Conflicts with other [marine resource] users
   - Avoiding sites used by other marine resource users
   - Limits on when feeds could take place
   - No feeds permitted to take place within 600 feet of an anchored boat or dive buoy
2. Minimum distance from swimming beaches
   - Minimum of one mile from swimming beaches
3. List of feeding locations and suggested feeding zones
   - Sandy areas
   - Areas not utilized by other resource users

• Minimum distance of 100 feet from natural reefs
4. Species allowed to be fed or species prohibited from feeding
  • No direct feeding [e.g., hand or spear feeding] of any species
  • If a shark other than nurse shark over five feet appears, termination of the feed
  • If behavior of marine animals is or becomes aggressive, termination of the feed
5. Hand-feeding or other feeding that associated food directly with humans
  • No handling of marine species
  • No direct feeding (hand, spear) of marine species
  • A container of bait emitting scents/oils to be used as attractant

These alternative proposals were not considered acceptable by the dive industry, which responded with suggestions and alternatives on seven issues. According to meeting minutes, “five of the suggested alternatives would be less conservative than those offered by the Commission and are not recommended” by FWC staff. Representatives of the dive operators responded that “adherence to the Commission-revised guidelines would nearly close marine-life feeding dives in Florida”. Later in the meeting, Commissioners directly asked Bob Harris, the lawyer representing DEMA, whether the dive industry would comply with the Commission’s revised guidelines. He “responded that they would not because it would put all four operators out of business.”

**Legal Basis for Regulation by the Fish and Wildlife Commission**

This impasse was clearly foreseen by the FWC Commissioners, and it was highly likely that the Commission planned to move forward with a ban on marine life feeding prior to the September 5 meeting. On August 28 the General Counsel to the FWC sent the Executive Director a memo detailing the basis of FWC authority to regulate or prohibit

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110 *Minutes, FWC Meeting, September 5-7, 2001.*
marine life feeding.\textsuperscript{111} The FWC derived such authority from Article IV, Section 9, of the Florida Constitution, which reads in part:

\begin{quote}
The commission shall exercise the regulatory and executive powers of the state with respect to wild animal life and fresh water aquatic life, and shall also exercise regulatory and executive powers of the state with respect to marine life...
\end{quote}

This memo argued that this constitutional mandate “gives the agency broad authority to regulate the behavior of people for the protection and benefit of the state’s marine resources” and that it also “invests the Commission with the authority to regulate human behavior vis-à-vis wildlife or marine life solely to assure the safety of those humans”.\textsuperscript{112} Public safety concerns were in fact an important rationale for the passage of several previous FWC rules, including a prohibition on using elephants for public rides “without first obtaining special authorization” (Rule 68A-6.0042, FAC). The memo concluded that a rule prohibiting the feeding of marine life within state waters was within the authority afforded by the Commission’s constitutional mandate.

Historically, bans on feeding of wildlife have taken a variety of forms. Some such laws are federal, like the Marine Mammal Protection Act of 1972 (as amended) which defines “feeding or attempting to feed” a wild marine mammal as “harassment” constituting a form of “take”. Similar protections exist for all animals listed under the Federal Endangered Species Act. At the present time, only one species of shark, the Scalloped Hammerhead, is listed under the Act, though ten more shark species are currently being considered for inclusion.\textsuperscript{113} In Florida, feeding of wildlife has sometimes been disallowed by rule, such as Rule 68A-4.001(3), which reads:

\textsuperscript{111} Memorandum, Office of the General Counsel, FWC, August 28, 2001.
\textsuperscript{112} Memorandum, Office of the General Counsel, FWC, August 28, 2001.
\textsuperscript{113} See 78 FR 69376 (2013); 78 FR 29100 (2013).
(3) Intentionally feeding black bears, foxes, raccoons, or sandhill cranes is prohibited.
(4) Intentionally placing, or allowing the placement of, or offering food or garbage in such a manner that it attracts black bears, foxes, raccoons or sandhill cranes and thereby creates a public nuisance is prohibited.

Such prohibitions have also been created by a combination of FWC rule and legislative law, as in the prohibition on feeding alligators and crocodiles, covered in Rule 68A-25.001 (“No person shall intentionally feed, or entice with feed, any Crocodilian…”) and a textually similar Florida Statute (Fla. Stat. Section 372.667(1)).

It seems clear that the FWC had a strong argument that the regulation of marine feeding fell within FWC authority, however it was less obvious what role (if any) the Florida legislature or local governments might have to play. Several municipalities had already passed ordinances moving marine life feeding away from public beaches, and these laws might or might not be at risk of being invalidated as infringing on the Commission’s constitutional authority. In the case of *City of Miramar v. Bain*, 429 So. 2d 40 (Fla. Dist. Ct. App. 1983) [hereinafter *Miramar*], the court held that when local governments exercise their police powers (in *Miramar*, regulating land use through zoning) in a way that affects subjects under the Commission’s jurisdiction, the court will attempt to harmonize local ordinance and the Commission rule. However, in the holding the court ruled that “a legislative enactment or municipal ordinance…if in conflict with the regulations of the [Florida Fish and Wildlife Conservation] Commission must give way to the Constitutional mandate establishing the Commission.” (Id., at 42) Thus, while a local ordinance employing municipal police powers to limit shark feeding dives might be permissible in the absence of a Commission rule, it would likely be pre-empted by such a rule if they were not in agreement.
Around this time, State Representative Charles Justice of St. Petersburg introduced a bill in the State Legislature to prohibit marine life feeding. He had previously gone on the record saying “[t]his has the potential to affect tourism, with all these people getting bitten by sharks,” and that he felt “the Legislature should make the final decision on it”.\footnote{St. Petersburg Times, August 25, 2001, 1B.} Shark diving operator Jeff Torode was particularly critical of this approach, telling a reporter from \textit{The Independent} “We are just the scapegoats out here. The politicians are saying, ‘We are going to be the saviours, we are going to rescue Florida's tourism and make it safe again.’ Well, it's all bullshit”.\footnote{The Independent, “Shark Practice”, August 31, 2001. http://www.independent.co.uk/news/world/americas/shark-practice-5546719.html, accessed August 1, 2017.} In terms of legislative authority to make such a decision, in Article IV, Section 9 of the Florida State Constitution, the Legislature is given authority to “enact laws in aid of the commission.” If the Commission were not to act to regulate marine feeding, it therefore might be constitutional for the legislature to pass a law prohibiting the practice, assuming it relied on traditional police powers belonging to the state. However, it seems clear that any law passed by the State Legislature or local governments could be superseded by Commission action on the basis of their constitutional authority to regulate wildlife.

The Commission’s authority in this matter would soon be put to the test. Following the dive industry’s refusal to adhere to the Commission’s proposed rules, the Commissioners acted almost immediately, passing a motion to “direct staff to prepare a rule to ban the practice of marine-life feeding by divers,” allowing for no further public comment or discussion, a decision that would be criticized (and defended), as well as
litigated.\textsuperscript{116} On September 24, the President of the Florida Association of Dive Operators sent an open letter to the Florida Fish and Wildlife Commission in which he compared the September 6 decision to move forward with the proposed ban to the September 11 terrorist attacks and the activities of the Third Reich, concluding,

I do feel sorry for you commissioners and all involved in your decision…I know you are in personal turmoil. You know you made the wrong decision for America and for American freedom. America knows you made the wrong decision…we will fight back and…we will prevail. The right outcome, the honest outcome, the just outcome will prevail.\textsuperscript{117}

Although there was significant discussion of the potential economic impacts of this decision on the four operators then running feeding dives and on Florida tourism more generally, when the proposed rule appeared in the \textit{Florida Administrative Weekly} on September 28, the estimated regulatory cost calculated a loss of income for the operators of between $660 and $1,320 per week per business—for a total maximum yearly loss of no more than $274,560, or $68,640 per year per operator.\textsuperscript{118} This loss estimate further assumed that these businesses would allow their boats and staff to sit idle, rather than replacing feeding dives with other (perhaps marginally less profitable) dive activities.

On October 9, Commission staff appeared before the Florida House Natural Resources Committee, where some members of the Committee urged the Commission to postpone making a final decision about the ban, and where the dive industry agreed to provide funding for research about the impacts of marine feeding—specifically, to address the question “[d]oes marine-life feeding alter shark behavior?” The offer to fund this study further clarifies that the purpose of the rule, regardless of the terms used to

\textsuperscript{116} Minutes, FWC Meeting, September 5-7, 2001.
\textsuperscript{117} Letter from Spencer Slate to FWC Commissioners, September 24, 2001.
describe it, was a ban on shark feeding as a potentially dangerous activity and that any other environmental or educational considerations were, at best, secondary.\textsuperscript{119}

On November 1, the Commission took up the issue of marine life feeding for the final time, presenting the proposed rule—which would “prohibit the practice of divers feeding fish” as well as “the operation of any vessel for hire for the purpose of carrying passengers to any site to observe fish feeding”.\textsuperscript{120} On October 19, DEMA lawyers had filed both an Administrative Hearing complaint and a lawsuit in Florida Circuit Court trying to prevent the proposed rule from being enacted. At the November 1 meeting, commissioners enquired of their General Counsel whether legal challenges to the rule impacted their ability to act on the proposed rule, and were told they did not. Dive industry representatives speaking against the rule again asserted that “it is a person’s right to feed marine life,” while also reiterating their eagerness to sponsor a study on the impacts of marine feeding and their willingness to continue to work on revising proposed guidelines.

The Commission was further advised that members of the Florida House Natural Resources Committee had requested that they delay action until completion of the industry funded study—which was estimated to require a minimum of one year to complete. The Commissioners were not receptive, declaring that the process had adequately taken into account public input and that there was sufficient scientific evidence on the potential harm of feeding wildlife to justify action. The Commission

\textsuperscript{119} Minutes, FWC Commission Meeting, November 1, 2001.
\textsuperscript{120} Minutes, FWC Commission Meeting, November 1, 2001.
voted six-to-one to pass the rule; Commissioner Huffman, who voted against the ban, had repeatedly claimed it would be “an unnecessary blow to tourism”.\(^{121}\)

**Administrative Hearing Complaint**

In the October 19 complaint to the Division of Administrative Hearings, DEMA lawyers alleged that the Commissioners had exceeded the scope of their authority:

> The purpose of the rule as stated by the Commission is to ensure public safety, which is a legislative function not delegated to the Commission by the legislature. The Commission’s function is limited to issues affecting marine life, its health and maintenance.\(^{122}\)

The complaint further asserted that (among other things) the Commission had failed to consider the impact of the rule on small businesses or explore ways to mitigate such impacts, as required under Section 120.54 (3)(b) of the Florida Administrative Code; failed to provide detailed written explanation of the facts and circumstances justifying the proposed rule; failed to send written notice of the rule to the Office of Tourism, Trade and Economic Development to allow them to review and offer regulatory alternatives; and failed to conduct a public hearing on the rule prior to scheduling the rule for final adoption. The complaint further alleged that there was no rational basis for the rule, claiming that

> Commission members and staff have admitted on the record that the reason for the rule is the “perception” and not due to a public safety problem. Commission members and staff have admitted on the record that there is a less than discernible detrimental impact of marine life feeding on marine life.\(^{123}\)

This complaint was a compilation of every possible error that could have been made regarding the rule, assuming it was subject to the Administrative Procedures Act. The

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\(^{122}\) *Complaint to the Division of Administrative Hearings*, October 19, 2001.

\(^{123}\) *Complaint to the Division of Administrative Hearings*, October 19, 2001.
FWC countered that rules promulgated under its constitutional authority were
“tantamount to legislative acts” and were not subject to Administrative Review under
Chapter 120.

The decision of the Administrative Hearing Judge on whether or not the case
would be heard hinged on one important issue: whether the Commission’s actions were
based on statutory authority (and thus subject to review under the Administrative
Procedures Act) or whether the rule was based solely on the Commission’s constitutional
authority, and therefore not subject to APA review.

DEMA lawyers argued that the Commissioners had regularly referenced Fla. Stat.
Section 370.025 (3)(a), as a source of their authority in this matter. This statute (enacted
by the legislature) reads, in part,

All rules relating to saltwater fisheries adopted by the commission shall be
consistent with the following standards:
(a) The paramount concern of conservation and management measures shall be
the continuing health and abundance of the marine fisheries resources of the
state…

Because the Commission had cited a legislative statute as a basis of their authority in this
matter, DEMA lawyers claimed it was both disingenuous and inaccurate to now argue
that the rule was exempt based on the constitutional authority of the Commission.

However, in section Fla. Stat. 20.331(6)(c), the Commission has only 14 duties or
responsibilities it considers “statutory” in nature. None of these statutory responsibilities
are marine life feeding, and therefore FWC claimed rulemaking about marine feeding
was constitutional in nature and not subject to APA review. The relevant statute reads:
“For purposes of this subsection, statutory duties or responsibilities include, but are not
limited to, the following…” and specifies that the Commission shall follow the
provisions of Chapter 120 when adopting rules in the performance of statutory duties.
DEMA lawyers used this ambiguity to argue that the marine life feeding rule was statutory rather than constitutional in nature.

DEMA lawyers cited the case *Florida Fish and Wildlife Conservation Commission v. Caribbean Conservation Corporation* 789 So.2d 1053 (Fla. Dist. Ct. App. 2001), in which the district court decided that the regulatory authority of the Marine Fisheries Commission (predecessor to the FWC) to enact rules related to endangered species was statutory in nature (as laid out in Chapter 99-254, Laws of Florida) and was therefore subject to Chapter 120 review, because such authority was shared with other agencies. However, Fla. Stat. 370.025 limits the applicability of this decision, as it specifies that:

…the commission has full constitutional rulemaking authority over marine life…except for:
(a) Endangered or threatened marine species for which rulemaking shall be done pursuant to chapter 120

FWC lawyers thus argued that this decision was limited in scope to endangered species specifically and that the decision could therefore not be applied to marine life feeding. On November 8, 2001, the Administrative Hearing complaint was dismissed for lack of subject matter jurisdiction.

**Request for Emergency Injunction**

On December 18, 2001, DEMA lawyers filed a request for an injunction for emergency relief in an attempt to prevent the rule from going into effect until the legal challenge had been ruled on. Circuit Court Judge L. Ralph Smith Jr. refused to grant the injunction on two grounds. He observed that the rule had been approved by the Commission on November 1, and that the plaintiffs had waited more than 45 days to file for emergency relief. He determined that the “[p]laintiffs’ delay does not create an
emergency”. The injunction was also refused on the grounds that the plaintiffs had failed to demonstrate “that they have a substantial likelihood of success on the merits of the underlying declaratory action.” Further, they had not addressed “their failure to avail themselves of their administrative remedies.”\(^{124}\) Thus their petition was found to be “facially insufficient” and the law went into effect as planned on January 1, 2002.

**Civil Suit**

The Complaint for Declaratory Judgment which DEMA filed in Circuit Court went even further than the brief filed with the Division of Administrative Hearings, requesting a declaratory judgment “that the proposed rule is invalid and facially unconstitutional because the rule is without basis factually, scientifically, and logically” and claiming that “[t]he agency proposes to act without any colorable legal authority”.\(^{125}\) The FWC moved for summary judgment on the case, calling for dismissal of the suit with prejudice. Summary judgment would hinge upon whether or not the “minimal scrutiny”\(^{126}\) standard applied to acts of the Legislature was the appropriate standard for judicial evaluation of the rule or whether the far more stringent standard for review of agency decisions under Fla. Stat. 120.68(7) applied.

DEMA lawyers argued that the ban was not legislative in nature, and therefore should not be subject to the “minimal scrutiny” judicial standard. The Commission responded that given their constitutional mandate, FWC rules are “tantamount to legislative acts” and therefore have a strong presumption of validity. Under this standard, the FWC need only demonstrate that some rational basis for the rule exists—without

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\(^{124}\) Ruling on Request for Emergency Injunction.
\(^{125}\) DEMA Complaint for Declaratory Judgment.
\(^{126}\) The minimal scrutiny standard requires that state laws have “some rational basis” are not “arbitrary or capricious” and are “rationally related to a legitimate state interest” summarized in Weinberg (1982), p. 446.
even being required to demonstrate that such rational basis was the true reason for the rule’s creation. In the final judgment, the court agreed that “the commission is not an agency as defined in the APA and its actions are not reviewable under that act,” and that rulemaking was therefore in fact “tantamount to a legislative act.”

The court went on to insist that “[t]he rational basis need not be readily apparent, nor must the state produce evidence to support the classification made.” The court cited *Heller v. Doe*, 509 US 312, 320 (1993), noting “…the classification ‘may be [legitimately] based upon rational speculation unsupported by evidence or empirical data.’” Therefore, the evidentiary burden was on the plaintiffs to “‘negate every conceivable basis which might support [the classification]’, whether or not the basis has a foundation in the record.” In order to be rejected by the court, there must be no possible rational basis for support of the rule, not simply a dispute over related facts.

The final ruling by Judge Janet E. Ferris on February 5, 2004, determined that the rule banning the feeding of marine life was a “valid exercise of the Commission’s constitutionally delegated authority,” and that it had demonstrated that there was a rational basis for the rule and for a “prohibition against divers, as opposed to others, feeding fish.” Although the court allowed the dive operators to submit “expert” affidavits criticizing FWC’s conservation expert, it found that under the rational basis test they failed to create “genuine issues of material fact.”

Plaintiffs also argue that the rule is, in reality, designed to protect people from shark attacks and that the Commission has no authority to adopt rules for public safety. The court need not address the scope of the Commission’s power in this respect because the rule itself clearly comes within the Commission’s constitutional authority to regulate marine life.127

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Summary judgment was accordingly granted, and although DEMA appealed, the judgment of the Circuit Court was upheld on appeal. At the time of this decision, the rule had already been law for several years. However, as we will see, there is a significant difference between passing and enforcing rules or statutes governing the practice of marine life feeding.

**Enforcement of Feeding Ban in Florida**

The ban on feeding marine life in Florida has proven consistently challenging to enforce. In March of 2014 dive operators were criminally charged with violating the ban after undercover Palm Beach County sheriff’s deputies allegedly observed (and filmed) these operators feeding sharks in state waters.\(^{128}\) The legal issues of the case centered around the exact jurisdictional location of boats and divers, but the operator clearly and publically expressed the intention to continue offering feeding dives regardless of legal penalties—which, based on what he was charged with (second-degree misdemeanors), would lead to maximum penalties of $500 in fines or 60 days in jail.

Other operators responded to the ban by moving their shark feeding dives offshore, offering week-long live-aboard dive trips during which shark feeds take place in international waters or in the territorial waters of the Bahamas, where shark feeding is legal. One of these companies, operating out of West Palm Beach, had a passenger die of exsanguination following a bull shark bite sustained during a feeding dive in February of 2008. A second death on the same boat in 2014 led to at least one call for a ban on shark

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feeding tourism in the Bahamas. The Bahamas has previously banned commercial fishing for sharks, in large part based on their tourism value, which is estimated at US$80 million per year in the Bahamas (Gallagher & Hammerschlag, 2011).

Even within the waters immediately surrounding Florida the marine feeding ban has caused considerable difficulty, given the patchwork of management jurisdictions. As we have seen, state law now bans feeding marine wildlife in waters controlled by the State of Florida. Within marine National Parks controlled by the National Park Service (NPS), the Code of Federal Regulations, Title 36, section 2.1 subsection (a)(1)(i) prohibits “possessing, destroying, injuring, defacing, removing, digging, or disturbing from its natural state, any living or dead wildlife or fish” located within national parks, making shark feeding impermissible there. However, in the case of federally protected near-shore waters administered by the National Oceanic and Atmospheric Administration (NOAA), including the one-third of the Florida Keys National Marine Sanctuary (FKNMS) which lies more than three miles offshore, the rules of the Florida Fish and Wildlife Conservation Commission are preempted by federal regulation. As of January 2017, there are no regulations prohibiting the feeding of marine life in the federal portion of NFKMS, where at least one operator continues feeding and handling sharks and other marine species. This operator, pictured in his own advertisements holding and restraining sharks and moray eels and feeding a barracuda with his mouth, is technically in compliance with the Commission rule.

Case Study 2: Hawaii

Following Florida’s ban on shark feeding, the state of Hawaii also took notice of the practice, and the Hawaii Department of Land and Natural Resources (DLNR) held a hearing on the possibility of instituting a ban on January 14, 2002. In both Florida and Hawaii, the “problem” being regulated was a relatively minor one—only a few dive operators in each state had been identified as participating in the feeding of marine life—and the DNLR similarly “felt it is desirable to take a proactive approach and prohibit such activities before they become established in Hawaii”. The stated motive for the ban was avoiding potential safety risks to participants and to other marine recreationists.

On June 6, 2002, the Hawaii Legislature passed legislation contending that “[a]ttacks on people involved in feeding operations have been documented, and untrained sharks may pose a generally increased risk of attacks on individuals not involved in feeding operations.” The law stipulates that “it shall be unlawful for any person to conduct any activity related to the feeding of sharks in state marine waters” except:

(b) Persons may engage in the feeding of sharks for traditional Hawaiian cultural or religious practices; provided that the feeding is not part of a commercial activity.
(c) Persons engaged in the taking of marine life that results in captured, injured, or dead fish being incidentally eaten by sharks shall not be considered in violation of this section; provided that the purpose of the taking of marine life is not the feeding of sharks.

As in Florida, the concern about a public hazard did not extend to fishing methods, even those which have the potential to expose humans to shark-related risk or to condition sharks to behave unnaturally. After the introduction of this legislation, a spokesman for the Hawaii State Department of Land and Natural Resources was quoted as saying that a

legislative approach was unnecessary and that such action could be taken by rules passed by the DLNR. As in Florida, there was significant disagreement not only about what action should be taken with regard to shark feeding, but about which governmental branch or agency had the best authority to act.

Tour operators attempted to skirt the Hawaiian Legislature’s ban by travelling outside state waters for the purposes of conducting shark feeding dives. The representatives to the US House of Representatives from Hawaii responded by amending the 2006 renewal of the Magnuson-Stevens Fishery Conservation and Management Act to read:

Except to the extent determined by the Secretary, or under State law, as presenting no public health hazard or safety risk, or when conducted as part of a research program funded in whole or in part by appropriated funds, it is unlawful to introduce, or attempt to introduce, food or any other substance into the water to attract sharks for any purpose other than to harvest sharks within the Exclusive Economic Zone seaward of the State of Hawaii and of the Commonwealths, territories, and possessions of the United States in the Pacific Ocean Area. (HR 5946 [109th])

By banning the practice of shark feeding in both state and federal Pacific waters, the state sought to close potential loopholes under which commercial shark feeding operations could continue; however in spite of a ban encompassing both state and federal waters, there are significant barriers to prosecution of violators, who must definitively be identified as illegally feeding sharks in an exact jurisdiction (state or federal waters) in order for prosecution to be practical.

The support of the rights of fishing interests also reiterates a major complaint of feeding ban opponents in Florida—that attracting sharks with bait for the purpose of observing them is illegal, while identical behaviors for the purpose of killing sharks remained perfectly permissible under state law. This makes claims that commercial shark
feeding is offensive to native Hawaiians slightly less credible. Native Hawaiians may consider sharks to be *aumakua* (guardian spirits) and Hawaiian religious or cultural practices may include reverence for sharks as demi-gods or ancestral spirits. One pro-ban activist noted that “the cultural concern is that they [dive operators] are profiting from our Hawaiian aumakua,” and that this constitutes “a direct slap in the face to Native Hawaiians as we are taught to leave [sharks] be”\(^\text{132}\). However, under Hawaiian law shark viewing tours are perfectly legal (and this pro-ban organization claims to have no objection to the shark tourism industry, provided it complies with the feeding ban). Thus shark viewing is apparently culturally permissible, so long as chumming does not take place; while both commercial and recreational fishing for sharks, including chumming, is also acceptable. It seems inconsistent that feeding sharks for viewing purposes constitutes cultural insensitivity while viewing without feeding, or commercial and recreational fishing including feeding, is acceptable.

Nor were bans on shark feeding in both State and Federal waters adequate to end the practice of shark feeding in Hawaiian waters; four years later the State Legislature would again pass relevant legislation, this time “[u]rging the Department of Land and Natural Resources to adopt rules to enforce the ban on shark feeding for the safety of the people of Hawaii and preservation of its marine ecosystem.” This legislation acknowledged that the DNLR has “expressed concerns over the enforceability and nominal penalties of the statutory prohibition,” but made clear that the Legislature expected action from the DLNR, and that rules should:

(1) Prohibit commercial use of shark cages or other devices designed to place humans in close proximity to sharks for the purpose of feeding them;
(2) Prohibit the use of public harbors and facilities, such as parks, piers, docks, and ramps, by shark tour operators using such cages;
(3) Prohibit the transportation of commercial shark feeding cages through state waters; and
(4) Stringently enforce the law prohibiting the feeding of sharks in the waters of Hawaii

This legislation went on to provide that should the DNLR decline to adopt such rules, they are “urged to make specific recommendations to the Legislature for the revision of the applicable state statutes to promote enforcement of the prohibition against the feeding of sharks and provide adequate deterrence from violation of existing statutes” (Hawaii SR 109, HCR 279). The conflict over who had regulatory authority led to a failure of regulation in spite of several aggressive legislative acts. The DNLR has since adopted the original legislative language from the bill passed in 2002 as HRS 188-40.6.

**Enforcement of Shark Feeding Ban in Hawaii**

As Hawaii’s demands on the DNLR demonstrate, enforcing a ban on a marine activity is difficult, particularly when the proposed penalties are relatively modest. Despite the practice having been banned by the Legislature in 2002, during the 2010 Legislative Session, Hawaiian lawmakers considered seven different bills intended to terminate or further restrict shark ecotourism. Failed bills sought to “ban tours that feed sharks, outlaw the use of cages for people to get closer to sharks, and block the use of state harbors and parks for the tours”. Among the failed legislation was House Bill 2583, which would have dramatically increased the penalties for shark feeding, making

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violations punishable by a fine between $5,000 and $15,000, as well as by possible vessel forfeiture. It was passed by the House and Senate, but vetoed by Governor Linda Lingle.

It seems reasonable to say, therefore, that the Hawaii ban (in spite of making shark feeding an offense under both state and federal law) has not proven to be a tremendous success. Both Hawaii Shark Adventures and North Shore Shark Adventures currently offer shark trips in Hawaiian waters, and claim that they don’t “feed” sharks—though the Hawaii Shark Adventures website acknowledges “a small amount of fish scraps is used to attract sharks close to the cage for easy viewing and photography,” in potential violation of both state and federal law.

Charges against five employees of these two companies were filed in Hawaiian District Court in January of 2011. Defense attorney Ken Kuniyuki responded, claiming that there was “no legal or factual basis for this law at all,” and that the DNLR had either overreacted or was scapegoating the defendants, subsequently telling newspapers that the charges were “a petty misdemeanor, and there’s only a fine involved here and yet DLNR sent three or four armed people to serve these penal summons, which is certainly a waste of DLNR resources”.134

The charges were dismissed after National Oceanic and Atmospheric Administration officials, who had assisted the state in investigating possible violations, refused to release details about the “secret law enforcement GPS” used to track the location of shark feeding boats. The charges were dependent on proving that the feeding took place within state jurisdiction (within three miles of shore) so when the judge rejected the GPS evidence, prosecutors for the case requested the dismissal of charges.

they could no longer prove. Opponents of shark feeding were “hopeful authorities will try the case again in federal court” since feeding in federal waters is also illegal—however, without definitive proof of location, federal charges were similarly unlikely.135

The issue of shark feeding and regulation continues to be a contentious one in Hawaii. Research and shark tagging partnerships with the University of Hawaii have allowed currently active shark feeding eco-tours to affiliate themselves with University research, exempting them from the feeding ban, which does not apply to federally funded scientific research.136 At least one opponent of shark feeding appears to have abandoned hope that legal remedies can resolve the issue: in January and March of 2011, there were three separate arson incidents targeting tour boats belonging to North Shore Shark Adventures, causing estimated total damage of approximately $550,000 to three different boats.137

Conclusion

Although there are many technical difficulties associated with enforcing a ban on commercial shark feeding, actually preventing shark feeding is only part of the purpose of such bans. Another significant motive is the need to protect the state, agencies and local governments (who now “know” about a potential risk) from liability associated with shark feeding. The bans discussed here are likely to beget further bans and regulations, as increasing knowledge about the “risks” which shark feeds might present expands the

threat of liability. The Cayman Islands, Guam, New Caledonia and Western Australia have all also acted to ban or limit the practice of shark feeding in their territorial waters.

The wellbeing of sharks, while not ignored by decision makers, has clearly not driven consideration of the issues discussed in this chapter. Both the scientific and social impacts of shark feeding ecotourism have been substantively debated, with some scientists and conservationists hoping it will further shark conservation, while others remain skeptical of the stability and strength of the incentives shark tourism creates to enact lasting protections for sharks. While there are cases in which shark ecotourism has been a catalyst for lifting communities out of poverty and generating well-paying local jobs (e.g., Brunnschweiler, 2010) there are also cases in which local people have felt deprived of access to valuable traditional shark fisheries without compensation (Rodríguez-Dowdell et al., 2007).

This chapter has attempted to illustrate by example some of the reasons that shark ecotourism is likely to be subject to regulation in many of the places where it currently exists, making it an uncertain mechanism for the future of shark conservation, as well as to illuminate the difficulties involved in creating and implementing such regulation. Based on these case studies, it appears that both shark dive operators and ban proponents are only nominally debating the issue of shark feeding. In Florida, the issue became a proxy war for the conflict between “consumptive” and “non-consumptive” marine resource users, while in Hawaii the debate over cultural sensitivity became a flash point for questions about racial identity, belonging and “in group” status. In both of these case studies, human issues have been sometimes awkwardly grafted onto conversations about sharks. However, in order to address both social and ecological questions in more
productive ways, a frank discussion about what shark ecotourism can and cannot do and
an exploration of the unspoken subtext of these legal debates is necessary.
Chapter 7

Grolar Bears and Florida Cougars:
Public Perceptions of Hybridization and Species Categorization
Background

More than 150 years after Darwin published *On the Origin of Species*, there is still
disagreement and confusion among biologists about exactly how and where distinctions
between species should be drawn. This has been both simplified and further complicated
by the increasing complexity of available tools for genetic research (Mallet, 1995). New types of data have required humans to grapple more deeply with inconsistencies
between biological processes and the systems of thought we have invented to describe
them. Some scientists understand that this is an insoluble challenge created by the
limitations of language; Helbig, Knox, Parkin, Sangster, & Collinson (2002) describe the
difficulties of clear definitions around speciation and hybridization as

…an inevitable consequence of the artificial partitioning of the continuous
processes of evolution and speciation into discrete steps. It would be a mistake to
believe that the adoption of any particular species concept will eliminate
subjectivity in reaching decisions. Adopting a different species concept merely
moves the boundaries, and changes the individual taxonomic decisions that are
controversial. (p. 518)

Of course, this has not prevented a range of researchers, over time, from proposing a
variety of “solutions” to this problem. Mayden (1997) similarly acknowledges that the
limitations of language in talking about species “ultimately results in a trade-off between
convenience, accuracy, precision, and the successful recovery of natural biological
diversity.” (p. 381). To a large degree, the debate among systematists about the nature
and definition of “species” has occurred without substantial participation from
conservation biologists, in spite of the complexity of conserving “species” and

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138 These questions are further complicated by the reality that “species” is used in science to refer to
multiple things—according to Mayden (1997), there are at least 24 independent and mutually exclusive
“species concepts” including “biological”, “recognition”, “ecological”, “evolutionary” “phylogenetic” and
“isolation” (see also De Queiroz, 2007). Species may also be used as a “unit of evolution”—e.g., the object
of measurement for evolutionary change. For further discussion of some of the various “species concepts”,
see also Helbig et al. (2002).
“biodiversity” without functional concrete definitions for either of those concepts (Rojas, 1992). On top of this confusion among experts, it is unclear the extent to which the non-expert public conceptualizes the idea of “species” as being a complex one involving a range of subjective judgments, or one with a simple, objective, definitive answer generated by scientists.

Hybridization, the interbreeding of closely related species, is one of the primary processes by which rapid, substantial evolutionary change occurs (Mallet, Beltrán, Neukirchen, & Linares, 2007). Introgression, the exchange of genes from one species to another through hybridization, can contribute both to adaptive evolution and to further speciation (Mallet et al., 2007). Hybridization (both naturally-occurring and anthropogenic) can thus be a vector for either species evolution or eventual extinction (Allendorf, Leary, Spruell, & Wenburg, 2001). Low levels of gene exchange across species is widespread in the natural world; approximately 25% of plant species and 10% of animal species are known to hybridize to varying degrees, and advances in DNA sequencing have made it clearer than ever before that “limited invasions of the genome” are relatively common (Mallet, 2005, p. 230).

Hybridization events have been increasing globally, however, at least in part as a result of translocation of plants and animals and anthropogenic changes to habitat or climate. Changing climate is likely to increase the extent to which hybridization occurs, as it leads to shifts in species’ ranges, resource use, and dispersal patterns (Parmesan, 2006). Hybrid individuals may exhibit greater genetic fitness than either parent species, but sometimes will be disadvantaged for ecological, rather than genetic, reasons, especially in climatically fluctuating environments (Templeton et al., 1986; Grant &
Grant, 1992). Thus, hybridization may represent an adaptive response to changes in climate (if it allows a greater variety of genes to persist) and/or may lead to the disappearance of previously recognized species and sub-species (Muhlfeld et al., 2014; Becker et al., 2013).

Hybridization inherently creates significant challenges to the formulation of species definitions and distinctions, and thus to the practices of biological and biodiversity conservation. These events raise complex questions about whether or not hybridization is occurring “naturally”, whether and when hybrids can or should be conserved, and how they fit into larger ecological systems, only some of which science is able to answer (Stronen & Paquet, 2013). While science can help explain the facts of how hybridization occurred, it cannot tell people how to respond to hybrids. Decisions about hybrid conservation are (at least theoretically) made the same way all conservation decisions are—on the basis of moral and ethical values, and perceptions of what is worth saving and protecting (Dunlap, 1995; Vining, 2003). Anthropogenic environmental change makes it a certainty that current levels of hybridization will continue or even accelerate, and that at least some divisions between species that have been stable throughout human history will change. These changes will also present novel challenges to many human policy and regulatory mechanisms, which often rely on unchanging and (at least theoretically) clearly delineated species or sub-species boundaries as the unit of conservation (e.g., for the US Endangered Species Act, Hill, 1993; Doremus, 2010).

This chapter seeks to build a preliminary understanding of some of the factors people consider in evaluating questions about species categories and fluctuations. Two case studies, the first involving the hybridization of polar bears (Ursus maritimus) and grizzly...
bears (*Ursus arctos horribilis*) in Canada, and the second involving the genetic rescue of Florida panthers (*Puma concolor coryi*) by Texas cougars (*P. c. stanleyana*) in Southern Florida, were used to assess how people apply their understandings of speciation to different hybridization events. We use these case studies as a means of exploring the extent to which respondents understand “species” as a strictly biological category, or one that has additional social, behavioral and conservation implications.

**General Methods**

Below we present the general sampling and recruitment methodologies for both case studies. We then discuss each case study (grolar bear/pizzly and panther/cougar) independently, providing background, detailing the analytical approach and results, and offering case-study specific conclusions. At the end of case study two, we offer more general conclusions touching on results from both case studies.

**Participant Recruitment and Sample Screening**

A sample of United States (US) residents (*N* = 350), aged 20-70 years (*M* = 34.80, *SD* = 10.06), was recruited from an online participant pool via Mechanical Turk (www.mturk.com). Mechanical Turk is a service provided by Amazon that allows online “requesters” (e.g., scientists, marketing researchers) to post tasks for “workers” from the online pool to complete for small fees. The survey was advertised on Mechanical Turk as a general “attitude survey” with eligibility restricted to those 18 years of age and older, fluent in English and residing in the United States. Residency is determined by Mechanical Turk in advance, allowing researchers to pre-filter who is able to see and complete a given task. Interested participants were directed to an online questionnaire.

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139 For a brief discussion of Mechanical Turk as a sampling tool please see the methods section within Chapter 3.
hosted by Qualtrics. Upon completion participants were paid $1.50. The research protocol for this study was reviewed and approved by the Institutional Review Board at the University of Miami (protocol #20161151). Both case studies below are based on this participant group.

The research items included in the current chapter were part of a larger survey, which was estimated to take approximately 10-15 minutes to complete. Participants who took less than 2 minutes or more than 500 minutes were excluded from analysis (final average completion time: 14.79 minutes). Data was screened using an attention check placed randomly within a battery of Likert items located toward the end of the survey ("Humans are sometimes distracted when filling these in, please leave this item blank."). Participants who marked a response for this item were excluded unless they noted in the feedback section at the end of the survey that they had marked this item by accident. Data was also screened for common rapid answering patterns (e.g., straightlining). Exclusion of individuals with these characteristics left a final sample of $N = 334$.

**Demographics and Environmental Attitudes**

Demographic variables were collected to both characterize the sample and as factors in exploratory correlation analysis. Gender (male = 0, female = 1), highest level of education, income, and race/ethnicity (US Census categories) were collected as categorical variables. Participants entered number values for their age in years. Participants also indicated their political party affiliation and rated their ideological lean on a 7-point Likert scale ranging from 1 (very conservative) to 7 (very liberal). Environmental attitudes were captured using an 8-item measure adapted from Dunlap et
al. (2000)’s New Ecological Paradigm scale ($\alpha = 0.78$). Demographic characteristics of the sample are summarized in Table 7.1.

**Case Study 1: Grolar Bears (or Pizzlys)**

**Background**

Although polar bears and grizzlies were previously known to be capable of hybridization in captivity, evidence of the existence of wild hybrids in Canada has begun to accumulate in the last decade. In April of 2006, a somewhat odd looking polar bear was shot by a trophy hunter in Canada’s Northwest Territories, which was ultimately

<table>
<thead>
<tr>
<th>Table 7.1. Demographic characteristics of the sample (self-reported)</th>
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<tbody>
<tr>
<td><strong>Gender</strong></td>
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<td>Female</td>
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<td>Male</td>
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<tr>
<td><strong>Age</strong></td>
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<td>55-64</td>
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<td>65+</td>
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<td><strong>Race</strong></td>
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<td>White</td>
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<tr>
<td>Black</td>
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<tr>
<td>Hispanic</td>
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<tr>
<td>Asian</td>
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<tr>
<td>Am. Indian/Alaska Native</td>
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<tr>
<td>Other</td>
</tr>
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<tr>
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</tr>
<tr>
<td>Associates degree</td>
</tr>
<tr>
<td>Bachelor's degree</td>
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<tr>
<td>Advanced degree</td>
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</table>

* Due to missing data the total N does not always add up to 334 for each variable.
found to be a wild polar-grizzly hybrid (Doupé, England, Furze, & Paetkau, 2007). The known examples of polar-grizzly hybrids have been phenotypically and behaviorally diverse, showing a mix of characteristics from each parent species (Pongracz, Paetkau, Branigan, & Richardson, 2017; Preuß, Ganslöser, Purschke, & Magiera, 2009).

Although the explanation given to survey participants (below) is somewhat simplified, the genetic relationship between polar bears and brown bears is complex and scientifically contested, with legitimate questions raised about whether or not they represent fully distinct species. Some scientists theorize that the demonstrable presence of polar bear mtDNA in brown bears, including grizzlies, is the result of an ancient hybridization event that may have allowed polar bears to survive interglacial periods (Doupé et al., 2007). Genetic research suggests that polar bear genes have substantially introgressed into brown bear genomes, while there has been no corresponding admixture introducing grizzly genes into the polar bear population (Cahill et al., 2015).

This asymmetry suggests the possibility that the introduction of brown bear DNA into polar bears could lead to poor fitness and low survival rates that prevent reproduction, while hybrids raised by grizzly mothers prove more successful. This asymmetrical genetic exchange is consistent with a biological definition of grizzly bears that includes polar bears, but inconsistent with a biological definition of polar bears that

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140 Pagés et al. (2008) found polar and brown bears to be reciprocally monophyletic, further supporting a theory of intermixed ancestry.
141 This seems plausible, given that polar bears are extremely specialized for their environment, including differences from other bears in fur color and structure, paw morphology, fat distribution, and several physiological adaptations to conserve moisture that allow polar bears to cope in fresh-water-poor arctic environments. Theoretically, the hybrid offspring of a polar bear mother might have difficulty hunting (because of poor camouflage of a non-white bear hunting seals on pack ice in the arctic), staying warm (because of differences in fur and fat morphology and distribution), and safely accompanying its mother on long-distance swims (because it might lack polar bear adaptations necessary for swimming (paw morphology, buoyancy) and heat retention (fur, fat). Although this proposed explanatory model is simplistic, it may suffice to explain introgression of polar bear genes into brown bear populations, and the corresponding lack of introgression of brown bear genes into the polar bear genome. Proposed model adapted and expanded from Cahill et al. (2015).
includes grizzlies (e.g., that polar bears are brown bears, but brown bears are not polar bears) (Cahill et al., 2015).

Hybridization of these species could have a range of significant conservation consequences. Polar bears and grizzlies are subject to different management, and it is unclear what regulatory framework should or would be applied to their hybrid offspring. Similarly, the distribution of monetary benefits associated with these populations, either from tourism or trophy hunting fees, the latter of which mostly benefits indigenous peoples, are likely to be affected by changes in the existing relationship between the two species. Of course, it is also worth noting that in recent decades polar bears have increasingly been used in affective appeals as symbols of the impacts of climate change or growing threats to arctic ecosystems (e.g., Slocum, 2004; Dillahunt, Becker, Mankoff, & Kraut, 2008; Manzo, 2010). This makes questions about how we perceive, value, and classify hybrid bears not simply an academic exercise, but an issue with practical (and potentially increasing) real world consequences.

**Measures**

After completing the voluntary consent form participants were given a brief overview of the grolar bear phenomenon. The following description was provided:

A “grolar bear” or “pizzly” is the hybrid offspring of a brown bear (also known as grizzly bear) and a polar bear. Grolar bears can have one parent of each species or can have a hybrid parent (so, for instance, may have three brown bear grandparents and one polar bear grandparent). They range in appearance from

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142 The lack of a scientific name for hybrid offspring is a substantial barrier to their protection under national or international law (O’Brien & Mayr, 1991), including the US Endangered Species Act (Hill, 1993; Doremus, 2010).

143 Inuit sport hunting of polar bears in Nunavut, Canada, has provided economic value which supports the continuation of Inuit cultural practices, including dog mushing and traditional hunting, sewing and survival skills. These benefits have been crucial to securing Inuit community support for western-style wildlife management practices. Support for polar bear protections thus might be eroded by changes to current management (Dowsley, 2009). Obviously such changes could be proposed or enacted in response to increasing hybridization as well as other threats faced by polar bear populations.
looking almost exactly like grizzlies to almost exactly like polar bears, with many falling somewhere between in appearance. Their behavior and habitat use also varies, with some behaving more like polar bears and living in the arctic and some behaving more like grizzlies and relying on forest habitats.

**Ranking factors.** Participants were asked to consider the multiple factors that may be used when categorizing these bears as grizzlies, polar bears, or a hybrid (i.e., their appearance, where they live, their behavior, their genetic makeup, and the potential protections or management policy that would apply to the animal). Participants were asked to rank how important each of these factors would be to them personally when making a determination of how to categorize an animal. They were then asked to provide a similar ranking for how factors should be weighted by scientists and by managers.

**Attitudes toward bears and hybrids.** Participants completed a battery of Likert items related to polar, grizzly, and grolar bears using the scale 1 (Strongly disagree) to 7 (strongly agree). Items within this battery were designed to capture the following concepts:

- **Importance of purity** (2 items): valuing the “genetic purity” of grizzlies or polar bears relative to hybrids ($\alpha = 0.61$).
- **Rarity value** (3 items): valuing the relative rarity of hybrid bears ($\alpha = 0.31$; low Cronbach’s alpha score means this measure was excluded from analysis as a combined scale and items were instead considered individually).
- **Naturalness** (3 items): believing hybridization is a natural process ($\alpha = 0.78$).
- **Positive conservation impact** (2 items): attitudes about whether hybridization is good for bear conservation ($\alpha = 0.66$).
- **Anti-protection of hybrids** (2 items): not supporting hybrid bear protection ($\alpha = 0.68$).
Using a 7-point scale from 1 (strongly disagree) to 7 (strongly agree) participants also indicated across 2 items whether they felt that polar bears/grizzlies and hybrids respectively have a right to exist. Participants used the same Likert scale across 3 items to indicate the degree to which they believed polar bears, grizzlies and hybrids respectively are important for the ecosystems in which they live. All of the above items were presented in randomized Likert blocks.

**Willingness to pay for tourism opportunities.** For each of the three types of bears (polar, grizzly, grolar), participants were shown a picture and asked to indicate how much they would be willing to spend in US dollars on tourism that allowed them to view that kind of bear. The order in which the bears were presented was randomized.

**Analytical Approach**

The non-parametric Friedman test was used to determine if individuals differed in how they ranked the importance of different factors for categorizing bears between themselves, scientists, and managers. Wilcoxon signed rank tests with a Bonferroni correction was used as *post hoc* analysis for each factor.

Visual inspection of frequency distribution of variables was used as an initial assessment of normality. Some skew was observed in some variables and the ordinal characteristics of the single item measures used led to the selection of a non-parametric alternative to a one way repeated measure analysis of variance. Thus, a Friedman test was used to determine whether subjects differed in their belief that grolar and grizzly or polar bears have a right to exist. This approach was also used to assess whether subjects differed in how important they believed each type of bear to be ecologically, and how much they would be willing to pay for a tourism opportunity that allowed them to view
each kind of bear. Wilcoxon signed rank tests with a Bonferroni correction was used as *post hoc* analysis for each factor. Exploratory correlation analysis was used to determine relationships between attitudes about hybrids and individual differences. Spearman Rank-Order correlation was used to account for the use of non-parametric ordinal data.

**Results and Discussion**

**Factors for determining how to categorize hybrid bears across potential decision makers.** There was a statistically significant difference in the mean rank assigned to all five factors when participants considered their own priorities versus those that they believe scientists and managers should apply (appearance: $\chi^2(2) = 103.05, p < 0.001$; where they live: $\chi^2(2) = 232.51, p < 0.001$; behavior: $\chi^2(2) = 28.18, p < 0.001$; genetics: $\chi^2(2) = 290.57, p < 0.001$; protections: $\chi^2(2) = 230.82, p < 0.001$). Median and mean rank are displayed in Table 7.2. How important individuals considered protections and behaviors for themselves and for scientists was not different, though each differed from how important participants felt this factor was for managers. These two exceptions aside, *post hoc* analysis revealed that all other differences between rankings on each list were significantly different, even accounting for a Bonferroni correction ($p < 0.001$ for all tests). The inverse mean ranks of each factor by decider are

<table>
<thead>
<tr>
<th>Factor</th>
<th>Who is deciding</th>
<th>You</th>
<th>Scientists</th>
<th>Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>You</td>
<td>2.5 (1.68)</td>
<td>3 (1.98)</td>
<td>4 (2.34)</td>
</tr>
<tr>
<td></td>
<td>Scientists</td>
<td>3 (2.18)</td>
<td>3 (2.39)</td>
<td>1 (1.42)</td>
</tr>
<tr>
<td></td>
<td>Managers</td>
<td>3 (1.96)</td>
<td>2 (1.86)</td>
<td>3 (2.19)</td>
</tr>
<tr>
<td>Where they live</td>
<td>You</td>
<td>3 (1.92)</td>
<td>1 (1.50)</td>
<td>4 (2.58)</td>
</tr>
<tr>
<td></td>
<td>Scientists</td>
<td>5 (2.25)</td>
<td>5 (2.29)</td>
<td>5 (1.46)</td>
</tr>
</tbody>
</table>
Respondents reported that consideration of the protections a species would receive should be relatively more important for managers than for scientists or the general public, but the level of protections was given relatively low importance for all categories of evaluator. Respondents felt the genetic categorization of animals was relatively unimportant for managers to consider, despite relatively high importance to scientists and the public. Respondents appeared to apply not only their understanding of the relative responsibilities of scientists, managers, and the public to determining which factors were most relevant, but may also have engaged heuristic standards of practicality, evaluating where a species lived as a factor of greater significance to managers than to others, and considered appearance as a factor appropriate for consideration by the general public, but not for scientists and managers.
Differences in attitudes toward hybrid and non-hybrid bears. Participants on average positively endorsed the attitudes about both hybrid and non-hybrid bears’ right to exist. However, subjects differed significantly in how much they agreed with statements about whether polar bears/grizzlies (M = 6.24, SE = 0.07, Median (IQR) = 7.00, 6.00 to 7.00) vs hybrids (M = 5.80, SE = 0.09, Median (IQR) = 6.00, 5.00 to 7.00) have a right to exist ($\chi^2(1) = 28.41, p < 0.001$) (Figure 7.2).

Subjects also differed significantly in how much they agreed with statements about whether polar bears ($M = 5.93, SE = 0.08, \text{Median (IQR)} = 6.00, 6.00 to 7.00$), grizzlies ($M = 5.93, SE = 0.07, \text{Median (IQR)} = 6.00, 6.00 to 7.00$), and hybrids ($M = 5.13, SE = 0.08, \text{Median (IQR)} = 5.00, 4.00 to 6.00$) are important to their ecosystems ($\chi^2(2) = 175.89, p < 0.001$). Post hoc analysis indicated that the mean for hybrids was significantly lower than that of polar bears ($Z = -8.54, p < 0.001$) and grizzlies ($Z = -8.86$, $p < 0.001$).
Subjects did not differ in their agreement about the importance of polar bears and grizzlies to their ecosystems ($Z = -0.34$, $p = 0.73$) (Figure 7.3).

It is clear from these responses that people may feel hybrid species have a different, and lesser, moral standing or existence right than even very similar animals occupying the same ecological niches. Respondents describe hybrid bears as less valuable to their ecosystems than their parent species, in opposition to scientific evidence that indicates that hybrids may successfully occupy the niches of parent species and fill comparable ecosystem roles (Stronen & Paquet, 2013). These findings suggest that there may be particular challenges associated with rallying public support to protect hybrid species in at least some cases, and that even if hybridization is successful as a biological strategy to conserve genes and adapt to a changing environment, it may also have negative effects on conservation efforts. Thus, increased hybridization has the potential to lead to declines in support for conservation if charismatic species like polar bears with high symbolic significance are partially or wholly supplanted by hybrids which are less...
highly valued by the public (for the symbolic importance of polar bears, see Dillahunt et al., 2008; Manzo, 2010).

Finally, subjects differed significantly in how much they were willing to pay for tourism opportunities that would give them the chance to see polar bears ($M = 390.16, SE = 53.78, \text{Median (IQR)} = 100.00, 21.25 \text{ to } 387.00$), grizzlies ($M = 235.10, SE = 31.74, \text{Median (IQR)} = 50.00, 20.00 \text{ to } 200.00$), or hybrids ($M = 252.31, SE = 30.76, \text{Median (IQR)} = 100.00, 20.00 \text{ to } 200.00$), ($\chi^2(2) = 117.26, p < 0.001$) (Figure 7.4). Post hoc analysis indicated that the mean willingness to pay (WTP) to see hybrids and grizzlies were each significantly lower than the mean WTP to see polar bears ($Z = -6.49, p < 0.001, Z = -9.79, p < 0.001$). Interestingly, participants were also slightly more willing to pay to see hybrids than grizzlies ($Z = -4.08, p < 0.001$). Note, however, that the parametric one way repeated measures did not find a significant difference between these two values ($t = 0.88, p = 0.38$). It is not clear what the cause of additional willingness to pay to see polar bears is, as the more exotic environment in which they are located may also play a role in generating a higher average WTP (though, of course, some hybrids would also likely occur in arctic environments).

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144 Willingness to pay (WTP) as a measure of value has significant limitations, particularly given that hypothetical responses are often higher than actual WTP and may vary based on the elicitation method (e.g., Blumenschein, Blomquist, Johannesson, Horn, & Freeman, 2008, Voelckner, 2006). These challenges are substantially less when it is being used to ascertain relative value, as the accuracy of the chosen value is less significant than its relationship to other WTP values.
These findings suggest that hybridization would likely have a minimal impact on existing tourism targeting grizzlies in Canada or Alaska, as polar bear-grizzly hybrids would not be less valued than the current target species. This has more serious implications for existing polar bear tourism operations, as at least some of these are located in remote arctic environments that hybrids could be less likely to occupy, and where there are limited opportunities for alternate nature tourism attractions. Similarly, the polar bears may not be replaced easily by hybrids in the role they have played as symbols of arctic ecosystems and the effect of climate change on the planet (e.g., Slocum, 2004; Dillahunt et al., 2008; Manzo, 2010). Finally, in cases in which a hybrid attracts significantly less tourist interest than one of the parent species, by being present at tourist sites it may serve to reduce tourist interest in and support for parent species, and could potentially affect the ability of tourism to generate sufficient revenues to support conservation of parent species (e.g., allow species to “pay their own way”).

Figure 7.4. Participants’ mean willingness to pay for tourism opportunities to see hybrid versus non-hybrid bears. Error bars represent the 95% confidence interval. All values are significantly different.
Exploratory correlation analysis between attitudinal and individual differences. A complete reporting of the Spearman Rank-Order correlation analysis is presented in Table 7.2. Select correlations are outlined and discussed below.

Pro-environmental attitudes. For the most part, demographic differences did not significantly correlate with the attitudes studied. Pro-environmental attitudes correlated positively with being female ($r_s(300) = 0.11, p < 0.05$), liberal ideology ($r_s(299) = 0.45, p < 0.01$), the belief that hybridization is good for bear conservation ($r_s(302) = 0.22, p < 0.01$), the belief that hybridization is a natural process ($r_s(302) = 0.12, p < 0.05$), and WTP for all three types of bear tourism opportunities (WTP to see hybrids, $r_s(296) = 0.18, p < 0.01$; WTP to see polar bears, $r_s(296) = 0.20, p < 0.01$; WTP to see grizzlies, $r_s(296) = 0.21, p < 0.01$). Pro-environmental attitudes correlated negatively with being against protecting hybrids ($r_s(302) = -0.29, p < 0.01$).

These findings suggest that respondents who are already concerned with environmental issues implicitly or explicitly see hybridization as a natural process with the potential to contribute to conservation, and have an overall greater willingness to pay to encounter all three types of bear. This may mean that hybrids and an ongoing process of hybridization are unlikely to alienate support among constituencies already concerned about the environment and predisposed to support conservation initiatives.

Willingness to pay. Willingness to pay for all three types of bear tourism correlated positively with each other (WTP to see hybrids with WTP to see polar bears, $r_s(313) = 0.85, p < 0.01$; WTP to see polar bears with WTP to see grizzlies, $r_s(313) = 0.93, p < 0.01$; WTP to see hybrids with WTP to see grizzlies, $r_s(313) = 0.85, p < 0.01$). WTP for all three types of bear tourism was also correlated positively with age (WTP to
see hybrids, $r_s(302) = 0.12, p < 0.05$; WTP to see polar bears, $r_s(302) = 0.18, p < 0.01$; WTP to see grizzlies, $r_s(302) = 0.16, p < 0.01$ and income (WTP to see hybrids, $r_s(302) = 0.13, p < 0.05$; WTP to see polar bears, $r_s(302) = 0.19, p < 0.01$; WTP to see grizzlies, $r_s(302) = 0.15, p < 0.01$). WTP to see polar bears was additionally positively correlated with education level ($r_s(301) = 0.13, p < 0.05$). WTP to see hybrids additionally correlated positively with the belief that hybridization is a naturally occurring process ($r_s(313) = 0.14, p < 0.05$) and agreement with the statement “The rarity of hybrid bears makes them special.” ($r_s(313) = 0.15, p < 0.01$), and negatively with anti-protection attitudes ($r_s(313) = -0.17, p < 0.01$).
| $r_s$ (df) | **Pro-environmental attitudes** | Positive conservation impact | Importance of purity | Anti-protection of hybrids | Naturalness | Rarity attitude 1 | Rarity attitude 2 | Rarity attitude 3 | WTP for polar bear tourism | WTP for grizzly bear tourism | WTP for hybrid bear tourism |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Gender (F) | 0.11 (300) * | -0.067 (307) | -0.00 (307) | -0.02 (307) | -0.13 (307)* | -0.02 (307) | -0.06 (307) | -0.05 (307) | -0.03 (301) | -0.05 (301) | -0.04 (301) | |
| Age | 0.09 (301) | -0.02 (308) | -0.00 (308) | -0.05 (308) | 0.04 (308) | 0.04 (308) | -0.09 (308) | 0.00 (308) | 0.18 (302)** | 0.16 (302)** | 0.12 (302)* | |
| Level of education | -0.00 (300) | 0.01 (307) | -0.07 (307) | 0.07 (307) | 0.03 (307) | -0.10 (307) | -0.05 (307) | 0.10 (307) | 0.13 (301)* | 0.10 (301) | 0.10 (301) | |
| Income | 0.04 (301) | -0.08 (308) | 0.04 (308) | 0.02 (308) | -0.02 (308) | -0.05 (308) | 0.00 (308) | 0.07 (308) | 0.19 (302)** | 0.15 (302)** | 0.13 (302)* | |
| Liberal ideology | 0.45 (299)** | 0.13 (306)* | -0.07 (306) | -0.18 (306)** | 0.17 (306)** | -0.05 (306) | -0.01 (306) | -0.18 (306)** | 0.06 (300) | 0.06 (300) | 0.09 (300) | |
| Pro-environmental attitudes | 0.22 (302)** | -0.05 (302) | -0.29 (302)** | 0.12 (302)* | 0.07 (302) | 0.01 (302) | -0.28 (302)** | 0.20 (296)** | 0.21 (296)** | 0.18 (296)** | 0.08 (313) | |
| Positive conservation impact | -0.29 (319)** | -0.57 (319)** | 0.54 (319)** | 0.23 (319)** | 0.12 (319)* | -0.34 (319)** | -0.04 (313) | -0.01 (313) | -0.01 (313) | -0.13 (313)* | -0.17 (313)** | |
| Importance of purity | 0.43 (319)** | -0.39 (319)** | -0.45 (319)** | -0.25 (319)** | -0.01 (319) | 0.15 (319)** | 0.04 (319) | 0.07 (313) | 0.05 (313) | 0.14 (313)* | | |
| Anti-protection of hybrids | Naturalness | Rarity attitude 1 | Rarity attitude 2 | Rarity attitude 3 | WTP for polar bear tourism | WTP for grizzly bear tourism | WTP for hybrid bear tourism | Notes: * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).  
Rarity attitude statements were analyzed separately because of the low Cronbach's alpha score when combined into a single scale. The items read as follows: Rarity attitude 1 "The rarity of hybrid bears makes them special."; Rarity attitude 2 "Because hybrid bears are less common, they are more valuable"; Rarity attitude 3 "It is not important to manage hybrid bears because they are uncommon".
These correlations, unsurprisingly, make clear that willingness to pay to encounter one type of bear is related to willingness to pay to encounter other types of bear. Similarly, older people with more money are willing to spend more of it on wildlife tourism than younger, poorer people would spend to encounter bears. Finally, willingness to pay to see hybrid bears was correlated with the belief that hybrids are rare and therefore special, suggesting the possibility that different framings of hybrids could be used to manipulate how they are perceived and valued. In the literature, framing which emphasizes the rarity and special features of an ecosystem has been shown to have a significant impact in choice modeling (Rolfe, Bennett, & Louviere, 2002). This framing is also often used in public discourse. Collins (2008) for instance noted the frequent use of a “rarity” framing across multiple documentaries and televised specials on nature and the environment. More research is needed to understand the role of perceived rarity on attitudes about environmental changes and support for conservation. More specifically, the impact of the perceived rarity or specialness of newly emerging hybrid species and the degree to which this perception can be emphasized to encourage support for particular policies is an interesting potential direction for future research.

**Protections.** Anti-protection of hybrid attitudes was associated with beliefs about the importance of purity ($r_s(319) = 0.43, p < 0.01$) and was negatively associated with liberal ideology ($r_s(306) = -0.18, p < 0.01$), environmental attitudes ($r_s(302) = -0.29, p < 0.01$), belief that hybridization is good for bear conservation ($r_s(319) = -0.57, p < 0.01$), and belief that hybridization is a naturally occurring process ($r_s(319) = -0.39, p < 0.01$).

Respondents who did not support hybrid protection were more politically conservative, less likely to support environmental protection in general, and less likely to
believe hybridization is a naturally occurring process or can contribute to bear
conservation. These findings suggest that among constituencies that are less likely to be
natural allies of environmental conservation (the politically conservative, e.g., Dunlap,
Xiao, & McCright, 2001), hybridization may actually contribute to declines in support for
conservation. This finding raised the question of whether survey measures are capturing
the expected difference between ideologically different groups (liberal/conservative, pro-
/anti-environmentalist), or whether hybridization is touching on other values, particularly
moral ones, in addition to those most obviously implicated in questions which invoke
political and environmental ideology. To begin to investigate this question, we performed
an exploratory regression analysis to assess the extent to which value-laden factors such
as attitudes toward the purity and naturalness of hybrids can explain variance in attitudes
toward hybrid conservation over and above ideology or environmental beliefs. The
results of the analysis are reported in Table 7.3. These findings confirm the hypothesis
that concepts of purity and naturalness, associated in other research with moral decision-
making, are also associated with determining whether individuals support protecting
hybrids (e.g., Graham, Haidt, & Nosek, 2009).\textsuperscript{145}

\textsuperscript{145} Moral Foundations research studies the extent to which individual beliefs are based in five foundational
“pillars”—harm/care (whether an individual was harmed or cared for), fairness/reciprocity (whether all
individuals were treated equally), ingroup/loyalty (whether the “greater good” of the group was factored
in), authority/respect (whether authority was respected), and purity/sanctity (whether the situation violated
spiritual or physical purity norms) (Graham et al., 2009).
Table 7.3. Stepwise Regression Model Predicting Anti-protection attitudes

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor Variable</th>
<th>F</th>
<th>$R^2$</th>
<th>Unstand. Coefficients</th>
<th>Stand. Coefficient</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>13.235**</td>
<td>0.08*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td>Liberal ideology</td>
<td></td>
<td></td>
<td>-0.10 (0.14)</td>
<td>-0.04</td>
<td>-0.72</td>
</tr>
<tr>
<td></td>
<td>Pro-environmental attitudes</td>
<td></td>
<td></td>
<td>-0.12 (0.03)</td>
<td>-0.26</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>Liberal ideology</td>
<td>47.65**</td>
<td>0.30*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pro-environmental attitudes</td>
<td></td>
<td></td>
<td>0.09 (0.13)</td>
<td>0.04</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>Pro-purity attitudes</td>
<td></td>
<td></td>
<td>-0.13 (0.03)</td>
<td>-0.27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naturalness attitudes</td>
<td></td>
<td></td>
<td>0.14 (0.04)</td>
<td>0.2</td>
<td>3.83**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.23 (0.03)</td>
<td>-0.36</td>
<td>6.80**</td>
</tr>
</tbody>
</table>

* p < .05; ** p < .01

Case Study 1 Conclusions

This exploratory study contributes to the limited existing data on public perception of hybrid species, suggesting a complex and mutable definition of species by the general public born out of social and biological, as well as practical and scientific considerations. The potential impacts of the differing perceptions and values applied to hybrid species suggests complex and nuanced avenues for future research in this area.

Potential future directions include:

1. Exploring how more expert environmental scientists and managers might respond to the same set of questions
2. Determining which of these groups (scientists, managers, the public) provide answers that align most closely with how the process of management is actually being performed;
3. Assessing the extent to which moral foundations research can be applied to emerging questions of conservation concern, particularly hybridization (e.g., to what extent does one’s emphasis on the importance of purity in moral decision making relate to attitudes toward hybrids);

4. Gathering information on additional real world case studies, especially of examples where hybridization might already be having a larger practical impact;

5. Surveying polar bear tourists in remote locations to discover the extent to which their interest in and willingness to pay for bear tourism might extend to hybrids, including hybrids living in different ecosystems;

6. Studying the extent to which individuals are willing to pay not just for polar, grizzly, and hybrid bear tourism, but for their conservation;

7. Developing a greater understanding of how these issues are understood by indigenous groups in Canada and Alaska, what their perceptions of hybrids and hybridization are, and what the probable or potential impacts of hybridization on the economically important limited-entry indigenous hunting permit process are.

**Case Study 2: Florida Panthers and Texas Cougars**

**Background**

In 1995, eight female Texas cougars (*Puma concolor stanleyana*) were translocated to southern Florida in an effort to assist in the recovery of a dwindling remnant population of Florida panthers (*P.c. coryi*), which were showing indications of
inbreeding depression and a lack of genetic diversity. Johnson et al. (2010) reported that this introduction ultimately led to threefold population increases, improvements in genetic health, cub survival, and individual fitness, and significantly reduced markers of inbreeding. Although the subspecies are closely related, Florida panthers are genetically and behaviorally different from Texas cougars, relying on cypress and hardwood swamp habitats in addition to upland forests (Maeher & Cox, 1995; Land et al., 2008), whereas cougars in Texas live primarily in forests and more arid environments of grass or scrub (Holbrook et al., 2012).

This case study is intended to explore questions about the social construction of species categories, asking respondents about the mental process they would use to categorize an animal that looks like, behaves like, and lives in the habitat of a Florida panther but that does not belong to the particular genetic subspecies *P. c. coryi*. Thus we presented respondents with a hypothetical conservation intervention in which both male and female Texas cougars *P. c. stanleyana* were introduced in Florida and then reproduced together, removing the question of relative genetic contributions from multiple sub-species as a variable.

**Measures**

Participants were presented with the following information regarding the use of hybridization with another sub-species as a conservation tool for the Florida Panther:

In 1995 Florida Panthers (*Puma concolor coryi*) became so endangered that it was necessary to bring in some closely related cougars (*Puma concolor stanleyana*) from Texas to help prevent the population from dying out. These animals look very similar but are genetically distinct. Florida Panthers are extremely rare and

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146 Low levels of genetic diversity led to severe reductions in fitness for Florida panthers, including poor sperm quality, cryptorchidism (undescended testicles), cardiac abnormalities and increased vulnerability to parasites and infectious diseases (Roelke, Martenson, & O’Brien, 1993).
live in the swamps and forests of Florida, while in Texas cougars are common and live in drier areas where they prefer dense underbrush.

Participants were then asked to consider the following hypothetical scenario:

In some cases, Texas cougars relocated to Florida have reproduced together, creating offspring that have no genes from the Florida panther subspecies but behave like Florida panthers, and live in panther habitat like swamps.

Participants were then asked to indicate how they believe an individual which is the genetic offspring of cougars but behaves like a panther and lives in panther habitat should be categorized, given the options: Florida Panther, Texas Cougar or “something else”. After indicating their choice, participants were asked to briefly explain their answer using an open response format.

**Analytical Approach**

The pattern of responses to the items asking participants to categorize a hypothetical Texas cougar living as a Florida panther were described and presented graphically. For the open response items regarding Florida panther categorization, the primary author and co-author each independently coded open-ended responses. After reading all responses, co-authors generated a list of broad coding categories to capture the range of answers provided (e.g., factors respondents used in categorizing). Sub-categories were then created in order to capture nuances of which factors respondents emphasized in their thought processes (i.e., whether genetics was mentioned as a factor or emphasized as the only factor of importance). If a particular coding category was represented in a participant’s response, that category was marked with a ‘1’ to indicate presence, and otherwise was marked ‘0’ to indicate absence.

Cohen’s $\kappa$ was calculated for each coding category. Inter-rater reliability across categories ranged from $\kappa = 0.64$ to $\kappa = 0.95$ ($M = 0.80$) or “substantial” to “near perfect”
using benchmarks established by Landis & Koch (1977). The primary author’s coding was used to conduct all further analysis. Descriptive statistics were used to determine patterns in the open-ended response items across the total sample, and was compared across participants who said they would categorize the hypothetical cougar as a “Texas cougar,” “Florida panther,” or “something else.”

Results and Discussion

Most respondents categorized the theoretical cougar born in Florida as either a Texas cougar (34.10%) or as something else (42.20%) while less than a quarter categorized the animal as a Florida panther (23.70%) (Figure 7.5).

The results of the coding of open responses are presented in Table 7.4. Although the smallest group of respondents (23.70%) characterized this hypothetical animal as a Florida panther, for management purposes, an animal in Florida that looked and behaved

![Pie chart showing percentage of participants categorizing the theoretical cougar born in Florida as a Texas cougar, Florida panther, or “something else”](image)

Figure 7.5. Percentage of participants categorizing the theoretical cougar born in Florida as a Texas cougar, Florida panther, or “something else”.
like a Florida panther would likely be managed as one.\textsuperscript{147} Most surprisingly, the largest group of respondents believed that the offspring of Texas cougars living in Florida panther habitat was \textit{neither} a Texas cougar nor a Florida panther, but was “something else”, categorically different from the genetic parent species or the closely related animals living in the same habitat. These findings suggest that people may experience “species” as being both a social and biological construct, and that the question of what a species is cannot be “solved” in separation from subjective and socially constructed questions about how an animal or group of animals fits into larger social and biological systems. When respondents were earlier asked what factors they should focus on to categorize a hypothetical bear, they emphasized the primacy of genetics in determining “what it is”. However, when given a question that placed a strictly genetic answer in opposition to practicality-based heuristics like, location, appearance, and behavior, only about a third of respondents appear to have been comfortable giving genetics alone full power to determine how an animal should be categorized.

\textsuperscript{147} The way humans process information and make decisions would tend to support this; the availability heuristic suggests that the greater the ease with which content comes to mind, the more likely we are to judge it to be true and accurate (Hudenko, 2012). A wildlife manager looking at an animal in southern Florida that looks like a panther would have no reason to question that identification.
Table 7.4. Percentage of participants listing factor in deciding how to categorize the hypothetical cougar in Florida across all participants and by the category they said they’d choose themselves. Bolded figures represent the three categories found most often across each group.

<table>
<thead>
<tr>
<th>Factors in decision</th>
<th>Percentage</th>
<th>Total</th>
<th>Florida Panther</th>
<th>Texas Cougar</th>
<th>“Something else”</th>
</tr>
</thead>
<tbody>
<tr>
<td>How to categorize</td>
<td></td>
<td></td>
<td>N = 336</td>
<td>N = 79</td>
<td>N = 114</td>
</tr>
<tr>
<td>Counts as a different species</td>
<td>21.43%</td>
<td>0.00%</td>
<td>1.75%</td>
<td>48.95%</td>
<td></td>
</tr>
<tr>
<td>Needs a new name</td>
<td>19.64%</td>
<td>0.00%</td>
<td>0.88%</td>
<td>45.45%</td>
<td></td>
</tr>
<tr>
<td>Is some kind of combo or hybrid</td>
<td>17.26%</td>
<td>3.80%</td>
<td>0.00%</td>
<td>38.46%</td>
<td></td>
</tr>
<tr>
<td>Genetics as a factor</td>
<td>53.27%</td>
<td>11.39%</td>
<td>90.35%</td>
<td>46.85%</td>
<td></td>
</tr>
<tr>
<td>Things other than genetics do not matter</td>
<td>12.20%</td>
<td>0.00%</td>
<td>33.33%</td>
<td>2.10%</td>
<td></td>
</tr>
<tr>
<td>Noted the complete lack of Florida panther genes</td>
<td>10.12%</td>
<td>0.00%</td>
<td>21.93%</td>
<td>6.29%</td>
<td></td>
</tr>
<tr>
<td>Behavior as a factor</td>
<td>29.76%</td>
<td>49.37%</td>
<td>28.07%</td>
<td>20.28%</td>
<td></td>
</tr>
<tr>
<td>Location as a factor</td>
<td>29.46%</td>
<td>63.29%</td>
<td>28.95%</td>
<td>11.19%</td>
<td></td>
</tr>
<tr>
<td>Appearance as a factor</td>
<td>3.27%</td>
<td>10.13%</td>
<td>0.88%</td>
<td>1.40%</td>
<td></td>
</tr>
<tr>
<td>Opinions about whether introduction of cougars was good or bad</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belief that the new cougars are important to save the FL panther</td>
<td>2.08%</td>
<td>6.33%</td>
<td>0.88%</td>
<td>0.70%</td>
<td></td>
</tr>
<tr>
<td>Belief that this is a failure to protect panthers and panther purity</td>
<td>1.79%</td>
<td>1.27%</td>
<td>0.88%</td>
<td>2.80%</td>
<td></td>
</tr>
<tr>
<td>Important for ecosystem health</td>
<td>0.60%</td>
<td>2.53%</td>
<td>0.00%</td>
<td>0.00%</td>
<td></td>
</tr>
<tr>
<td>Noted it was hard to make a decision</td>
<td>2.98%</td>
<td>5.06%</td>
<td>0.00%</td>
<td>4.20%</td>
<td></td>
</tr>
<tr>
<td>Comments on the decision process</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decided based on what seemed most practical</td>
<td>2.38%</td>
<td>10.13%</td>
<td>0.00%</td>
<td>0.00%</td>
<td></td>
</tr>
<tr>
<td>Decided based on what felt right (“gut instinct”)</td>
<td>1.19%</td>
<td>2.53%</td>
<td>1.75%</td>
<td>0.00%</td>
<td></td>
</tr>
</tbody>
</table>
While slightly more than half of all respondents mentioned genetics in explaining how they arrived at their answer, this varied substantially depending on the conclusion they ultimately reached. Ninety percent of those who categorized a hypothetical cougar living in Florida as a “Texas cougar” mentioned genetics in their answer; half of people who concluded that it was “something else” mentioned genetics, but only 12% of people who concluded that it was a “Florida panther” used genetics to explain their answer. One-third of all respondents who categorized it as a Texas cougar specified in their open response that factors other than genetics do not matter (e.g., “they are genetically cougars; changing behavior does not change the essence of a thing”) and are irrelevant to categorization, and 22% mentioned the complete lack of panther genes (“They should be considered cougars because they have no genes from the panther subspecies,” or “they are not in anyway related to florida [sic] panthers”) in the explanation of their answer.

Thus it appears that those who confidently identified the cougar living in Florida as a “Texas cougar” were relying solely on an artificial sense of scientific certainty—none of these respondents described categorization as a difficult decision, unlike some of those who classified it as a Florida panther (5.06%) or something else (4.20%). This points to the role of the production of scientific knowledge in discursively transforming difficult questions with ethical implications into answerable matters of scientific fact.

Without embracing post-modern conceptions of science as merely a social construct, our data points to the risks of uncritically embracing scientism, some forms of which suggests that science, in isolation, can adequately respond to all human questions, including complex moral and ethical quandaries. These findings suggest the importance of finding

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148 This points to the challenge of assigning meaning appropriately to scientific fact. As Knorr-Cetina advises, “rather than considering scientific products as somehow capturing what is, […] consider them as selectively carved out, transformed and constructed from whatever is” (1981, p. 3).
“a path between an exaggerated view of science’s importance…and an impoverished view of science’s importance” (Stenmark, 2001, p. 4).

The idea that genetics is the only factor that matters when categorizing or conserving species is not aligned with the practicalities of how humans manage a wide variety of species, including panthers, and is unlikely to be aligned with how people want to or think we should manage species. This also suggests that respondents may not understand genetics or genetic differences as occupying a spectrum, but as discrete unconnected groupings—for instance, some respondents noted that the hypothetical cougar living in Texas had “no panther genes” when, of course, Florida panthers and Texas cougars are closely related sub-species with a history of genetic exchange between populations and substantially similar genomes (O’Brien & Mayr, 1991).

Those respondents who believed that the offspring of Texas cougars living in Florida should be considered Florida panthers were much more likely to mention behavior and location than those who thought it should be categorized as a “Texas cougar” or “something else.” They were also much more likely to focus on the practicalities of species management: “If they still look and act like panthers and are in Florida, just call ’em Florida panthers”, or “So long as the species helps to prevent the population from dying out, it doesn't matter if its genes are considered “pure” or not”; and were more likely to say things like “I just went with what felt right to me” or that they “went with [their] gut instinct.” For the most part this heuristic decision-making did not include explicit reference to ecology or ecosystem roles, although two respondents

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149 For instance, few people would be likely to agree that a large number of frozen tissue samples from a species adequately conserves that species, even as it may successfully protect a large amount of genetic information about that species indefinitely. Similarly, utilitarian philosophies of wildlife management, although still prevalent in many places, are no longer in step with public opinions and attitudes about appropriate and ethical wildlife management (e.g., Gill, 1996).
who felt the animals should be called panthers explained those relationships as playing a role: “The important thing is they are back in Florida performing their natural role in nature”, and “They are now part of the Florida ecosystem.”

A substantial proportion of respondents who described the offspring of Texas cougars living in Florida as “something else” went on to opine that new terminology was necessary to describe the offspring of a cougar that lived in Florida. The most common suggestion by far was the “Florida cougar” while others stressed the novelty saying things such as “They are a new and entirely different category of animal.” Several respondents compared the process of introducing cougars in Florida as similar to the process of moving (“Just because I move to France doesn't magically make me a native born French citizen”), suggesting that relocating an animal doesn’t change the “essence” of what it is—but, of course, humans do in fact use complex language to manage these types of identity questions (e.g., “Italian-American”).

**Case Study 2 Conclusions**

This case study begins to suggest some of the complexities of how people think about and categorize animals based on a variety of information about their genes, appearance, behavior, and habitat. Potential future research directions include:

1. Further research into how evaluative factors shape human perceptions of “what an animal is,” which can help us further understand how future hybridization might impact valuations of parent species and hybrids;

2. Comparison of the results of this question as posed to the general public with the responses of a sample of scientists and managers, particularly in terms of understanding the extent to which those groups may have different intuitions
about such categorizations, and may prove more or less likely to attempt to answer these questions from a strictly factual or scientific perspective, downplaying or ignoring their moral or ethical dimensions;

3. An exploration of how moral foundations might shape intuitions and beliefs about genetic purity and hybridization;

4. Framing experiments to explore the extent to which increased scientific literacy, particularly information about the complexity and scientific uncertainty of genetic relationships might affect responses.

**Conclusion and Future Directions**

This chapter has attempted to draw out some of the ways in which the historical struggle to find a functional scientific concept of “species” has led to a lack of clarity about what species divisions actually mean among the general public. In a poststructuralist loop, research into speciation has shaped what we perceive “species” to mean, and what we mean by “species” has shaped our understanding of the kinds of research questions to be asked (Sarup, 1993). This history has informed how people respond to potential changes in current species conceptions, and their perspectives potentially have significant real world impacts under currently projected scenarios of large-scale anthropocentric climate change.

This study is exploratory and as such findings are preliminary and future research will be necessary to confirm conclusions and further understanding. Studies of this type can always benefit from larger sample sizes, and some of the measures could be more meaningfully illuminated by adding additional context-specific comparative sample groups, including scientists and managers. This study should be seen as presenting a
starting point for future research into public perceptions of, and intuitions about, hybridization and how it relates to existing management and conservation structures. In coming years, we will face a series of moral questions about the impacts of anthropogenically forced climate change, including those on species and speciation. These questions bear special import: What should we do about hybrids? What are our responsibilities? Ethically? Practically? Ecologically? If humans choose to work to protect hybrid populations, what options exist for interventions? Further research is necessary to determine whether framing can encourage people to value hybrids more (or less) highly; to identify the kinds of information that might help “sell” hybrid conservation; and to determine how big genetic differences have to be in order to “count”. This chapter represents a first step in the process of identifying the factors that most strongly affect perceptions of hybrids. One broad future research question of particular interest is: how do people respond when the way they define “species” precludes their preferred conservation or management outcome? Is it their definition or their preferred outcome that changes?

Our findings suggest that some people may respond differently to hybrids than to other species, and that this difference may be in part the result of underlying moral intuitions or pillars. This suggests that business-as-usual approaches to conservation in the face of hybridization may not adequately address these concerns, and may create additional challenges in engaging some segments of the population with conservation issues. Future research to determine if a general emphasis on purity in moral decision-making relates to attitudes toward hybrids in particular would help better place these
findings in the context of recent environmental psychology research associating moral purity with environmental attitudes (Feinberg & Willer, 2013; Wester et al., 2015).

Findings reflect the ongoing process by which science can be used to turn a range of ethical and moral judgments into scientific ones; but only some portion of the public appears to be fully comfortable embracing such an approach. However, the confidence of many respondents about the primacy of genetics does suggest the extent to which scientific discourse has created a perception of absolute clarity about species categorization that does not exist biologically. Of course, a much larger percentage of respondents believed that genetics should *theoretically* be the primary factor in categorizing species (51.50% of respondents ranked “genetics” as the most important factor for them making a decision about how to categorize a hybrid grolar bear) than were willing to categorize an actual animal based solely on genes when other factors did not align with that categorization (i.e., only 34.10% categorized a hypothetical cougar living in Florida as a Texas cougar). This finding suggests that many respondents, in spite of acknowledging the primacy of genetics in scientific descriptions of species, are not prepared to make decisions based solely on that criterion. Respondents seem to be suggesting that categorizations should be made with attention to both the best scientific information available and what is practical and “feels right”—though, at present, management judgments may fail to account for those latter, more subjective categories. Functionally, reducing the question of species categorization to one of genetics alone is allowing the authority of “science” to dismiss the complexity of questions about conservation (“What *actually* makes a panther a panther? What roles does this animal play in the ecosystem? In society? How should different aspects of that role be valued?”).
Chapter 8

Conclusion
Environmental challenges are complex and inextricably linked to their historical contexts, arising out of past and present interactions between biological, ecological, social, economic and political systems. Interdisciplinary historical study of these systems and their interactions can take many forms. As Smout observes, environmental history is “…not so much a subject in its own right as a theatre where other subjects appear and interact” (2009, p. 1). This dissertation has attempted to use the space created by an historical perspective to investigate the contributions it can provide to understanding some of the modern environmental challenges facing a diverse range of wildlife species. Crosby describes the unique contribution which can be made to environmental science by historians thus:

Scientists need the help of scholars, that is, people devoted to exactitude and truth but accustomed to bias (their own included) and the wringing of truth out of dubious data. Scientists need historians because historians can place environmental problems in their chronological and cultural context. The scientists sometimes seem to think that solving such problems is no more than a matter of putting things right, and they have little idea of how subjective a concept such as “right” can be. (Crosby, 1999, p. xii)

In Crosby’s formulation, historians and natural scientists have complementary responsibilities when addressing environmental problems, and are dependent on each other. In this, he is arguing not against the value of science or scientific knowledge production, but for the value of multiple lenses when approaching environmental questions. The work of natural scientists can be necessary without being sufficient to fully address conservation problems which are fundamentally interdisciplinary in nature and involve both social and biological systems.

History can serve to identify complexities by providing context. Thus, history can become part of the process of avoiding the risks of what Demeritt (1994b) describes as “foundationalism”—the basing of pro-environmental or pro-conservation arguments
solely in the authority of science and scientists (Demeritt, 1994b). Constant revision is an inherent, expected, and desirable part of the scientific process, but it also means that science alone can be a rather uncertain basis for environmental decision-making, compared to decision frameworks incorporating both scientific knowledge and moral and ethical values and considerations.

Moral decision making has two primary modes—deontological, in which the morality of an action depends on the intrinsic nature of the action taken (e.g., causing harm is wrong regardless of the potential positive consequences of the act) or utilitarian (e.g., causing harm to one is morally acceptable where the action also results in a concomitant larger-scale benefit to others). While both of these modes are used in moral decision-making by any individual, utilitarian decision-making is closely aligned with cognition, helping to explain the common use of a utilitarian ethic in the existing scientific literature on wildlife tourism reviewed in chapter two, or in negotiations of complex values reframed as scientific questions in discussions of shark tourism or polar bear and panther hybridization. Deontological considerations are associated not only with empathy, but with perspective-taking of various kinds, which historical study can help provide (Conway & Gawronski, 2013).

This disconnect between “objective” science and “subjective” values and norms applied to difficult environmental decisions can be identified across subject matters and academic disciplines. McCauley (2006) identifies a similar risk in economic valuation, of letting neoliberal arguments determine the value of a particular species or ecosystem, rather than serving as a tool for communicating about value. Economic valuation can be used to advance a larger moral argument, he suggests, but cannot and should not act as
the basis for argumentation itself. This is not to say that science-based management of natural resources isn’t appropriate, or that the monetary values of such resources are not relevant, but simply that it makes sense not to forget that “timber” is also “forests”; that it has a variety of values—biological, genetic, existence, ecological, aesthetic, moral—that should also have weight in policy and decision-making. By requiring that we consider what a forest has been and meant to different people over time, historians can transmute it from an economic object into a place enmeshed in systems of relationship with other actors, human and non-human, across a range of time scales. So, for instance, historical perspective can help us reconceptualize news coverage of shark attacks as providing not just factual information about events, but a way of tracking interrelationships between journalists, sharks, public opinions and attitudes, potential policy responses, pop culture, the global environmental movement, and the ways all of these have interacted and influenced one another over time.

There are three primary forms of environmental history: material (based in the physical realities of the natural world), cultural or intellectual (based in the ways people think or talk about the natural world), and political or nation-state (based in policy and human action on a large scale). Each of these forms has been used in this dissertation to explore a range of subjects, from the physical details of how coral has been utilized as medicine through much of recorded human history to the ways in which political and social systems can combine to undermine the conservation potential of shark tourism economics. Although these forms may be used independently or in conjunction, Radkau argues that

The inner coherence of environmental history, which until now has presented itself often as a colorful potpourri of themes, is guaranteed, in the final analysis,
by the reality that there are intimate connections between external nature and the inner nature of human beings (2008, p. 6).

Thus the unavoidable interconnectedness of all objects of study prevents a lack of cohesion within environmental history, despite a broad diversity of approaches and methods. In my own work, I ask historically grounded questions explore these intimate connections temporally, seeking to generate a deeper understanding of environmental issues and their roots, and perhaps to provide perspectives useful for contemporary problem solving (Myllyntaus & Saikku, 1999).

This dissertation has attempted to demonstrate some of the ways in which a historically-minded inquiry into environmental issues may yield different insights than other disciplinary approaches, and allow us to see old problems with new eyes. In it, historical perspective has been used for a range of purposes, from the obvious (looking to understand the past and how it may inform the present) to turning to the past and historical patterns of thought and understanding as the basis for formulating survey questions directed at a modern population.

The first chapter laid out environmental history’s disciplinary past from the creation of the field through the present day, briefly touching on some of the theoretical developments most useful to this dissertation. It also explored some of the reasons that greater interdisciplinarity has proven challenging for environmental historians, including funding and publication infrastructure that does not necessarily value interdisciplinary work, and disciplinary norms that may not reward interdisciplinary collaborations. Many of the social sciences have clear relevance to conservation research, with economists, anthropologists, geographers, sociologists, psychologists, and others increasingly joining inter-, trans- and multi-disciplinary environmental research teams. However, historians
have yet to achieve even the level of integration of other social scientific disciplines. One goal of this dissertation has been to serve as preliminary evidence that environmental history represents a natural space in which to conduct interdisciplinary environmental research.

Chapter two provided a literature review of research into wildlife tourism, treating this body of work as historical objects in an effort to better understand the currents shaping modern research questions. The chapter identifies questions which recur throughout the dissertation about the extent to which the practice of science may be used to discursively transform ethical and values debates into hypothesis-driven research which can provide an “answer”. This transformation can allow decision-makers to deny the need for discussion and negotiation of complex human feelings and values in relation to the environment, making these debates “solvable” with more objective data.\footnote{In some sense, this can serve to remove the humanity of scientists from the process of creation of scientific knowledge; to elide the reality that “knowledge contains its own morality, that it begins not in neutrality but in a place of passion within the human soul. Depending on the nature of that passion, our knowledge will follow certain courses and head toward certain ends” (Palmer, 1993). A historical perspective cannot fail to enquire into the nature of the discoverers as well as the discovery, making explicit the relationship between knowledge and knowledge producers.}

Interrogating these studies not simply as scientific facts but as historical objects created by specific people in a specific time and context allows for a nuanced approach to understanding the entire social-ecological system created by the relationships between and among scientists, tourists, local peoples, and wildlife populations. These findings suggested that many scientists are hopeful about the ability of wildlife tourism to contribute to animal and human wellbeing in a way that appears to exceed existing data. It is worth noting the important distinction, from a policy making perspective, between expert opinion (“I believe tourism can help conservation”) and expert knowledge (“in this
specific case, tourism did help conservation in the following ways”). As Cooke (1991) observes, the “phenomenon of experts is not new; however, the notion that the musings, brainstorms, guesses, and speculations of experts can be significant inputs in a structured decision process is relatively recent” (p. 4). The increase in reliance on expert opinion has included arguments that scientific uncertainty should be presented as a desirable part of decision making frameworks—as a strength representing a knowledge of unknowns, rather than as ignorance (Bradshaw & Borchers, 2000).

Chapter two’s literature review was intended in part to provide data to begin the process of looking at the inner workings of the scientific community as they attempt to grapple with a complex neoliberal approach to restructuring (or maintaining, depending upon the scientist’s perspective) existing human relationships with the non-human animal world. Through the review process, this chapter intended to begin to understand the existing body of scientific research on this topic and the process by which scientific facts are being created, by retaining “both the history of humans’ involvement in the making of scientific facts and the sciences’ involvement in the making of human history” (Latour, 1999, p. 10).

Chapter three used a survey of the general public to explore the ways in which previously understood definitions of wildlife and ecotourism are (or are not) shaping how these key terms are understood today. While ecotourism may have initially been a relatively tightly defined term, in modern usage it does not necessarily seem to carry the specificity of historical meaning. The differences between historical usage and modern popular usage can help illuminate the importance of an agreement on terms—both academic and non-academic—in understanding environmental and conservation impacts.
in the real world. Of course, these questions about terminology and how it is understood by multiple groups also further complicate questions about decision-making, as evaluating the conservation impacts of ecotourism necessarily requires first reaching a broad agreement about what activities should be considered ecotourism.

Chapter four used primary and secondary source historical materials to draw connections between ancient and modern uses of coral in medicine and healing, and to explore historical uses of scleractinian corals as a tool for understanding the medicinal exploitation of corals. Historical study can not only shed light on how present day relationships were arrived at (in terms of the biological, physical and social patterns which led to them) but also may suggest potential threats or future developments. This chapter argues that an understanding of present and future patterns of exploitation can be strengthened and deepened by access to historical data; and that there may be more similarities than differences between modern people and our forebears—we’re equally enthusiastic about miracle cures, even if the ways in which we market and understand them have changed. In drawing out some of the similarities between past and present exploitation of corals for medicinal purposes, this chapter illustrates that previous patterns of human relationships to the natural world can serve to shape specific conservation challenges and debates to a greater degree than is presently recognized.

Chapter five looked at newspaper reporting of shark attacks in Cape Town, South Africa from 1850 through 2000 as a window into how public perceptions of sharks have changed over time. Although shark scientists have emphasized the importance of the movie “Jaws” in shaping the human-shark relationship, longitudinal data suggests a much longer, slower shift towards a greater level of tolerance for shark-related risk among at
least some segments of the population, and increased knowledge of shark behavior and
importance to ecosystems. These attitudinal changes track more closely with the overall
global environmental movement than with the release of “Jaws” or efforts in recent
decades to improve perceptions of sharks. This finding has implications for conservation
interventions, suggesting that broader movements to shape pro-environmental attitudes
may be as (or more) significant than issue- or species-specific advocacy. Particularly
when historical data to validate anecdotal narratives about human-nature relationships is
available, such data should not be overlooked. This chapter argued that remaining open to
such data may suggest alternate possible narratives which can lead to new approaches to
or ways of thinking about modern conservation challenges.

Chapter six considered the reasons for and effects of shark feeding tourism bans
in the United States and what those bans can tell us about the potential of shark tourism
to act as a driver of, or funding mechanism for, shark conservation. The socio-historical
reasons for resistance to these practices are not likely to disappear, although they may
vary in intensity outside the United States. The fact that questions about the safety and
advisability of shark tourism have been used in Florida and Hawaii as a proxy for more
difficult moral and ethical debates about how to utilize marine resources (and who is
entitled to control those decisions) suggests the extent to which similar conflicts are
likely to arise anywhere that a significant shark tourism industry develops. Historical
research creates a space in which the interaction of the political ecology of shark tourism
regulation, the economics of tourism-based shark conservation, and the sociology of
resource conflicts are all part of creating a grounded, contextualized historical narrative
contributing to our understanding of the development of shark tourism bans. The chapter
also addressed the extent to which arguments nominally about a small-scale diving activity were actually only one facet of cultural, resource, political, and power conflicts on a much larger scale. As in other case studies, ethical, moral, and philosophical differences were framed as solvable by the judicious application of scientific facts.

In chapter seven, the history of how scientists have understood and conceived of speciation was used as a starting point for studying how the general public understands these issues. Findings suggest that while the scientific literature is concerned with the details of species as a biological, genetic system of categorization, some portion of the public mentally and functionally treat species as incorporating numerous other factors, including habitat and behavior. The Linnaean system is far tidier in the abstract than the actual biological relationships between living creatures, but it has shaped the mental models people have of the natural world. Now it will also shape responses to changes in wildlife populations and speciation resulting from anthropogenic environmental change.\(^{151}\) Thus the polar bear exists as a physical animal, but also as an idea with roots in the history of science; the animal shapes the idea and the idea shapes our view of the animal. This chapter concerns itself with how people may respond when their historical concept of an animal, and the categorization that concept supports, becomes increasingly mismatched to the biological animal over time.

This dissertation has sought to develop some of the ways historical perspectives might be used to advance interdisciplinary environmental research, which are only beginning to be explored.

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\(^{151}\) In Czech, Krausman, and Borkhataria (1998) the authors argue that “species” represents a socially constructed category for non-human species for which political power is held in trust by human interest groups, and that some constructed categories are advantaged (birds, mammals, fish) while others are not. This raises the question of whether biological changes to species will also alter their social construction (findings suggest yes, at least somewhat) and access to political power.
In particular, environmental history allows and asks us to look simultaneously both at scientific findings, the process by which those findings were created, and who created them and in what context. Historical lenses allow for perspectives that make the role of science and scientists in transforming moral and ethical questions into scientific ones more visible because of the ways in which the “right” questions, answers, decisions, and definitions change over time. An historical approach can also give weight and understanding to present day patterns or help us identify enduring and powerful trends in how we interact with the natural world. By creating context and coloring in backgrounds, historical data can shape or change how we understand the present. Working on this dissertation was often surprising: it turns out that there are clear historical roots of modern-day coral quackery that confidently connect back into pre-history, and that “Jaws” may not be as useful and complete a frame as was previously thought for understanding the human-shark relationship—neither of which I knew (or expected) when I began this work.

In large part because of the diversity and porous boundaries of history as a discipline, it potentially represents an enriching space for diverse environmental science practitioners. As a simple example, an interdisciplinary study of wolves from a historical perspective would, by nature, comprehend ecological and biological details about wolves and how these details changed over time, longitudinal data on socio-cultural and attitudinal shifts, and inquiry into how people’s perceptions of wolves had changed—and would then ask how those lines of inquiry interact with and shape one another, in both the past and present. Unlike many narrower lenses, historical frames do not assume the primacy of any particular factor—biology, culture, economics—in determining
outcomes. Thus history can represent a generous poststructuralist space in which meaning is understood both as being continuously created discursively and as being shaped by and shaping material reality in a never-ending process of relation and inquiry.
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Appendix 1:

Coral in Art and Objects
Appearances of Coral in a Medieval European Herbal (c. 1440)

Variety of Historical Pharmacy Containers Used to Hold Coral Remedies


Examples of infant coral teething sticks (sometimes including whistles and bells)


Figure A.8. Whistle and Bells, Daniel Christian Fueter (Swiss/American), 1761-1765. Acquisition Number: 1942.91. Yale University Art Gallery, http://artgallery.yale.edu/collections/objects/38299.
Figure A.10. Rattle, Whistle, and Bells, Nicholas Roosevelt, New York, 1755-1768. Accession number 47.70. Metropolitan Museum of Art, https://www.metmuseum.org/art/collection/search/2255.
Examples of cutlery incorporating coral, likely in part for a perceived ability to detect poisons

Figure A.11. Spoon of John II, King of Poland. Unknown, Germany, ca. 1600s. Inventory Number: Э-2390. Hermitage State Museum, https://www.hermitagemuseum.org/wps/portal/hermitage/digital-collection/?u/p/a/1/lVBBTsMwEPxKesyjReB3XqXu0AkKqVAJBqLEvkZu4wTRx0sYCno9z49JC97Q72p2dGaxwIZXTn7bV3g5Od_Os0ioXliU0g02esXsQefHMiuzpEcgS77DCqnmItlsbNbe386N-xPOreTpVxMXwN5-MUDYdIn30MwO8iPY6dNc0MTDEQAgmn8-1Y2wbLICT7ekUblPK1RkvSULRmlCDNTIDhslfGBF0y6IILJeBfsq8zyPBidYkj3Sb4debYZdvq5e2hCNu_UrjByeVvqGq_TidlAjhDs6bb4_Lm9Md-57THpWAtOSUda1YLH4AYwMhWg/!/dI5/dI5/L2dBISevZ0FBIS9nQSEh/?lng=en.
Portraits of an infant Christ which depict him wearing coral beads

Portraits of children incorporating coral necklaces or bracelets

Figure A.17. Family Portrait, Anthony Van Dyck, Flanders, 1621. Inventory Number: ГЭ-534. The State Hermitage Museum, https://www.hermitagemuseum.org/wps/portal/hermitage/digital-collection/?t=1lzBPT8MwDMW.
Page from a translation of Discorides’ Materia Medica created around 1244

Painting of an Indian coral trader, ca. 1840

Figure A.21. Indian Merchant Selling Jewelry to a Woman, Unknown, Tanjore (Thanjavur), ca. 1840. Wellcome Library, no. 29060i. 
Websites promoting coral calcium’s exceptional properties

Figure A.22. Website promoting coral calcium as more “bioavailable” than other forms of calcium. http://www.coralcalcium-watchdog.com/facts.htm, screenshot collected October 1, 2017.