

# Bibliography: Dolphin and other wildlife provisioning and considering human behavior for beneficial effects on the environment.

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**NCRL subject guide 2021-01**

<https://doi.org/10.25923/63s4-vt52>

April 2021



U.S. Department of Commerce  
National Oceanic and Atmospheric Administration  
Office of Oceanic and Atmospheric Research  
NOAA Central Library – Silver Spring, Maryland

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## **Background & Scope**

Research has documented that illegal human interactions (e.g., food provisioning) changes bottlenose dolphin behaviors in the wild, causing them to engage in unnatural risky foraging behaviors. These behaviors can include begging, depredating fishing gear and scavenging discarded fish. The risky foraging behaviors are known to cause direct negative impacts to bottlenose dolphins, including mortality and injury from entanglement in, and ingestion of, fishing gear, boat strikes, and injuries intentionally inflicted by humans. Other effects, such as reduced reproductive success and survival, have also been observed. Similar adverse consequences of inappropriate human interactions with terrestrial wildlife are also well documented. The purpose of this guide is to identify materials examining potential conservation strategies/approaches that may reduce or stop humans from illegally feeding dolphins in the wild. We found virtually no literature documenting successful conservation strategies that changed human behaviors (i.e. reduce/stop provisioning) and resulted in a concurrent reduction in bottlenose dolphin risky foraging behaviors.

This bibliography provides a sample of references with a focus on: the impacts to dolphins from provisioning (feeding) and repeated exposure to provisioning; effects on other wildlife from supplemental human feeding; and various topics involving human behavior change resulting in beneficial effects to the environment. Given the expansive breadth of the latter category, it should be noted that a sample of articles were selected to maintain bibliography conciseness. References include peer-reviewed articles, white papers, and graduate-level theses. Our search was limited to references published between 2000 and 2020, with some selective inclusion of earlier articles. References are organized as outlined in the Section Descriptions below. For each reference, the citation and document abstract (when available) are provided.

## **Section Descriptions**

### **Section 1 – Wildlife Provisioning**

This section covers the impact of human feeding on bottlenose dolphins and other wildlife.

#### **Part 1.1 – Bottlenose Dolphins**

References document bottlenose dolphin behavior with repeated exposure to human interaction centered on feeding

#### **Part 1.2 – Other Animals**

References document animal behavior when supplemental feeding is involved, ranging from foxes to sharks and rays.

### **Section 2 – Humans**

This section includes literature that discusses how humans change their behavior in regards to the natural world. This literature is mostly from the fields of psychology, sociology, and anthropology.

#### **Part 2.1 – General**

This section includes general literature on how humans react to and change their behavior around the natural world.

#### **Part 2.2 – Consumption, Waste, and Energy Use**

This section includes literature relating to how humans change their consumption behavior, whether in terms of food, food waste, or energy resources.

**Part 2.3 – Human-Wildlife Interaction**

This section includes literature covering how humans change their behavior around wildlife and especially how they make a shift from negative human-wildlife interactions to positive ones.

**Part 2.4 – Place Conservation**

This section includes literature covering how humans can change their behavior in regards to physical places, whether those are their own property or public lands such as national parks.

## **Sources Reviewed**

The following sources were consulted and searched in order to create this bibliography: Clarivate's Web of Science, ProQuest's Aquatic Science Fisheries Abstracts, Google Scholar, Dimensions, JSTOR, EBSCO's Academic Search Premier and EconLit, Elsevier's ScienceDirect, BioOne Complete, Science.gov, and open web searching.

# Section 1 – Wildlife Provisioning

## Part 1.1 – Bottlenose Dolphins

Brennan, O. (2018). Feeding Wildlife as a Means of Promoting Animal Welfare. Retrieved from <https://was-research.org/paper/feeding-wildlife-as-a-means-of-promoting-animal-welfare/>

Many people propose providing supplemental food to wildlife in order to promote their welfare. However, it is likely that providing supplemental food actually causes wild-animal suffering. While supplemental food has some positive effects, such as improved body condition and nutritional status and lower adult mortality, it also has many negative effects. Some food makes animals sick because it is contaminated or inappropriate for their species. Animals tend to aggregate around sources of food, which makes them vulnerable to disease, predation, and aggression from conspecifics. In the long run, supplemental feeding may also increase population size. At the new, larger population size, animals would no longer benefit from supplemental food; they would need it to prevent a population crash and attendant mortality. Ways to reduce the harm from supplemental feeding when it is necessary are discussed.

Christiansen, F., McHugh, K. A., Bejder, L., Siegal, E. M., Lusseau, D., McCabe, E. B., . . . Wells, R. S. (2016). Food Provisioning Increases the Risk of Injury in a Long-Lived Marine Top Predator. *Royal Society Open Science*, 3(12). <https://doi.org/10.1098/rsos.160560>

Food provisioning of wildlife is a major concern for management and conservation agencies worldwide because it encourages unnatural behaviours in wild animals and increases each individual's risk for injury and death. Here we investigate the contributing factors and potential fitness consequences of a recent increase in the frequency of human interactions with common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. A rising proportion of the local long-term resident dolphin community is becoming conditioned to human interactions through direct and indirect food provisioning. We investigate variables that are affecting conditioning and if the presence of human-induced injuries is higher for conditioned versus unconditioned dolphins. Using the most comprehensive long-term dataset available for a free-ranging bottlenose dolphin population (more than 45 years; more than 32000 dolphin group sightings; more than 1100 individuals), we found that the association with already conditioned animals strongly affected the probability of dolphins becoming conditioned to human interactions, confirming earlier findings that conditioning is partly a learned behaviour. More importantly, we found that conditioned dolphins were more likely to be injured by human interactions when compared with unconditioned animals. This is alarming, as conditioning could lead to a decrease in survival, which could have population-level consequences. We did not find a significant relationship between human exposure or natural prey availability and the probability of dolphins becoming conditioned. This could be due to low sample size or insufficient spatio-temporal resolution in the available data. Our findings show that wildlife provisioning may lead to a decrease in survival, which could ultimately affect population dynamics.

Cunningham-Smith, P., Colbert, D. E., Wells, R. S., & Speakman, T. (2006). Evaluation of Human Interactions with a Provisioned Wild Bottlenose Dolphin (*Tursiops truncatus*) near Sarasota Bay,

Florida, and Efforts to Curtail the Interactions. *Aquatic Mammals*, 32(3), 346-356.  
<https://doi.org/10.1578/am.32.3.2006.346>

Boaters have provisioned a free-ranging bottlenose male dolphin (*Tursiops truncatus*) for more than 15 years near Nokomis, Florida. The dolphin is a well-known attraction to tourists and local boaters because of his predictable presence in a narrow section of the Intracoastal Waterway near the Albee Road Bridge. Observations and records collected since 1990 documented this animal being fed by and interacting with humans, sometimes resulting in injury to the humans attempting to touch, feed, or swim with it. We initiated a study in 1997 to document the dolphin's interactions with boaters, to characterize the frequency and types of boater interactions with the animal, and to evaluate the effectiveness of public education and enforcement efforts to curtail these illegal activities. The project consisted of three phases: (1) a baseline study, (2) a docent program, and (3) a follow-up study. Approximately 26% of the 1,797 interactions observed during the baseline study involved touching, teasing, or splashing, and 11% of interactions involved feeding. The docent program involved increased signage and the operation of a marked vessel to shadow the dolphin, monitor the types and frequencies of interactions, and offer educational materials about responsible wildlife viewing. Only 1.3% of boaters interacted with the dolphin in the presence of the docents; more than half of those questioned indicated that they were aware of the illegality of their actions. During follow-up observations to assess the effectiveness of the docent program and minimally increased law enforcement efforts, boater interactions with the dolphin increased by 5% after docent discussions. The docent and follow-up studies demonstrated that a small segment of the boating public continue to interact with the dolphin in spite of highly visible public education efforts. Increased law enforcement efforts, including the application of well-publicized punitive sanctions, may be required to bring about a further reduction in dolphin-human interactions in this area.

Donaldson, R., Finn, H., Bejder, L., Lusseau, D., & Calver, M. (2012). The Social Side of Human-Wildlife Interaction: Wildlife Can Learn Harmful Behaviours from Each Other. *Animal Conservation*, 15(5), 427-435. <https://doi.org/10.1111/j.1469-1795.2012.00548.x>

Although harmful human wildlife interactions involving anthropogenic food sources are a significant issue for wildlife conservation, few studies have addressed whether social learning may influence how animals learn to use anthropogenic foods. We examined a long-term (1993-2003) human wildlife interaction involving the illegal feeding of bottlenose dolphins (*Tursiops aduncus*) by recreational fishers in south-western Australia. We developed predictor variables for whether dolphins learned to accept food handouts from human provisioners, based on biological (age-class, sex) and behavioural (ranging and association patterns) data for a population of 74 dolphins. Two variables provided clear predictors for whether dolphins became conditioned to food handouts: the use of areas with high densities of recreational boats (BOAT) and the average coefficient of association with previously conditioned dolphins (ASSOC). An individual was more likely to become conditioned when it spent more time in high boat density areas and when it spent more time with other conditioned dolphins. When considering all the models available, there was strong weight of evidence for the effects of ASSOC and BOAT on the response variable. We were unable to detect any effects of age-class and sex with the available statistical power. These findings suggest that social learning can facilitate the acquisition of undesirable and maladaptive behaviours in wildlife, and indicate the value of long-term individual-specific data for the conservation management of wildlife engaging in undesirable interactions with humans.

Donaldson, R., Finn, H., & Calver, M. (2010). Illegal Feeding Increases Risk of Boat-Strike and Entanglement in Bottlenose Dolphins in Perth, Western Australia. *Pacific Conservation Biology*, 16(3), 157-161. <https://doi.org/10.1071/PC100157>

One reason for the legislative restrictions on feeding dolphins in many parts of the world is the putative increased risk of injury to dolphins conditioned to human interaction through food reinforcement. However, there are few empirical data to support this. Here, we present data for a population of Bottlenose Dolphins *Tursiops* sp. in Cockburn Sound, in the city of Perth, Western Australia, indicating higher incidence of boat strike injury and fishing line entanglement for dolphins conditioned to taking food from humans, compared to others in the population that were not conditioned. The data support prohibitions on feeding dolphins and rigorous enforcement of existing regulations. [PUBLICATION ABSTRACT]

Finn, H. (2005). *Conservation Biology of Bottlenose Dolphins (Tursiops Sp.) in Perth Metropolitan Waters*. Murdoch University, Retrieved from <http://researchrepository.murdoch.edu.au/id/eprint/49>

This thesis examines two potential conservation problems for a residential sub-population of ~75 bottlenose dolphins (*Tursiops* sp.) in Cockburn Sound, a small embayment within the southern metropolitan waters of Perth, Western Australia: (1) human-induced habitat change and (2) illegal feeding (i.e. unregulated provisioning) of dolphins. The work is important because Cockburn Sound is the most intensively utilised marine environment in Western Australia and industrial, commercial, and recreational uses of the area will intensify in coming decades. These considerations, coupled with the demographic and ecological vulnerability of residential populations of small cetaceans, suggested a risk of population decline without a more informed scientific basis for management. This study (2000 - 2003) complemented an earlier study of the Cockburn Sound dolphins (1993 - 1997) to provide a decade-long longitudinal study of the population. The original contributions of this study relate to: (a) the foraging ecology of dolphins; (b) the effects and mechanisms of human-dolphin interaction, particularly interactions based on unregulated provisioning; and (c) an integration of previous research and other information.

Studies of the foraging ecology of dolphins within Cockburn Sound were undertaken between 2000-2 to determine the areas used by dolphins and their feeding behaviours so that the implications of human-induced habitat change could be assessed. These studies used belt transect sampling and event-specific sampling of foraging aggregations of dolphins to quantify the foraging habitat use of dolphins within the Sound and to characterise spatial and temporal patterns in aggregations of foraging dolphins. The results showed that the density of foraging dolphins varied significantly across habitats and that foraging aggregations consistently occur in an area known as the Kwinana Shelf during the austral autumn-spring period. The studies also suggested that the foraging ecology of dolphins in Cockburn Sound reflects the consistent utilisation of both: (a) low-density prey species (i.e. individual or weakly-schooling prey) and (b) high-density prey species (i.e. schooling species such as forage fish). These findings indicate that ecosystem-based conservations of the population should consider the conservation requirements of dolphin prey species and the ecological integrity of key foraging habitats like the Kwinana Shelf.

Human-dolphin interactions based on the illegal feeding of dolphins in Cockburn Sound escalated between 1993 and 2003. By 2003, a total of 14 individuals exhibited behaviours indicative of conditioning to human interaction by food reinforcement, including some individuals that engaged in



provisioning interactions on a chronic (i.e. long-term) basis. Observations of the effects of unregulated provisioning indicated that: (a) provisioned dolphins sustained increased higher rates of human-induced injury than non-provisioned dolphins and (b) provisioning was associated with substantial and enduring behavioural changes including changes in ranging and association patterns. Other observations of human-induced injury in Cockburn Sound included seven instances of calf entanglement. These findings indicate that the effects of illegal feeding and other forms of direct human-dolphin interaction (e.g. entanglement) could achieve biological significance for the population.

The possible contribution of (a) human influences, (b) social learning, and (c) behavioural propensities (e.g. age and sex) on the acquisition of an attraction response to human provisioning was examined through logistic regression analysis using age, sex, use of high-boat density areas, and the number of close associates that were previously provisioned as predictor variables and the acquisition of an attraction response as the dependent variable. This analysis was supplemented by behavioural observations of interactions between provisioned and naive individuals during provisioning interactions. The results supported three findings: (1) a relatively high level of exposure to human provisioners was a significant predictor for the acquisition of an attraction response by dolphins; (2) social learning contributed to the acquisition of an attraction response in those individuals that more frequently utilised high-boat density areas; and (3) the potential contribution of behavioural propensities relating to age and sex was uncertain. These conclusions suggest that the acquisition of an attraction response to human provisioning can best be understood as the outcome of a complex of interacting factors.

The findings also indicate: (a) the management value of individual-specific and longitudinal data for the management of harmful human-wildlife interactions and (b) the potential for social learning to contribute to the development and persistence of these interactions. The findings of this study indicate that population decline in Cockburn Sound could be induced by: (1) a reduction in the Sound's environmental carrying capacity or (2) mortality, injury, and behavioural changes resulting from interactions with humans. The potential for such a decline and evidence demonstrating the harmful effects of human activities on dolphins supports the application of preventative approach to the management of illegal feeding and entanglement and a precautionary approach to environmental impact assessments of proposed developments. Mitigation of direct human-dolphins like illegal feeding requires an enforcement and education program to encourage more responsible human attitudes towards interactions with dolphins. Research on the ecology and composition of finfish assemblages and the trophic structure of the Kwinana shelf would assist efforts to mitigate the impact of human-induced habitat change.

Finn, H., Donaldson, R., & Calver, M. (2008). Feeding Flipper: A Case Study of a Human-Dolphin Interaction. *Pacific Conservation Biology*, 14(3), 215-225. <https://doi.org/10.1071/PC080215>

We document a human-dolphin interaction involving the illegal feeding of wild Bottlenose Dolphins (*Tursiops sp.*) in Cockburn Sound, Western Australia from 1993-2003. In 1993 only one dolphin was considered conditioned to human interaction through food reinforcement. By 2001, 16% (n = 12) of the resident community of 74 adult dolphins were conditioned, and at least 14 dolphins were conditioned by 2003. Of the 13 conditioned dolphins of known sex, 11 (85%) were males. We observed conditioned dolphins initiating interactions by approaching recreational fishing boats and by residing for several hours at boat ramps and shore-based fishing sites. We only observed recreational fishers feeding dolphins, although anecdotal reports indicated additional feeding sources. We used belt transects to determine the densities of recreational boats and encounter rates for conditioned dolphins across

habitats within Cockburn Sound. Encounter rates and boat densities were positively correlated, suggesting an association between recreational boat density and the ranging patterns of conditioned dolphins. This study demonstrates how illegal feeding interactions can intensify over time to affect a potentially biologically significant proportion of a local dolphin population. This emphasizes the need for early and pro-active intervention and demonstrates the value of longitudinal, individual-specific wildlife studies.

Foroughirad, V., & Mann, J. (2013). Long-Term Impacts of Fish Provisioning on the Behavior and Survival of Wild Bottlenose Dolphins. *Biological Conservation*, 160, 242-249.  
<https://doi.org/10.1016/j.biocon.2013.01.001>

To promote close encounters with wildlife, humans sometimes provision wild animals with food. However such practices can be harmful, and the impacts of human provisioning on wild animals can be difficult to determine, especially indirect effects such as those on the offspring of provisioned animals. In Shark Bay, Australia, a small subset of the resident population of bottlenose dolphins is regularly provisioned with fish handouts under the supervision of the West Australian Department of Environment and Conservation (DEC). Previous studies have shown that calves born to provisioned females experienced reduced care and higher mortality relative to calves of non-provisioned mothers. These results led to changes in the management practices in 1994, which we assessed the efficacy of by comparing (1) calf mortality before and after the intervention and (2) behavior of provisioned with non-provisioned dolphins in the population. Although calves born to provisioned females exhibited higher survivorship (86.7%) than before the intervention (23.1%,  $\chi^2(2) = 9.05$ ,  $df = 1$ ,  $p = 0.003$ ,  $N=28$ ), group differences in maternal and calf activity budgets were still observed over the course of calf development. Provisioned mothers provided less care to their calves and their calves appeared to compensate by foraging more and separating more from their mothers compared to their non-provisioned counterparts ( $N = 114$  calves). Our study shows that careful regulation and reduced wildlife provisioning can increase calf survivorship, but behavioral development continues to be affected.

Hazelkorn, R. A., Schulte, B. A., & Cox, T. M. (2016). Persistent Effects of Begging on Common Bottlenose Dolphin (*Tursiops truncatus*) Behavior in an Estuarine Population. *Aquatic Mammals*, 42(4), 531-541. <https://doi.org/10.1578/am.42.4.2016.531>

Human interactions can have negative effects on individuals and populations of dolphins. Quantifying these effects is essential for conservation. Common bottlenose dolphins (*Tursiops truncatus*) near Savannah, Georgia, have demonstrated some of the highest rates of human interactions worldwide; thus, our aim was to determine if begging by dolphins has become a persistent foraging strategy which subsequently has altered behavioral patterns of the bottlenose dolphins in waters around Savannah. Dolphins were classified as either beggars or non-beggars based on whether they had displayed human-interactive behaviors, such as patrolling, begging, or human-interaction foraging, during their sighting history. Instantaneous and continuous observation sampling during 90-min focal follows were used to collect behavioral data on 17 individual beggars and 16 individual non-beggars. A Pearson's chi-squared and Kruskal Wallis ANOVA were used to analyze behavioral data. In the time they were observed, beggars spent a significantly smaller percentage of time foraging (26%) compared to non-beggars (45%;  $p < 0.0001$ ). In contrast, beggars spent significantly more time observed traveling (53%) compared to

non-beggars (40%;  $p < 0.0001$ ). The amount of time they were observed at play, rest, and engaged in social behaviors were similar when comparing beggars and non-beggars (approximately 1% of all behaviors). Boat presence was not a major factor influencing behavioral differences as on average less than one boat, including the research vessel, was within either 10 or 50 m during each focal follow. Thus, the behavioral differences observed are likely indicative of a persistent behavioral shift taking place. Increased interactions with humans not only perpetuate potential further behavioral changes but raise the potential for injuries in dolphins resulting from these human interactions. Health implications for dolphins and their offspring are also a concern as the quality of food received by begging dolphins has not been quantified to determine if a provisioned diet is calorically dense enough for their long-term health.

Kovacs, C. J. (2012). *Interactions between Common Bottlenose Dolphins (*Tursiops truncatus*) and Shrimp Trawlers in Savannah, Georgia*. Savannah State University, Available through ProQuest Dissertations and Theses Database. No URL available.

Observations of common bottlenose dolphins (*Tursiops truncatus*) begging around shrimp trawlers near Savannah led to speculation that the high rates of begging observed in the area may have stemmed from interactions with shrimp trawlers. The objectives of this study were to quantify interactions between dolphins and shrimp trawlers and determine the relationship between trawler associations and begging. Dolphin surveys were conducted from 2009-2011, and observations were made from a commercial trawler in 2010 and 2011. Fifty-four percent of dolphins associated with trawlers. Dolphins associated with a trawler for a large portion ( $68.2 \pm 33.9\%$ ) of the fishing day. Dolphins were observed begging at the trawler 89.5% of fishing days; however, sightings from boat-based surveys indicated both trawler and non-trawler dolphins begged. Results of this study suggest there are two potential sources of begging behavior by dolphins: trawler associations and illegal feeding from recreational vessels.

Kovacs, C. J., Perrtree, R. M., & Cox, T. M. (2017). Social Differentiation in Common Bottlenose Dolphins (*Tursiops truncatus*) That Engage in Human-Related Foraging Behaviors. *PLoS one*, 12(2), e0170151. <https://doi.org/10.1371/journal.pone.0170151>

Both natural and human-related foraging strategies by the common bottlenose dolphin (*Tursiops truncatus*) have resulted in social segregation in several areas of the world. Bottlenose dolphins near Savannah, Georgia beg at an unprecedented rate and also forage behind commercial shrimp trawlers, providing an opportunity to study the social ramifications of two human-related foraging behaviors within the same group of animals. Dolphins were photoidentified via surveys conducted throughout estuarine waterways around Savannah in the summers of 2009–2011. Mean half-weight indices (HWI) were calculated for each foraging class, and community division by modularity was used to cluster animals based on association indices. Pairs of trawler dolphins had a higher mean HWI ( $0.20 \pm 0.07$ ) than pairs of non-trawler dolphins ( $0.04 \pm 0.02$ ) or mixed pairs ( $0.02 \pm 0.02$ ). In contrast, pairs of beggars, non-beggars, and mixed pairs all had similar means, with HWI between 0.05–0.07. Community division by modularity produced a useful division (0.307) with 6 clusters. Clusters were predominately divided according to trawler status; however, beggars and non-beggars were mixed throughout clusters. Both the mean HWI and social clusters revealed that the social structure of common bottlenose dolphins near Savannah, Georgia was differentiated based on trawler status but not beg status. This finding may

indicate that foraging in association with trawlers is a socially learned behavior, while the mechanisms for the propagation of begging are less clear. This study highlights the importance of taking into account the social parameters of a foraging behavior, such as how group size or competition for resources may affect how the behavior spreads. The positive or negative ramifications of homophily may influence whether the behaviors are exhibited by individuals within the same social clusters and should be considered in future studies examining social relationships and foraging behaviors.

Machernis, A. F., Powell, J. R., Engleby, L., & Spradlin, T. R. (2018). *An Updated Literature Review Examining the Impacts of Tourism on Marine Mammals over the Last Fifteen Years (2000-2015) to Inform Research and Management Programs*. St. Petersburg, FL  
<https://doi.org/10.7289/V5/TM-NMFS-SER-7>

This current literature review updates and builds upon Samuels et al. 2000, by including almost 190 new references from 2000-2015 pertaining to swim-with activities, as well as vessel, land-based, and feeding interactions. The scope has also been expanded to include additional species of cetaceans, pinnipeds, and sirenians. Our updated review highlights the major animal responses to viewing activities in four major themes: (1) behavior, (2) habitat use, (3) health, and (4) reproduction. Reoccurring responses documented in all four interaction themes include changes in animals' behavioral budgets and ranging patterns, habitat displacement, avoidance behaviors, and reduced maternal care. Many studies highlighted the risks and effects associated with interactions, such as increased energetic demands, predation, acoustic disturbance, reduced juvenile survivorship, boat collision, and entanglement injuries. This updated literature review provides a comprehensive analysis of human-marine mammal interactions to date that can help guide future potential research projects and management strategies.

Mangott, A. H. (2010). *Behaviour of Dwarf Minke Whales (Balaenoptera Acutorostrata Subsp.) Associated with a Swim-with Industry in the Northern Great Barrier Reef*. (PhD), James Cook University, Retrieved from <https://researchonline.jcu.edu.au/19001/>

A diffuse aggregation of dwarf minke whales occurs in the northern Great Barrier Reef World Heritage Area during the austral winter months. This area coincides with a region heavily used by a large dive and snorkel tourism industry. Over the last two decades a small part of this industry has developed into a swim-with dwarf minke whale industry that has been limited via a permit scheme since 2003. Very little was understood about the whales' behaviour or the response of the whales to the vessels and swimmers. In order to address this knowledge gap, I designed this study with two major aims: (1) to provide detailed insights into the behaviour of dwarf minke whales around tourism vessels and swimmers, and (2) to establish recommendations for the tourism industry and management agencies to provide for discussions on future management and to contribute to the sustainability of this industry.

During my research (2006-2008), I described over 30 distinctive dwarf minke behaviours and provided evidence for the presence of behaviours with potential social and investigative functions. Behaviours with likely social attributes such as belly presentations and bubble releases, were significantly influenced by a large group size (>6 animals), while investigatory behaviours such as close and very close approaches, motorboating, and headrises were positively influenced by the presence of resighted animals. Dwarf minke whales are a predominantly solitary oceanic species. When they form social groups, behaviours which convey information among conspecifics via visual communication (e.g.

presenting the white belly or releasing bubbles) may be particularly important. The presence of several investigative behaviours during interactions with vessels and swimmers highlights the inquisitive nature of these whales and suggests that such behaviours are an important part of their ecology (i.e. finding mates, food or avoiding predators).

I also investigated potential agonistic and disturbance displays of dwarf minke whales and provided an indication on the metabolic costs of interacting with humans. The scarcity of agonistic and disturbance responses and the absence of avoidance behaviours, all suggest that the vessels and swimmers have a relatively low impact on the whales. Nonetheless, several behaviours including close (>1-3 metres) and very close ( $\leq 1$  metre) approaches to human observers and potential agonistic and disturbance behaviours (e.g. gapes/gulps, jaw claps) were identified as of potential harm to both the whales and the swimmers.

The investigative nature of dwarf minke whales was further explored by quantifying the distribution of interacting whales around vessels and swimmers and examining if their behaviour changes in interactions with humans over time. Dwarf minke whales voluntarily approached dive tourism vessels and maintained contact for prolonged periods ( $X \pm SE$ , 2006-2008 =  $171 \pm 11$  minutes). These whales showed a highly clumped distribution around the vessel, surfacing more often within a 60 metres radius of the boat than expected and aggregating around swimmers. My results also suggest that dwarf minke whales change their behaviour over time in interactions with humans. Individual whales repeatedly passed very close to the swimmers ( $X=7.08$  metres  $\pm SE$  0.09 metres;  $N=119$  whales) and significantly decreased their passing distance over the course of an interaction. In both cases, closeness was significantly influenced by group size; the larger the group of whales, the closer individuals approached the observers. Individual dwarf minke whales significantly decreased their passing distance in subsequent interactions and resighted animals approached swimmers significantly closer than unknown individual whales.

The voluntary initiation of contact with humans, the whales' close and prolonged association with the vessel and swimmers, the closeness of their approaches and the increased familiarity to the stimuli, all suggest a strong exploratory drive of dwarf minke whales. Indeed, the inquisitive behaviour of dwarf minke whales contrasts with the behaviour of most free-ranging marine mammals interacting with humans. These behavioural attributes raise management issues and concerns about the safety of both the whales and the human participants.

I assessed the risk of harm associated with swimming with dwarf minke whales for both, the swimmers and the whales using both, my observational data and the perceptions of Key Informants (marine mammal experts, and members of management and non-governmental organisations). This assessment revealed that most dwarf minke whale behaviours displayed during interactions are of low risk of harm to the swimmers and the whales. Nevertheless, in a fifth of the total observed interactions ( $n=101$ ) there was at least one whale behaviour present with potential to harm swimmers and/or whales. In addition, I identified 22 occasions from all interactions of the endorsed industry ( $N=467$ ; 2006-2008) where whales made physical contact with objects (e.g. ropes, dinghy) or swimmers and five (22%) of those incidents were caused by only one individual resighted whale.

The Key Informants perceived the risk of harm to swimmers from the swim with industry as much greater than the risk of harm to the whales. Nonetheless they were concerned about the wellbeing of the whales in the medium to longer term, i.e. the potential of such industries to change the behaviour of the whales and impact on their behavioural budget and fitness. Most Key Informants evaluated the current swim-with dwarf minke whale industry positively; however, they considered that this industry

needs continuous monitoring and future research in order to identify any long-term impacts and to address research gaps for adequate management.

I also evaluated the accuracy of data collected by crew on dwarf minke whale behaviours. The crew reported dwarf minke whale behaviours via the Whale Sighting Sheets. I compared these records (presence/absence of behaviour per encounter) with my data. The best fitting commonalities between my observations and data reported via the Whale Sighting Sheets were between close (>1-3 metres) and very close approaches ( $\leq 1$  metre), headrises, motorboating and touching behaviour. For crew to be able to identify these particular whale behaviours is important for both, cost-efficient longer-term monitoring and the risk management of interactions. I also used a passenger questionnaire (Interaction Behaviour Diary) to evaluate passengers' satisfaction with their whale swims, and to investigate their perceptions about potential harmful dwarf minke whale behaviours. Swimmers were more satisfied when dwarf minke whales approached very close ( $\leq 1$  metre) to them and perceived such close encounters as harmless. Both these reactions pose challenges to the effective management of risks associated with interactions.

This study is the first comprehensive assessment of the behaviour of a baleen whale associated with a tourism industry. It provides a scientific basis for future studies on dwarf minke whales and will be useful for behavioural studies of other baleen whales associated with humans. This study provides specific recommendations to improve the future management of the swim-with dwarf minke whale industry and to ensure the protection of this species.

Mann, J., & Kemp, C. (2003). The Effects of Provisioning on Maternal Care in Wild Bottlenose Dolphins, Shark Bay, Australia. In *Marine Mammals, Fisheries, Tourism, and Management Issues*. N. Gales, M. Hindell, & R. Kirkwood (Eds.), (pp. 292-305). Collingwood, Vic.: CSIRO Retrieved from <https://ebooks.publish.csiro.au/content/marine-mammals-fisheries-tourism-and-management-issues>

Cetaceans command considerable public interest and provisioning sites attract worldwide attention. Despite substantial fines in some countries, the pressures to feed wild dolphins are high. Illegal feeding is common off the US coasts of South Carolina, Florida and Texas (Samuels et al. 2000). The aims of the current study were to quantify the effects of provisioning on maternal care in wild bottlenose dolphins at Monkey Mia, and to offer strategies that might minimize the effects of provisioning on dolphin welfare.

Orams, M. B. (1995). Development and Management of a Feeding Program for Wild Bottlenose Dolphins at Tangalooma, Australia. *Aquatic Mammals*, 21, 137-137. Retrieved from [https://aquaticmammalsjournal.org/share/AquaticMammalsIssueArchives/1995/AquaticMammals\\_21-02/21-02\\_Orams.pdf](https://aquaticmammalsjournal.org/share/AquaticMammalsIssueArchives/1995/AquaticMammals_21-02/21-02_Orams.pdf)

No abstract.

Orams, M. B. (2002). Feeding Wildlife as a Tourism Attraction: A Review of Issues and Impacts. *Tourism Management*, 23(3), 281-293. [https://doi.org/10.1016/S0261-5177\(01\)00080-2](https://doi.org/10.1016/S0261-5177(01)00080-2)

The feeding of wildlife has become a popular means by which tourists and tourism operators can facilitate close observation and interaction with wildlife in the wild. These practices are widespread and have a variety of impacts on the wildlife—and on the tourists. Deliberate and long-term provision of food to wildlife has been shown to alter natural behaviour patterns and population levels. It has also resulted in the dependency of animals on the human provided food and their habituation to human contact. Intra- and inter-species aggression has also occurred where wildlife, in their efforts to obtain food, have harmed one another and harmed tourists. There are also important health implications arising from artificial food sources where injury and disease have resulted. While the great majority of cases show negative impacts arising from supplemental feeding of wildlife, this is not always the case. Certainly there are psychological, social and economic benefits that are experienced on the human side of the interaction and, in a limited number of cases, the wildlife can be shown to have benefited as well. The issue of feeding wildlife for tourism is a controversial one with little consensus regarding how it should be managed. Approaches range from complete prohibition, to active promotion and management, to simply ignoring the practices. Little empirical research, inconsistent management and differing views of the role of animals in humans' lives ensure that this issue will remain a contentious one worthy of further examination and consideration.

Orams, M. B., Hill, G. J., & Baglioni Jr, A. J. (1996). "Pushy" Behavior in a Wild Dolphin Feeding Program at Tangalooma, Australia. *Marine Mammal Science*, 12(1), 107-117. <https://doi.org/10.1111/j.1748-7692.1996.tb00308.x>

A program where wild bottlenose dolphins (*Tursiops truncatus*) are fed by tourists in shallow water adjacent to a wharf has been established at Tangalooma, Queensland, Australia. Up to nine dolphins attend the nightly feedings, and between 60 and 80 resort guests are permitted to hand feed these dolphins each night. Since this program began in 1992, the dolphins have increased in confidence and have started, at times, to make forceful contact with guests who enter the water to feed them. This paper categorizes such behavior as "pushy" and reports on a study which quantifies the "pushiness" of the dolphins which feed at Tangalooma. The study examines ecological variables which may determine how pushy the dolphins are at different feeding sessions. The number of dolphins attending a particular feeding significantly increases the pushiness. In addition, the presence of adult males at a feeding is likely to increase pushing. Tidal state also influences how pushy the dolphins are. At low tide, when the dolphins' mobility is restricted by the water depth, they are less likely to be pushy. Given the problems experienced in a number of other situations where wild animals are fed by humans, it is important to monitor carefully the escalation of pushy behavior in this dolphin feeding program, as it may be a precursor to more aggressive actions on the part of the dolphins.

Perrtree, R. M., Kovacs, C. J., & Cox, T. M. (2014). Standardization and Application of Metrics to Quantify Human-Interaction Behaviors by the Bottlenose Dolphin (*Tursiops* spp.). *Marine Mammal Science*, 30(4), 1320-1334. <https://doi.org/10.1111/mms.12114>

The conditioning of dolphins to human-interaction behaviors has been documented in several areas worldwide. However, the metrics used to report human-interaction behaviors vary among studies,



making comparison across study areas difficult. The purpose of this study was to develop standard metrics for reporting human-interaction behaviors and utilize these metrics to quantify the prevalence of human-interaction behaviors by common bottlenose dolphins (*Tursiops truncatus*) near Savannah, Georgia. The four metrics used were percentage of days with human-interaction behaviors, percentage of sightings with human-interaction behaviors, percentage of the catalog that interacted with humans, and spatial extent of human-interaction behaviors. Human-interaction behaviors were observed on 69.6% of days and 23.5% of sightings near Savannah. In addition, 20.1% of the animals in the catalog were observed interacting with humans. These rates are much higher than those found in other areas with known issues with human-interaction behaviors. These behaviors were observed across an area of 272.6 km<sup>2</sup>, which is larger than other reported areas. The four metrics used in this study proved to be a valuable way to report human-interaction behaviors, and their use is recommended for future studies to allow for comparison among areas.

Powell, J. R. (2009). *Depredation and Angler Interactions Involving Bottlenose Dolphins (Tursiops truncatus) in Sarasota Bay, Florida*. (Masters), University of South Florida, Graduate Theses and Dissertations. Retrieved from <https://scholarcommons.usf.edu/etd/2153>

Typical depredation behavior by cetaceans involves stealing or damaging prey items already captured by recreational or commercial fishing gear. Depredation among cetaceans has been reported to be increasing in both severity and frequency globally. This behavior is of particular concern for small stocks of cetaceans since any interaction with fishing gear has the potential to injure or kill animals leading to unsustainable losses. In Florida, depredation became evident in 2006 when the number of bottlenose dolphin (*Tursiops truncatus*) strandings resulting from fishing gear ingestion or entanglement sharply increased. For the resident dolphin community in Sarasota Bay, modeling showed continued mortalities from recreational fishing gear interactions were not sustainable.

The major goals of this study were to 1.) characterize depredation and recreational angler interactions involving dolphins in Sarasota Bay, 2.) reduce dolphin-angler interactions through outreach, 3.) examine a case study to investigate the link between dolphin hearing loss and angler interaction behavior, 4.) test the effectiveness of passive acoustics in monitoring dolphin depredation at a fishing pier. Findings from this study provided a better understanding of depredation and angler interactions. Results indicated that dolphin-angler interactions in Sarasota Bay are increasing in frequency and are affecting an increasing number of dolphins, specifically adult males. Some dolphins in Sarasota Bay appear to utilize depredation as a foraging method (not just an opportunistic behavior) and were significantly more likely to be within 50 m of an active fishing line.

Depredation and angler interaction behavior appear to increase in times of prey depletion (such as during a red tide) and heightened angler fishing activity. Educational outreach using an informational card proved successful in a case study showing about a 30% reduction in dolphin provisioning rates. The case study of F201 offers preliminary evidence that hearing loss is linked to depredation behavior and death for wild dolphins. Also, by detecting echolocation clicks as a proxy for dolphin presence, passive acoustics showed potential as an inexpensive method for monitoring depredation in problematic areas. Conclusions from this study can be utilized by scientists and managers when assessing depredation rates for a cetacean community and implementing an action plan.



Powell, J. R., Machernis, A. F., Engleby, L. K., Farmer, N. A., & Spradlin, T. R. (2018). Sixteen Years Later: An Updated Evaluation of the Impacts of Chronic Human Interactions with Bottlenose Dolphins (*Tursiops truncatus*) at Panama City, Florida, USA. *The Journal of Cetacean Research and Management*, 19, 79. Retrieved from <https://search.proquest.com/docview/2183645970?accountid=28258>

Panama City, Florida is considered a notorious 'hot spot' in the southeastern United States for chronic illegal feeding and harassment of bottlenose dolphins. The nature and extent of these interactions was evaluated by Samuels and Bejder (2004); they concluded that food provisioning was the basis for human interactions with wild dolphins, and that these encounters were likely harmful to dolphins. A follow-up study was conducted in 2014 to reassess the current state of human interactions with wild dolphins. The number of conditioned dolphins (n = 21) tripled compared to the previous study. Both studies found conditioned dolphins engaged in human interaction events during approximately 75% of observable time points when vessels or swimmers were present. In this study, conditioned dolphins spent as much as 81% of their time begging or patrolling and significantly decreased their distance moved while doing so. Nested multinomial regression analysis revealed conditioned dolphins engaged in resting or foraging (i.e. natural) behaviour were extremely likely to switch to begging or patrolling (i.e. interaction) behaviours when vessels or swimmers were present. Numerous high risk situations were observed for both conditioned dolphins and humans during these interactions. The latest development in illegal feeding was documented: bait boats feeding dolphins to lure the animals into interactions with tour vessels and swimmers. Our observations indicate that the problem in Panama City has escalated: dolphins are being actively provisioned, often for long periods of time; the proportion of conditioned dolphins has increased; interacting dolphins and humans are both at increased risk for injury, illness, or death; and conditioned dolphin activity budgets and movement patterns continue to be negatively impacted by human behaviour. We recommend a more aggressive management strategy, such as targeted and sustained enforcement of existing regulations as well as additional restrictions that prohibit close approaches and in-water interactions for Panama City in order to curtail continued harassment of dolphins and reduce the risk of injury for both humans and dolphins.

Powell, J. R., & Wells, R. S. (2011). Recreational Fishing Depredation and Associated Behaviors Involving Common Bottlenose Dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. *Marine Mammal Science*, 27(1), 111-129. <https://doi.org/10.1111/j.1748-7692.2010.00401.x>

Odontocete depredation involves stealing or damaging bait or prey already captured by fishing gear. The increase in depredation is of concern for small stocks of cetaceans because interactions with fishing gear can lead to serious injury or mortality through entanglement or ingestion. Using long-term data sets available for the bottlenose dolphin (*Tursiops truncatus*) community in Sarasota Bay, Florida, we investigated recreational fishing gear interactions by (1) examining temporal patterns in depredation and associated behaviors from 2000 to 2007; (2) quantifying the behavior of dolphins that depredate or engage in associated behaviors; and (3) identifying factors associated with the rise in depredation locally. The number of incidents of dolphins (primarily adult males) interacting with recreational anglers and boaters increased following 2004. Depredation and associated behaviors increased during red tide lags and tourist seasons during times of prey depletion and heightened angler and boater activity. Dolphins with a history of fishing gear interactions shifted away from natural activity patterns and were more likely to be within 50 m of fishing lines. Recreational fishing gear interactions were attributed to a

two percent population decline in Sarasota Bay in 2006 and need to be considered along with other cumulative human impacts in the development of conservation measures for dolphins.

Samuels, A., & Bejder, L. (2004). Chronic Interaction between Humans and Free-Ranging Bottlenose Dolphins near Panama City Beach, Florida. *Journal of Cetacean Research and Management*, 6(1), 69-77. Retrieved from <https://researchrepository.murdoch.edu.au/id/eprint/3007/>

'Swim-with' activities, in which humans enter the water to interact with free-ranging cetaceans, are a popular form of nature tourism; however, there is considerable disagreement as to whether these encounters constitute a threat to the animals. At the request of the US Marine Mammal Commission, a systematic study was designed to quantify effects of swim-with activities on the behaviour of bottlenose dolphins in waters near Panama City Beach, Florida. Certain dolphin behaviours were identified as indicative of chronic interaction with humans, and based on presence of these behaviours, at least seven dolphins were identified that permitted people to swim nearby. Because these dolphins accepted food handouts from people, they were considered to be conditioned to human interaction through food reinforcement. Specific human-dolphin interactions that posed a risk for dolphins or humans were identified, and it was calculated that human interaction put a specific juvenile dolphin at risk once every 12 min, including being fed by humans once every 39-59 min. Humans interacting with that dolphin were estimated to be at risk once every 29 min. Although the study was of limited duration, the observations were so clear-cut and the nature of interactions so potentially hazardous it was concluded that food provisioning was the probable basis for swimming with free-ranging dolphins near Panama City Beach, Florida, and therefore, human interaction at this location was likely to be harmful to the dolphins and in clear violation of the US Marine Mammal Protection Act. Of equal importance to the findings of this study is the methodology. A systematic behavioural methodology was designed that can be adapted to study potential impacts of nature tourism on coastal communities of cetaceans in which individuals are readily distinguished. The focus was on the behaviour of individual animals in order to describe and quantify in-water interactions between dolphins and humans, to make behavioural comparisons for the same individual dolphins in the presence and absence of swimmers, and to make behavioural comparisons for individual dolphins in the same region that do and do not interact with swimmers. Coupled with standard photo identification techniques, these methods can be used to identify the class of animals, or proportion of a local community, that is more likely to interact with, be detrimentally affected by, and/or avoid human interaction. Sequential observations of the same individuals taken over time can be used to document habituation or sensitisation to human interaction.

Senigaglia, V., & Bejder, L. (2020). Pregnancy Cravings: Visitation at a Food-Provisioning Site Is Driven by the Reproductive Status of Bottlenose Dolphins. *Tourism in Marine Environments*, 15(3-4), 237-248. <https://doi.org/10.3727/154427320X15943283422072>

Marine wildlife tourism attractions often use food rewards to ensure close-up encounters with freeranging animals. In Bunbury, Western Australia, the Dolphin Discovery Centre (DDC) conducts a foodprovision program where bottlenose dolphins (N= 22; between 2000 and 2018) are offered food rewards to encourage their visitation at a beach in front of the DDC. We used historical records on individual beach visits by adult female dolphins collected by the DDC from 2000 to 2018 to develop generalized mixed effects models (GLMM) to test whether the frequency of beach visitation was

influenced by their reproductive status (pregnant, lactating, nonreproductive) or climatic events (El Niño-Southern Oscillation phases) that could affect prey availability. We also quantified the behavioral budget of dolphins during food-provisioning sessions and documented intra- and interspecific aggressive behaviors using individual focal follows collected in 2017-2018. Provisioned females spend most of the time resting within the interaction area (66.3%) and aggressive interactions arise as a consequence of dominance behavior over food access. Visitation rates were most influenced by reproductive status with pregnant and lactating females visiting the provisioning area more frequently ( $z = 2.085$ ,  $p = 0.037$  and  $z = 2.437$ ,  $p = 0.014$ , respectively). Females that frequently visit the provisioning area expose their dependent calves to regular human interactions at an early age when they are more susceptible to behavioral conditioning. Such experiences could cause the loss of awareness towards humans and promote maladaptive behaviors such as begging that increase risk of entanglement in fishing gear, boat strikes, and propeller injuries.

Senigaglia, V., Christiansen, F., Sprogis, K. R., Symons, J., & Bejder, L. (2019). Food-Provisioning Negatively Affects Calf Survival and Female Reproductive Success in Bottlenose Dolphins. *Scientific Reports*, 9. <https://doi.org/10.1038/s41598-019-45395-6>

Food-provisioning of wildlife can facilitate reliable up-close encounters desirable by tourists and, consequently, tour operators. Food-provisioning can alter the natural behavior of an animal, encouraging adverse behavior (e.g. begging for food handouts), and affect the reproductive success and the viability of a population. Studies linking food-provisioning to reproductive success are limited due to the lack of long-term datasets available, especially for long-lived species such as marine mammals. In Bunbury, Western Australia, a state-licensed food-provisioning program offers fish handouts to a limited number of free-ranging bottlenose dolphins (*Tursiops aduncus*). Coupled with long-term historical data, this small (<200 individuals), resident dolphin population has been extensively studied for over ten years, offering an opportunity to examine the effect of food-provisioning on the reproductive success of females ( $n(\text{total}) = 63$  ;  $n(\text{provisioned})(\text{females}) = 8$ ). Female reproductive success was estimated as the number of weaned calves produced per reproductive years and calf survival at year one and three years old was investigated. The mean reproductive success of provisioned and non-provisioned females was compared using Bayes factor. We also used generalized linear models (GLMs) to examine female reproductive success in relation to the occurrence of food-provisioning, begging behavior and location (within the study area). Furthermore, we examined the influence of these variables and birth order and climatic fluctuations (e.g. El Nino Southern Oscillation) on calf survival. Bayes factor analyses (Bayes factor =6.12) and results from the best fitting GLMs showed that female reproductive success and calf survival were negatively influenced by food-provisioning. The negative effects of food-provisioning, although only affecting a small proportion of the adult females' population (13.2%), are of concern, especially given previous work showing that this population is declining.

Smith, H., Samuels, A., & Bradley, S. (2008). Reducing Risky Interactions between Tourists and Free-Ranging Dolphins (*Tursiops Sp.*) in an Artificial Feeding Program at Monkey Mia, Western Australia. *Tourism Management*, 29(5), 994-1001. <https://doi.org/10.1016/j.tourman.2008.01.001>

We studied interactions between tourists and free-ranging bottlenose dolphins in an artificial feeding program at Monkey Mia, Australia. We used logistic regression to identify factors that contributed to the incidence of “risky” (potentially injurious) interactions between tourists and dolphins. Rates of dolphin-to-tourist risky interactions were heightened with longer waiting times before dolphins were fed. We documented differences among provisioned dolphins in their proclivity to engage in risky interactions; however, it was more likely for risky interactions to be initiated by tourists. Our findings suggest several readily implemented management strategies to reduce incidence of risky interactions. Long-term monitoring of tourism based on artificial feeding is essential to identify and rectify detrimental effects of provisioning on dolphins, to ensure the safety and welfare of dolphins and tourists, and to promote sustainability of this potentially harmful tourist activity.

Strandin, T., Babayan, S. A., & Forbes, K. M. (2018). Reviewing the Effects of Food Provisioning on Wildlife Immunity. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1745), 20170088. <https://doi.org/10.1098/rstb.2017.0088>

While urban expansion increasingly encroaches on natural habitats, many wildlife species capitalize on anthropogenic food resources, which have the potential to both positively and negatively influence their responses to infection. Here we examine how food availability and key nutrients have been reported to shape innate and adaptive immunity in wildlife by drawing from field-based studies, as well as captive and food restriction studies with wildlife species. Examples of food provisioning and key nutrients enhancing immune function were seen across the three study type distinctions, as were cases of trace metals and pharmaceuticals impairing the immunity of wildlife species. More generally, food provisioning in field studies tended to increase innate and adaptive responses to certain immune challenges, whereas patterns were less clear in captive studies. Mild food restriction often enhanced, whereas severe food restriction frequently impaired immunity. However, to enable stronger conclusions we stress a need for further research, especially field studies, and highlight the importance of integrating nutritional manipulation, immune challenge, and functional outcomes. Despite current gaps in research on this topic, modern high throughput molecular approaches are increasingly feasible for wildlife studies and offer great opportunities to better understand human influences on wildlife health. This article is part of the theme issue ‘Anthropogenic resource subsidies and host–parasite dynamics in wildlife’.

Vail, C. S. (2016). An Overview of Increasing Incidents of Bottlenose Dolphin Harassment in the Gulf of Mexico and Possible Solutions. *Frontiers in Marine Science*, 3. <https://doi.org/10.3389/fmars.2016.00110>

The panhandle region of the Gulf of Mexico is known by scientists, regulatory agencies and conservation organizations as a “hotbed” area of dolphin harassment. Interactions between humans and wild dolphins routinely occur through close vessel approaches or through direct contact associated with commercial or recreational fisheries, swimwith, or feeding activities. Such interactions are of serious concern for wild dolphin welfare and conservation under the U.S. Marine Mammal Protection Act, as well as for human safety. In recent years, an alarming number of dolphins in this region have been fatally wounded by gunshot, hunting arrows, or sharp tools (i.e., screwdriver). The potential to mitigate the detrimental impacts resulting from these human-dolphin encounters requires a comprehensive

outreach strategy to address increasing incidents of harassment and vandalism, as well as an evaluation of the serious trends and challenges hampering dolphin protection in this region. In addition to the identification and conviction of perpetrators through the application of existing law, voluntary outreach programs offer real potential to educate and reform public attitudes and behaviors through community-based stewardship initiatives, which can foster dolphin protection in areas of high human-dolphin conflict. The development of these types of programs underlines the potential for non-regulatory approaches to serve as an effective means to reach and activate the public on some of the most pressing local and regional marine conservation issues. In tandem with regulations and enforcement, voluntary stewardship programs can provide stakeholders an opportunity to engage in local dolphin conservation efforts through a positive approach aimed to inspire accountability.

## Part 1.2 – Other Animals

Alves, L., Andriolo, A., Orams, M. B., & Azevedo, A. D. (2013). Resource Defence and Dominance Hierarchy in the Boto (*Inia geoffrensis*) During a Provisioning Program. *Acta Ethologica*, 16(1), 9-19. <https://doi.org/10.1007/s10211-012-0132-2>

Aggression is often utilised in intraspecific competition to establish and maintain dominance hierarchies in social mammals. Here, we determine if aggressiveness in conditioned botos (*Inia geoffrensis*) during interactions with humans under provisioning is influenced by the presence or absence of food rewards and if provisioning leads to the establishment of a dominance hierarchy among these generally solitary animals. Mean values of bites among the botos for sessions in which food rewards were delivered were significantly higher than sessions in which no food reward was delivered. No significant difference exists between the mean number of bites per individual during feeding sessions, but the mean number of bites increased significantly with time when animals were not fed. Supplant behaviours were used as a non-harming alternative to bites. The botos' provisioning is a case of instrumental conditioning, in which the conditioned botos expect to receive food from tourists, increasing competition among the animals when they are not fed. The provisioned botos exhibited an almost linear dominance hierarchy. Bites and supplant behaviours were used more frequently by dominant botos to prevent subordinates from obtaining food provisions. Interactions brought about by provisioning are likely to be harmful to the botos and potentially dangerous to humans.

Brena, P. F., Mourier, J., Planes, S., & Clua, E. (2015). Shark and Ray Provisioning: Functional Insights into Behavioral, Ecological and Physiological Responses across Multiple Scales. *Marine Ecology Progress Series*, 538, 273-283. <https://doi.org/10.3354/meps11492>

The use of olfactory stimuli and the provision of food are a common practice to prompt artificial aggregations of emblematic wild species and ensure the economic viability of the wildlife-watching industry. Several elasmobranch species have been targeted by such operations in a variety of locations for over 4 decades. A recent review succinctly addressed the potential effects of shark diving tourism, including shark provisioning, on shark individual behavior and ecology, but the paucity of data on the ecology of elasmobranchs precluded general statements. By using a functional framework, we reviewed the findings of the 22 available studies that investigated the behavioral, physiological, and ecological response of 14 shark and 3 ray species targeted by artificial provisioning. Focusing on the underlying processes that rule the response of targeted elasmobranch species, we report further effects acting beyond the individual scale. We suggest that the most commonly described alterations of individual movement patterns have cascading effects through the group and community scales, ultimately resulting in altered health condition and individual behavior toward humans. We conclude by stressing the potential for provisioning activities to support the investigation of complex ecological and behavioral processes in elasmobranchs.

Cox, D. T., & Gaston, K. J. (2018). Human–Nature Interactions and the Consequences and Drivers of Provisioning Wildlife. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1745), 20170092. <https://doi.org/10.1098/rstb.2017.0092>

Many human populations are undergoing an extinction of experience, with a progressive decline in interactions with nature. This is a consequence both of a loss of opportunity for, and orientation towards, such experiences. The trend is of concern in part because interactions with nature can be good for human health and wellbeing. One potential means of redressing these losses is through the intentional provision of resources to increase wildlife populations in close proximity to people, thereby increasing the potential for positive human–nature experiences, and thence the array of benefits that can result. In this paper, we review the evidence that these resource subsidies have such a cascade of effects. In some Westernized countries, the scale of provision is extraordinarily high, and doubtless leads to both positive and negative impacts for wildlife. In turn, these impacts often lead to more frequent, reliable and closer human–nature interactions, with a greater variety of species. The consequences for human wellbeing remain poorly understood, although benefits documented in the context of human–nature interactions more broadly seem likely to apply. There are also some important feedback loops that need to be better characterized if resource provisioning is to contribute effectively towards averting the extinction of experience. This article is part of the theme issue ‘Anthropogenic resource subsidies and host–parasite dynamics in wildlife’.

de Sá Alves, L. C. P., Orams, M., Andriolo, A., & de Freitas Azevedo, A. (2012). The Growth of ‘Botos Feeding Tourism’, a New Tourism Industry Based on the Boto (Amazon River Dolphin) *Inia geoffrensis* in the Amazonas State, Brazil. *Sitientibus: Série Ciências Biológicas*, 11(1), 8-15. <https://doi.org/10.13102/scb140>

The Amazon’s reputation and ability to draw tourists is strongly associated with the natural environment and with tourist’s ability to sight and interact with iconic animals. In Brazil, four cases of aggregations of wild boto (Amazon River dolphin; *Inia geoffrensis*), becoming conditioned to human contact through food provisioning are occurring in Amazonas State, Central Amazon, where tourists can feed, touch and swim with the botos. The feeding of wild dolphins imposes significant risks, both for the dolphins and for the tourists, and these dangers are evident at Novo Airão City, which is the longest established of the four mentioned cases. There are few rules imposed, inadequate infrastructure and no specialized employee training or surveillance. Competitive, aggressive interactions between dolphins, pushing, ramming and biting are common and a number of dangerous interactions between the dolphins and tourists have been observed. It is evident that the establishment of this tourist-dolphin interaction is facilitated by the deliberate feeding of the dolphins and that this activity has become financially lucrative for local people. Despite bringing benefits to the region, the growth of this ‘botos feeding tourism’ activity in the Amazon is currently poorly managed and there is a high risk of injury or fatality if interactions continue to develop without improved and careful management.

Garshelis, D. L., Baruch-Mordo, S., Bryant, A., Gunther, K. A., & Jerina, K. (2017). Is Diversionary Feeding an Effective Tool for Reducing Human-Bear Conflicts? Case Studies from North America and Europe. *Ursus*, 28(1), 31-55. <https://doi.org/10.2192/ursu-d-16-00019.1>

Diversionary feeding uses food to lure animals away from areas where they are unwanted or could cause conflicts with people. With bears (Ursidae) increasingly attracted to human food sources worldwide, diversionary feeding represents a seemingly logical and publicly acceptable means of alleviating conflicts. Feeding wildlife is widely practiced in Europe to enhance hunting and reduce



conflicts, but feeding of bears is discouraged across North America. The efficacy and potential side effects of bear feeding remain an open question because of a lack of rigorous studies. Here we examine 5 case studies from which we attempt to draw inferences about feeding as a conflict-mitigation strategy. Studies included U.S. national parks, where after bear feeding was banned conflicts were reduced; Aspen, Colorado, where lucrative dumpsters in town did not divert bears from using human-related foods at other sources; rural Minnesota, where results of intentional feeding of a small sample of bears were confounded with other variables; the Tahoe Basin of California Nevada, where an emergency feeding effort during a drought-caused food failure seemed to reduce conflicts within approximately 1 km of the feeding site; and Slovenia, where a high density of feeders at established locations seemed to divert bears from using settlements during autumn hyperphagia. Although none of these studies were true experiments with treatments and controls, the range of circumstances yielded insights into when feeding could be effective: when food demands are not readily met by natural foods; when the provisioned food is easily found outside the potential conflict area; when the food is attractive; and when bears do not associate the feeding with people. However, long-term feeding may increase bear population size, which may increase conflicts overall, or trigger a demand for population control. Diversionary feeding, if used, should be conducted as an adaptive management strategy by professionals so as to learn more about factors influencing its effectiveness.

Godbois, I. A., Conner, L. M., & Warren, R. J. (2004). Space-Use Patterns of Bobcats Relative to Supplemental Feeding of Northern Bobwhites. *The Journal of Wildlife Management*, 68(3), 514-518. [https://doi.org/10.2193/0022-541X\(2004\)068\[0514:SPOBRT\]2.0.CO;2](https://doi.org/10.2193/0022-541X(2004)068[0514:SPOBRT]2.0.CO;2)

In the southeastern United States, supplemental feeding of northern bobwhites (*Colinus virginianus*) is a common management practice. To determine whether bobcats (*Lynx rufus*) are attracted to supplemental food provided to northern bobwhites and whether this food affects bobcat home-range size, we radiomarked bobcats and assessed space use relative to supplemental feeding. We found little evidence to suggest that bobcat home-range sizes were affected by the supplemental food, but we observed bobcats to be approximately 10 times closer to supplemental food than expected under a null model. Our data suggest that supplemental feeding of prey can result in a spatial response by predators. Further research is needed to determine whether supplemental feeding of prey attracts other top predators and whether supplemental feeding results in decreased prey survival by attracting predators.

Jones, D. (2011). An Appetite for Connection: Why We Need to Understand the Effect and Value of Feeding Wild Birds. *Emu - Austral Ornithology*, 111(2), i-vii. [https://doi.org/10.1071/MUv111n2\\_ED](https://doi.org/10.1071/MUv111n2_ED)

While there is no denying the scale and importance of bird-watching, there is another facet of the human-bird relationship that is even more common and certainly more intimate: the virtually universal practice of feeding wild birds. Although attracting birds by the provision of food is probably the most widespread and popular form of human-wildlife interaction throughout the world (Fuller et al. 2008; Robb et al. 2008), remarkably little is known about the practice (Jones and Reynolds 2008). This lack of reliable knowledge is becoming increasingly important. In Australia, concerns about the implications and impacts of feeding have resulted in a widely acknowledged but largely unofficial opposition to the practice. This contrasts with the U.S. and U.K. where most bird and conservation organisations actively



promote the practice as an important conservation activity (Toms 2003; CLO 2011). Both the promotion and opposition to feeding are, however, based on alarmingly little evidence and also tend to ignore the considerable complexity of this multidimensional phenomenon (Fuller et al. 2008).

Jones, D. N., & James Reynolds, S. (2008). Feeding Birds in Our Towns and Cities: A Global Research Opportunity. *Journal of Avian Biology*, 39(3), 265-271. <https://doi.org/10.1111/j.0908-8857.2008.04271.x>

Wild bird feeding is one of the most common forms of human-wildlife interactions in the Western world. Originally a practice providing nutritional assistance to over-wintering birds, especially in more northern latitudes, birds throughout the cities of the world are now provided with considerable amounts and a variety of foods year-round. Despite the global nature of the practice, remarkably little is known about the outcomes and implications of what may be seen as a supplementary feeding experiment on a massive scale. Although many claims are made about the benefits of feeding, there are growing concerns about the spread of disease, poor nutrition, risk of dependency and many other important issues. Constructive debate among increasingly vigorous proponents and opponents is currently constrained by a lack of reliable information. Here we argue that bird feeding provides an important, if challenging, opportunity for fundamental research in urban ecology.

Mazur, R., & Seher, V. (2008). Socially Learned Foraging Behaviour in Wild Black Bears, *Ursus Americanus*. *Animal Behaviour*, 75, 1503-1508. <https://doi.org/10.1016/j.anbehav.2007.10.027>

To date, research on social learning has been limited mainly to only a few taxa in captive or seminatural settings. We undertook a quantitative study of social learning in free-ranging black bears at Sequoia and Yosemite National Parks, U. S. A. from 1995 to 2006. We tested the hypothesis that food-conditioned foraging behaviour (foraging on human food in developed areas) by some bears is transmitted vertically from sows to cubs. Food conditioning in young bears was strongly related to their rearing conditions. Nine wild sows reared 20 cubs in the wild, with 18 (90%) of the cubs remaining wild by the end of their second year. By contrast, of 79 cubs reared by food-conditioned mothers, 31 were reared in the wild and 48 were reared on anthropogenic food sources. Eighty-four per cent (26/31) of those reared in the wild foraged in the wild as independents, and 81% (39/48) of those reared on anthropogenic food continued to exploit this resource later in life. The outcome of the cubs was determined more by where the cubs were reared than by whether the sow was food conditioned. The Association for the Study of Animal Behaviour. Published by Elsevier Ltd.

Meissner, A. M., Christiansen, F., Martinez, E., Pawley, M. D. M., Orams, M. B., & Stockin, K. A. (2015). Behavioural Effects of Tourism on Oceanic Common Dolphins, *Delphinus* sp., in New Zealand: The Effects of Markov Analysis Variations and Current Tour Operator Compliance with Regulations. *PloS One*, 10(1), e0116962. <https://doi.org/10.1371/journal.pone.0116962>

Common dolphins, *Delphinus* sp., are one of the marine mammal species tourism operations in New Zealand focus on. While effects of cetacean-watching activities have previously been examined in

coastal regions in New Zealand, this study is the first to investigate effects of commercial tourism and recreational vessels on common dolphins in an open oceanic habitat. Observations from both an independent research vessel and aboard commercial tour vessels operating off the central and east coast Bay of Plenty, North Island, New Zealand were used to assess dolphin behaviour and record the level of compliance by permitted commercial tour operators and private recreational vessels with New Zealand regulations. Dolphin behaviour was assessed using two different approaches to Markov chain analysis in order to examine variation of responses of dolphins to vessels. Results showed that, regardless of the variance in Markov methods, dolphin foraging behaviour was significantly altered by boat interactions. Dolphins spent less time foraging during interactions and took significantly longer to return to foraging once disrupted by vessel presence. This research raises concerns about the potential disruption to feeding, a biologically critical behaviour. This may be particularly important in an open oceanic habitat, where prey resources are typically widely dispersed and unpredictable in abundance. Furthermore, because tourism in this region focuses on common dolphins transiting between adjacent coastal locations, the potential for cumulative effects could exacerbate the local effects demonstrated in this study. While the overall level of compliance by commercial operators was relatively high, non-compliance to the regulations was observed with time restriction, number or speed of vessels interacting with dolphins not being respected. Additionally, prohibited swimming with calves did occur. The effects shown in this study should be carefully considered within conservation management plans, in order to reduce the risk of detrimental effects on common dolphins within the region.

Milazzo, M. (2011). Evaluation of a Behavioural Response of Mediterranean Coastal Fishes to Novel Recreational Feeding Situation. *Environmental Biology of Fishes*, 91(1), 127-132.  
<https://doi.org/10.1007/s10641-011-9784-4>

Fish may learn to associate food with human presence through recreational hand-feeding, a popular tourist activity. The conditional learning--e.g. when an organism learns by continuous exposure to one stimulus--of different coastal fish species exposed to novel feeding situations was evaluated. The latencies of learning response to the initiation of supplementary feeding were rapid and species-specific. However differences in the learning response between different fishes decreased over time, demonstrating that associating with others might incur costs especially for small-sized species, likely due to increased competition for food. Nevertheless some other fish species did not acquire any specific human oriented behavior, being naturally timid or avoiding humans.

Putman, R. J., & Staines, B. W. (2004). Supplementary Winter Feeding of Wild Red Deer *Cervus elaphus* in Europe and North America: Justifications, Feeding Practice and Effectiveness. *Mammal Review*, 34(4), 285-306. <https://doi.org/10.1111/j.1365-2907.2004.00044.x>

1. Supplementary winter feeding of game animals, and particularly deer, is a common practice throughout northern (continental) Europe and parts of North America. Feeding is normally associated with maintaining high densities of animals for hunting, in terms of: (i) maintaining or increasing body weights and condition overwinter; (ii) improving reproductive performance and fertility; (iii) increasing overwinter survival; and (iv) reducing levels of damage caused to agriculture and forestry or the natural heritage. We consider the balance of evidence on the effectiveness of winter feeding of red deer *Cervus elaphus* in achieving these objectives. Where that evidence is equivocal, we attempt to reconcile

apparent contradictions to evaluate the circumstances under which winter feeding may or may not be effective. 2. In general, feeding of red deer on open range appears to have relatively little effect on body weights or fecundity. Effects on increasing antler size and quality are variable and seem to depend on the degree to which animals may be mineral limited on native range. Effects on survival are similarly ambiguous. It is apparent, however, that to be effective in reducing mortality, any supplementation is required early in the season and not simply when heavy mortalities are already being experienced. If provision of supplementary foods is delayed until animals are perceived already to be in poor condition, such feeding may have little effect. 3. One of the primary goals of winter feeding in both Europe and the USA has become the prevention of environmental damage, particularly damage to commercial and native forests, while maintaining deer populations at densities suitable for hunting. Again, empirical evidence for effectiveness in this regard is inconclusive, with some studies showing a decrease in damage caused, some showing no effect and others showing a significant increase in local impact. 4. There are equally a number of problems associated with the provision of supplementary feeds overwinter. Those animals which come to the feeding stations may develop a reliance on the food supplement provided, reducing intake of natural forages to near zero; where feed provided is less than 100% of daily requirement, such animals may regularly lose, rather than gain condition. Feed provision is also extremely uneven at such feeding stations; dominant stags displace younger stags and hinds from the feed provided until they have themselves finished feeding. Concentrations of high densities of animals around small feed-areas may also increase the risk of infection and lead to development of high parasite burdens. 5. In an attempt to assess the current status and distribution of supplementary winter feeding in Scotland, a questionnaire was circulated to a number of individual across the country. Results of this survey are summarized and conclusions presented on the likely effectiveness of current feeding practices in achieving their aims.

Schakner, Z. A., Petelle, M. B., Tennis, M. J., Van der Leeuw, B. K., Stansell, R. T., & Blumstein, D. T. (2017). Social Associations between California Sea Lions Influence the Use of a Novel Foraging Ground. *Royal Society Open Science*, 4(5), 8. <https://doi.org/10.1098/rsos.160820>

Social relationships define an individual's position in its social network, which can influence the acquisition and spread of information and behavioural variants through the population. Thus, when nuisance behaviours spread through wildlife populations, identifying central individuals may provide valuable insights for problem-species management. We studied the effects of network position on California sea lion (*Zalophus californianus*) discovery and foraging success at a novel foraging ground-the salmonids that aggregate at the Bonneville Dam tail-race, 235km up the Columbia River. We found that an individual's centrality in their social network influenced discovery of the Bonneville Dam and whether they returned the next year. Foraging success once at the dam was independent of network position. Extensive lethal and nonlethal removal efforts have been implemented at Bonneville Dam and focused on reducing the number of individual sea lions at the dam. Since social relationships forged at the opening of the Columbia River influence both the discovery and return to the Bonneville Dam, efforts to increase salmon recovery may be enhanced by breaking apart social networks at the opening of the river.

Scheer, M., De Sá Alves, L. C. P., Ritter, F., Azevedo, A. F., & Andriolo, A. (2014). Behaviors of Botos and Short-Finned Pilot Whales During Close Encounters with Humans: Management Implications

Derived from Ethograms for Food-Provisioned Versus Unhabituated Cetaceans. In *Dolphins: Ecology, Behavior and Conservation Strategies*. J. B. Samuels (Ed.), (pp. 1-36): Nova Science Publishers, Inc Retrieved from <http://www.pilot-whales.org/www/en/pdf/SC-65b-WW01.pdf>

Wildlife encounters of humans diving, swimming and wading in the vicinity of cetaceans in open water environments have increased worldwide. At the same time, the quality and quantity of close-up or interactive cetacean behaviors addressed towards humans appear to vary widely. In the past, free-ranging cetaceans were reported to avoid, affiliatively or aggressively interact with, injure or even kill humans. Indirect effects compromising the health status of target species such as entanglements, boat strikes or alterations of behavior have been reported as negative by-products. From the management perspective, encounters have to be regulated in order to reduce the likelihood of detrimental outcomes for both sides. It has been proposed to conduct studies on the quality of behavioral interactions to enable a comparison between species and locations, as well as to conduct research before commercial programs are implemented. However, self-initiated cetacean behaviors addressed towards humans still have received little attention, hence their structure and function largely remain unclear. This study compares self-initiated behaviors addressed towards human feeders and swimmers as well as intraspecific behaviors addressed towards cetacean conspecifics during encounters with food-provisioned Amazon botos (*Inia geoffrensis*) and unhabituated short-finned pilot whales (*Globicephala macrorhynchus*) in the Canary Islands. Encounters with botos were observed for a total of 18 h 30 min in Novo Airão city, Amazonas State (Brazil), during two field seasons in 2008 and 2009. Short-finned pilot whales were observed 9 h 06 min off Tenerife and La Gomera (Spain) during three field seasons in 1996, 2001 and 2012. For the first time, an *a priori* ethogram on interand intraspecific behaviors was used in each location and for each species to enable a comparison. During the majority of encounters (71%), shortfinned pilot whales addressed affiliative behaviors towards swimmers. Neutral or avoidance behavior was shown during 29% of encounters. Intraspecific agonistic behaviors were rare. In contrast, botos did not show avoidance reactions to human feeders but were permanently attracted to them. During 36% of encounters, botos initiated affiliative behaviors. However, risky behaviors occurred during all encounters and botos also showed agonistic behaviors towards conspecifics. Nearly all risky interspecific behaviors remained constant or increased and all agonistic intraspecific behaviors increased from 2008 to 2009. Thus, humans continually were exposed to health risks. Food-provisioning of botos is now being managed aiming to reduce risky interactions. Swim programs seem to be the more preferable form to closely encounter cetaceans in the wild. However, it remains unclear how unhabituated animals would react when being exposed to repeated swim activities. Thus, we recommend that close interactions between humans and cetaceans -be it feeding or swimming- should be generally discouraged. Where such interactions with tourists take place, they have to be regulated ideally from the very beginning. Our results can be used as referential data before initiating new interactive programs.

Warrick, G. D., Scrivner, J. H., & O'Farrell, T. P. (1999). Demographic Responses of Kit Foxes to Supplemental Feeding. *The Southwestern Naturalist*, 44(3), 367-374. Retrieved from <http://www.jstor.org/stable/30055233>

Food availability is believed to be a major factor regulating the size of kit fox (*Vulpes macrotis*) populations, but this association has been based mostly on correlative or descriptive studies. In 1988 and 1989, we experimentally evaluated the effects of food availability on a kit fox population by comparing survival, sources of mortality, reproduction, and dispersal between foxes with access to

supplemental food (fed foxes) and foxes without access to supplemental food (controls). Fed pups and adults from 1988 had significantly higher survival than corresponding control foxes. However, there was no significant difference in survival rates between fed and control pups of 1989. Most foxes for which a cause of death could be determined were killed by mammalian predators, primarily coyotes (*Canis latrans*). The proportion of deaths caused by predators did not differ between control and fed groups. Five of six adult females and four of eight yearling females from the supplementally fed group whelped. Three of five adult females and one of four yearlings from the control group whelped. The proportion of male foxes that dispersed during their first year was higher for control foxes than fed foxes. Average dispersal distances were not significantly different between fed and control groups, but the two longest dispersal distances were made by control foxes. Overall, supplemental feeding had a positive affect on demographic parameters of kit foxes, suggesting that recruitment rates of kit foxes are influenced by prey availability. However, dissimilar survival results among the two cohorts of pups indicate that the relationship between survival and food availability is complicated by other factors, such as coyote predation.

## Section 2 – Humans

### Part 2.1 – General

Aral, O. H., & Lopez-Sintas, J. (2020). A Comprehensive Model to Explain Europeans' Environmental Behaviors. *Sustainability*, 12(10). <https://doi.org/10.3390/su12104307>

Understanding the nature of consumers' environmental behaviors will help design better environmental policies for a sustainable future. Drawing on the responsible environmental behavior (REB) theoretical framework, we disentangle the effects of social and psychological environmental factors on Europeans' behaviors, considering that living contexts vary from country to country. Using data on attitudes to the environment sourced from the 2017 Eurobarometer, we measure the socio-psychological factors and environmental behaviors using exploratory factor analysis. A multilevel model measures the effect of individual-level environmental factors and analyzes the impact of the country context on Europeans' environmental behaviors. Results show that the three tested environmental behaviors (eco-friendly purchasing, public transport use, and reduced resource consumption) are explained by individual-level environmental factors as well as by country differences, but the effects differ depending on the behavior considered. We also find that the effects of knowledge, attitudes, and perceived behavioral control are mediated by a set of social indicators (age, gender, education, and income). We conclude with a discussion of the implications for policymakers.

Batavia, C., Bruskotter, J. T., Jones, J. A., Vucetich, J. A., Gosnell, H., & Nelson, M. P. (2018). Nature for Whom? How Type of Beneficiary Influences the Effectiveness of Conservation Outreach Messages. *Biological Conservation*, 228, 158-166. <https://doi.org/10.1016/j.biocon.2018.10.029>

In recent years the conservation community has engaged in debate over value in nonhuman nature, especially as it relates to motivations for conservation. Many have expressed the assumption that more people are willing to support conservation when emphasis is placed on the human benefits of nonhuman nature, rather than the value of nonhuman nature for its own sake. To test this assumption, we designed an online survey investigating how the type of beneficiary (human, nonhuman, or both) depicted in outreach messages affects two metrics of support: attitudes toward the message and donations for a conservation organization. Each respondent viewed one message highlighting humans, nonhumans, or both as conservation beneficiaries. Predicting that the effect of beneficiary type would depend partially on individual differences, we also measured respondents' moral inclusivity, i.e., the values and beliefs they hold with regard to human and various nonhuman entities. Although beneficiary type did not affect attitudes, we report several key findings for donation. Compared to messages depicting only nonhuman beneficiaries, messages depicting only human beneficiaries were associated with lower likelihood of donation overall and, among less morally inclusive respondents, lower donation amounts. At the same time, messages depicting both human and nonhuman beneficiaries were not associated with more positive donation outcomes than messages depicting only nonhuman beneficiaries. Our results suggest that highlighting humans as conservation beneficiaries may not most effectively generate social support for conservation. Messages advocating the protection of nonhuman nature for its own sake may produce the most consistently positive donation outcomes.

Beyerl, K., Putz, O., & Breckwoldt, A. (2016). The Role of Perceptions for Community-Based Marine Resource Management. *Frontiers in Marine Science*, 3, 17.  
<https://doi.org/10.3389/fmars.2016.00238>

Every community-based marine resource management (CBMRM) inherently takes place in a highly complex social-ecological environment, and stakeholder perceptions related to various aspects of the natural and social environment guide behavior in every stage of the management process. This paper provides an introduction to the psychology of perception with regard to marine resource management. In particular, it offers a typology of CBMRM relevant perceptions along with an analysis of psychological, societal, and physical factors that modulate them. Based on this analysis, we propose the introduction of specially trained local Perception Experts (PE's), whose role will be to recognize and reflect individual perceptions of involved stakeholders, and to communicate them at community meetings where decisions are made. This empirically testable addition to current CBMRM schemes could help to increase participation, develop management measures that fit the capacities of the involved stakeholders more accurately, and hence, contribute to a faster rehabilitation of marine resources.

Blatt, E. (2014). Uncovering Students' Environmental Identity: An Exploration of Activities in an Environmental Science Course. *Journal of Environmental Education*, 45(3), 194-216.  
<https://doi.org/10.1080/00958964.2014.911139>

This study at a public high school in the Northeastern United States explores how students' environmental identities are affected by various activities in an Environmental Science course. Data was collected as part of an ethnographic study involving an Environmental Science teacher and her tenth-twelfth grade students. The results focus on interviews with 10 students and the teacher, conducted at three points during the semester-long course. The findings illuminate ways in which students' identities (environmental and consumer-materialist) are affirmed or disconfirmed during classroom activities, the importance of establishing personal connections with environmental issues, and challenges related to the teaching of controversial environmental issues.

Bolderdijk, J. W., Gorsira, M., Keizer, K., & Steg, L. (2013). Values Determine the (in) Effectiveness of Informational Interventions in Promoting Pro-Environmental Behavior. *PloS One*, 8(12), 7.  
<https://doi.org/10.1371/journal.pone.0083911>

Informational interventions (e.g., awareness campaigns, carbon footprint calculators) are built on the assumption that informing the public about the environmental consequences of their actions should result in increased pro-environmental intentions and behavior. However, empirical support for this reasoning is mixed. In this paper, we argue that informational interventions may succeed in improving people's knowledge about the negative environmental consequences of one's actions, but this knowledge will not gain motivational force if people do not consider protecting the environment an important personal value. In an experiment, we measured individual differences in value priorities, and either presented participants a movie clip that portrayed the negative environmental consequences of using bottled water, or a control movie. As predicted, we found that the environmental movie improved recipients' knowledge of the negative environmental impact of bottled water, but this knowledge only resulted in concomitant changes in intentions and acceptability of related policies among participants who strongly endorsed biospheric (i.e. environmental) values, while having no effect on those who care



less about the environment. Interestingly, the results suggest that although informational interventions are perhaps not always successful in directly affecting less environmentally-conscious recipients, they could still have beneficial effects, because they make those who strongly care about the environment more inclined to act on their values.

Braun, T., & Dierkes, P. (2019). Evaluating Three Dimensions of Environmental Knowledge and Their Impact on Behaviour. *Research in Science Education*, 49(5), 1347-1365.  
<https://doi.org/10.1007/s11165-017-9658-7>

This research evaluates the development of three environmental knowledge dimensions of secondary school students after participation in a singular 1-day outdoor education programme. Applying a cross-national approach, system, action-related and effectiveness knowledge levels of students educated in Germany and Singapore were assessed before and after intervention participation. Correlations between single knowledge dimensions and behaviour changes due to the environmental education intervention were examined. The authors applied a pre-, post- and retention test design and developed a unique multiple-choice instrument. Results indicate significant baseline differences in the prevalence of the different knowledge dimensions between subgroups. Both intervention subsamples showed a low presence of all baseline knowledge dimensions. Action-related knowledge levels were higher than those of system and effectiveness knowledge. Subsample-specific differences in performed pro-environmental behaviour were also significant. Both experimental groups showed significant immediate and sustained knowledge increases in the three dimensions after programme participation. Neither of the two control cohorts showed any significant increase in any knowledge dimension. Effectiveness knowledge improved most. The amount of demonstrated environmental actions increased significantly in both intervention groups. Both control cohorts did not show shifts in environmental behaviour. Yet, only weak correlations between any knowledge dimension and behaviour could be found.

Carmi, N. (2013). Caring About Tomorrow: Future Orientation, Environmental Attitudes and Behaviors. *Environmental Education Research*, 19(4), 430-444.  
<https://doi.org/10.1080/13504622.2012.700697>

Almost any pro-environmental behavior arouses a temporal conflict, as protecting long-term interests requires the sacrifice of short-term ones. Similarly, many health promoting behaviors may involve present discomfort for the sake of future well-being. In both contexts, health or environmental, developed future orientation (FO) is required to succeed in achieving long-term goals. This study examined FO, measured by Zimbardo's time perspective inventory (ZTPI), in both contexts in a sample of 333 Israeli undergraduate students. FO correlated positively with health concern and behavior. In the environmental context, the results were different. Highly future-oriented (according to ZTPI) respondents did not express stronger pro-environmental attitudes, and their willingness to sacrifice for the sake of the environment was significantly lower. They adopted pro-environmental behavior only if it coincided with their personal benefit. The study suggests that the future of the environment may not be perceived in the same way as people's personal future health. The implications for environmental education and communication are discussed.



Carmi, N., & Arnon, S. (2014). The Role of Future Orientation in Environmental Behavior: Analyzing the Relationship on the Individual and Cultural Levels. *Society & Natural Resources*, 27(12), 1304-1320. <https://doi.org/10.1080/08941920.2014.928393>

The concept of sustainability includes a personal and societal imperative to assume responsibility for the future outcomes of present actions, to look forward, or in other words, to have a future orientation. Future orientation is both a personality trait and a cultural characteristic that strongly influences behavioral decisions on the personal and societal levels, respectively. This research addresses the relationship between future orientation and pro-environmental behavior on both levels. In a representative sample of the population (n=1216), we found that individuals with developed future orientation demonstrated more pro-environmental tendencies. On the cross-cultural level we also found that in countries that conduct future-oriented practices in general the environment benefits, because the citizens tend to behave more pro-environmentally. The parallel between factors that affect future orientation and environmental behavior and the implications for promoting pro-environmental practices in the social and personal levels are discussed.

Carmi, N., Arnon, S., & Orion, N. (2015). Transforming Environmental Knowledge into Behavior: The Mediating Role of Environmental Emotions. *Journal of Environmental Education*, 46(3), 183-201. <https://doi.org/10.1080/00958964.2015.1028517>

The present study was based on the premise that environmental knowledge can drive environmental behavior only if it arouses environmental emotions. Using a structural equations modeling approach, we tested the direct, as well as the indirect (mediated) effects of knowledge on behavior and assessed the mediating role of environmental emotions. We found that knowledge is an important but distal variable, whose significant effect is fully mediated by emotions. The high explanatory power and good fit indices of the model supported and validated the important role of emotions in the learning process.

Cheng, T., Woon, D. K., & Lynes, J. K. (2011). The Use of Message Framing in the Promotion of Environmentally Sustainable Behaviors. *Social Marketing Quarterly*, 17(2), 48-62. <https://doi.org/10.1080/15245004.2011.570859>

The use of message framing, a technique that shapes perceptions of the outcomes of the promoted behavior, in combination with a specific target audience can substantially enhance the success of social marketing campaigns. Although the persuasive effects of message framing have been widely publicized in the field of social and cognitive psychology, there is a surprising dearth in the literature regarding the role of message framing as a strategy within the context of social marketing to influence environmentally sustainable behaviors. This article provides an overview of the main principles of message framing, including gain and loss framing as well as social and physical threat. The most effective combination of frame and threat may in fact depend on the measure used to assess its influence on behavior. In particular, the literature suggests that the effect of frame and threat interaction may be most prominent in changing attitudes toward the behavior. Four factors should be considered in the use of framing and threat in message design, including: (1) level of risk involved in uptake of the behaviour, (2) degree of self-referencing or self-other referencing in the message, (3) level of experience and knowledge of the target audience and stage of change of the target audience, and (4) gender of target

audience. Thus, proper segmentation of the population should be carried out before designing messages with frame/threat factors. Further research on the influence of message framing and the role of audience segmentation in behavioral change strategies is needed to deepen our understanding of its effectiveness in designing social marketing campaigns that focus on environmentally sustainable behaviors.

de Lange, E., Milner-Gulland, E. J., & Keane, A. (2019). Improving Environmental Interventions by Understanding Information Flows. *Trends in Ecology & Evolution*, 34(11), 1034-1047. <https://doi.org/10.1016/j.tree.2019.06.007>

Conservationists are increasingly interested in changing human behaviour. One understudied aspect of such interventions is information flow. Different patterns of interpersonal communication and social structures within communities influence the adoption of behavioural changes through social influence and social reinforcement. Understanding the structure of information flow in a group, using tools such as social network analysis, can therefore offer important insights for interventions. For example, communications may be targeted to highly connected opinion leaders to leverage their influence, or communication may be facilitated between distinct subgroups to promote peer learning. Incorporating these approaches into conservation interventions can promote more effective behaviour change. This review introduces conservation researchers and practitioners to key concepts underpinning information flows for interventions targeting networks of individuals.

Dean, A. J., Church, E. K., Loder, J., Fielding, K. S., & Wilson, K. A. (2018). How Do Marine and Coastal Citizen Science Experiences Foster Environmental Engagement? *Journal of Environmental Management*, 213, 409-416. <https://doi.org/10.1016/j.jenvman.2018.02.080>

Citizen science programs enable community involvement in scientific research. In addition to fostering greater science literacy, some citizen science programs aim to foster engagement in environmental issues. However, few data are available to indicate whether and how citizen science programs can achieve greater environmental engagement. We survey individuals choosing to attend one of seventeen reef citizen science events and examine the extent to which attendees reported three indicators of greater environmental engagement: (i) willingness to share information, (ii) increased support for marine conservation and citizen science, and (iii) intentions to adopt a new behavior. Most participants reported being willing to share information about reef conservation (91%) and described increased support for marine science and conservation (87%). Half of participants (SA) reported intentions to adopt a new conservation behavior. We found that key elements of the citizen science experience associated with these outcomes were learning about actions to protect reefs and coasts (procedural learning), experiencing surprise, and experiencing negative emotions about environmental problems. Excitement was also associated with positive outcomes, but only in participants who were less likely to see themselves as environmental, or were less frequent visitors to reefs and coasts. Importantly, the association between factual learning and environmental engagement outcomes was limited or negative. These findings suggest that the way citizen science experiences make people feel, may be more important for fostering future environmental engagement than factual-based learning. When designing citizen science programs for community members, these findings provide a reminder to not focus on

provision of factual information alone, but to highlight environmental impacts while providing meaningful experiences and building environmental skills.

Dean, A. J., Gulliver, R. E., & Wilson, K. A. (2020). "Taking Action for the Reef?"-Australians Do Not Connect Reef Conservation with Individual Climate-Related Actions. *Conservation Letters*, 10. <https://doi.org/10.1111/conl.12765>

Climate change is the most significant threat to the Great Barrier Reef (GBR). While Australians express appreciation and concern for the GBR, it is not clear whether they connect climate-related action with reef conservation. An online survey of 4,285 Australians asked "horizontal ellipsis what types of actions could people like you do that would be helpful for the GBR?" Only 4.1% mentioned a specific action related to mitigating climate change; another 3.8% mentioned climate change but no specific action. The most common responses related to reducing plastic pollution (25.6%). These findings demonstrate that most Australians have poor capacity to identify individual climate-related actions as helpful for reef protection, and that generic calls to action-such as "protect the reef"-are unlikely to elicit climate-related actions. As such, reef conservation initiatives must explicitly promote actions-in the home and in society-that reduce emissions and support the transition to a low carbon society.

Diaz-Sieffer, P., Neaman, A., Salgado, E., Celis-Diez, J. L., & Otto, S. (2015). Human-Environment System Knowledge: A Correlate of Pro-Environmental Behavior. *Sustainability*, 7(11), 15510-15526. <https://doi.org/10.3390/su71115510>

An effective program of environmental education requires the identification of the knowledge that must be imparted. This paper compares the effects of human-environment system knowledge (i.e., knowledge related to environmental problems caused by humans) and environmental action knowledge (i.e., knowledge of possible courses of action to reduce human impact on the environment) on pro-environmental behavior. Environmental knowledge and pro-environmental behavior of 950 Chilean adults were assessed with a survey. Both types of knowledge were related to pro-environmental behavior ( $r = 0.25$  and  $r = 0.22$ , respectively,  $p < 0.001$ ). These results seem to contradict previous studies that found that system knowledge is not directly related to pro-environmental behavior. However, existing scales of environmental system knowledge are behavioral-distant due to their greater number of general geography knowledge items. In contrast, our human-environmental system knowledge scale focuses on understanding global environmental problems and, therefore, can be expected to relate more closely to pro-environmental behavior. To promote pro-environmental behavior, we suggest teaching more human-environment system knowledge and environmental action knowledge. Since different forms of environmental knowledge must work together in a convergent manner in order to foster pro-environmental behavior, the present study represents an important contribution by showing that greater human-environment system knowledge is correlated with pro-environmental behavior.

Dobson, A. D. M., de Lange, E., Keane, A., Ibbett, H., & Milner-Gulland, E. J. (2019). Integrating Models of Human Behaviour between the Individual and Population Levels to Inform Conservation

Interventions. *Philosophical Transactions of the Royal Society B-Biological Sciences*, 374(1781), 9. <https://doi.org/10.1098/rstb.2018.0053>

Conservation takes place within social-ecological systems, and many conservation interventions aim to influence human behaviour in order to push these systems towards sustainability. Predictive models of human behaviour are potentially powerful tools to support these interventions. This is particularly true if the models can link the attributes and behaviour of individuals with the dynamics of the social and environmental systems within which they operate. Here we explore this potential by showing how combining two modelling approaches (social network analysis, SNA, and agent-based modelling, ABM) could lead to more robust insights into a particular type of conservation intervention. We use our simple model, which simulates knowledge of ranger patrols through a hunting community and is based on empirical data from a Cambodian protected area, to highlight the complex, context-dependent nature of outcomes of information-sharing interventions, depending both on the configuration of the network and the attributes of the agents. We conclude by reflecting that both SNA and ABM, and many other modelling tools, are still too compartmentalized in application, either in ecology or social science, despite the strong methodological and conceptual parallels between their uses in different disciplines. Even a greater sharing of methods between disciplines is insufficient, however; given the impact of conservation on both the social and ecological aspects of systems (and vice versa), a fully integrated approach is needed, combining both the modelling approaches and the disciplinary insights of ecology and social science. This article is part of the theme issue 'Linking behaviour to dynamics of populations and communities: application of novel approaches in behavioural ecology to conservation'.

Duerden, M. D., & Witt, P. A. (2010). The Impact of Direct and Indirect Experiences on the Development of Environmental Knowledge, Attitudes, and Behavior. *Journal of Environmental Psychology*, 30(4), 379-392. <https://doi.org/10.1016/j.jenvp.2010.03.007>

This study employed a mixed-methods design to examine the relationship between nature experience type (e.g. direct and indirect) and learning outcomes (e.g. environmental knowledge, attitudes and behavior) associated with an environmental education international immersion program for adolescents. Longitudinal data from 108 participant and 49 comparison group members were analyzed to test the study's hypotheses. Additionally, qualitative data were analyzed using grounded theory methodology to assess participants' perceptions of these processes. The findings indicate that environmental knowledge increased more than environmental attitudes during the indirect portion of the program (i.e. preparatory program), whereas the direct portion (i.e. international workshop) produced similar levels of knowledge and attitude growth. Further, while attitudes were more strongly associated with behavior during the indirect component of the program, the strength of the relationships between attitudes and behavior and knowledge and behavior were similar during the direct portion of the experience. A synthesis of the findings suggests that the program's direct experiences catalyzed environmental knowledge into a stronger motivating force than it had been during the indirect experiences. The qualitative findings also provide insights into the characteristics of direct experiences. These findings offer important insights for both theory and practice related to the use of direct and indirect nature experiences to develop environmental knowledge, attitude and behaviors.

Estrada, M., Schultz, P. W., Silva-Send, N., & Boudrias, M. A. (2017). The Role of Social Influences on Pro-Environment Behaviors in the San Diego Region. *Journal of Urban Health-Bulletin of the New York Academy of Medicine*, 94(2), 170-179. <https://doi.org/10.1007/s11524-017-0139-0>

From a social psychological perspective, addressing the threats of climate change involves not only education, which imparts objective facts upon a passive individual, but also a socializing process. The Tripartite Integration Model of Social Influence (TIMSI) provides a theoretical framework that connects acquiring climate change knowledge with integration into a community, which results in greater engagement in climate friendly behaviors. Survey data were collected from 1000 residents in San Diego County. Measures included (a) knowledge about climate change; (b) self-efficacy, what pro-environmental actions they felt they could do; (c) identity, to what extent they identified as part of a community that is concerned about climate change; (d) values, endorsement of values of the community that is concerned about climate change; and (e) pro-environmental behavior, engagement in conservation behaviors. Results indicated that self-efficacy and values mediated the relationship between knowledge and pro-environmental behavior.

Fishbein, M., & Ajzen, I. (2011). *Predicting and Changing Behavior: The Reasoned Action Approach*. New York: Taylor and Francis. <https://doi.org/10.4324/9780203838020>

This book describes the reasoned action approach, an integrative framework for the prediction and change of human social behavior. It provides an up-to-date review of relevant research, discusses critical issues related to the reasoned action framework, and provides methodological and conceptual tools for the prediction and explanation of social behavior and for designing behavior change interventions.

Frick, J., Kaiser, F. G., & Wilson, M. (2004). Environmental Knowledge and Conservation Behavior: Exploring Prevalence and Structure in a Representative Sample. *Personality and Individual Differences*, 37(8), 1597-1613. <https://doi.org/10.1016/j.paid.2004.02.015>

Knowledge is commonly seen as a necessary precondition for a person's behavior. Consistent with this, most educational interventions rely on knowledge transfer. However, for the most efficient informational strategies for education, it is essential that we identify the types of knowledge that promote behavior effectively and investigate their structure. A questionnaire consisting of three environmental knowledge scales and a conservation behavior measure was sent to 5000 randomly selected Swiss adults. A completed questionnaire was returned by 55% of them (N = 2736). A series of structural equation analyses indicates that the three knowledge forms exert different influences on conservation behavior: Action-related knowledge and effectiveness knowledge have a direct effect on performance. In contrast, system knowledge is more remote from behavior, exerting only a mediated influence on it by way of affecting the other two knowledge types.

Geiger, S. M., Geiger, M., & Wilhelm, O. (2019). Environment-Specific vs. General Knowledge and Their Role in Pro-Environmental Behavior. *Frontiers in Psychology*, 10, 12. <https://doi.org/10.3389/fpsyg.2019.00718>

Environmental knowledge has been established as a behavior-distal, but necessary antecedent of pro-environmental behavior. The magnitude of its effect is difficult to estimate due to methodological deficits and variability of measures proposed in the literature. This paper addresses these methodological issues with an updated, comprehensive and objective test of environmental knowledge spanning a broad variety of current environment related topics. In a multivariate study (n = 214), latent data modeling was employed to explore the internal factor structure of environmental knowledge, its relationship with general knowledge and explanatory power on pro-environmental behavior. We tested competing factor models and uncovered a general factor of environmental knowledge. The main novel finding of the study concerns its relationship with general knowledge. Employing an established test of general knowledge to measure crystallized intelligence revealed a near perfect relationship between environmental and general knowledge. This general knowledge (including the environmental domain) accounted for 7% of the variance in environmentally significant behavior. Age, additionally to acquired education, emerged as a common predictor for both general knowledge and environmentally significant behavior. We discuss the consequences of the strong relation between general and environmental knowledge and provide a possible explanation for the positive age-environmental conservation relationship reported in the literature.

Green, K. M., Crawford, B. A., Williamson, K. A., & DeWan, A. A. (2019). A Meta-Analysis of Social Marketing Campaigns to Improve Global Conservation Outcomes. *Social Marketing Quarterly*, 25(1), 69-87. <https://doi.org/10.1177/1524500418824258>

The rapidly increasing rate of biodiversity and habitat loss across the globe can be largely attributed to human behaviors. Conservation practitioners have struggled to influence behaviors through traditional awareness-raising efforts and been slow to adopt techniques from the behavioral sciences such as social marketing to change behaviors and improve conservation outcomes. We conducted a meta-analysis of 84 social marketing campaigns that applied the same theory of change for human behavior to disrupt patterns of destructive activities such as illegal hunting and overfishing. Questionnaires of more than 20,000 individuals across 18 countries measured changes in behavioral variables pre- and post-campaigns, including knowledge, attitudes, interpersonal communication, behavior intention, and behavior. For each campaign, we extracted data and validated data for behavioral variables, estimated mean effect sizes for each variable across all campaigns, and used path analysis to measure relationships among variables included in seven different models. On average, all behavioral variables increased significantly ( $p < .001$ ) from 16.1 to 25.0 percentage points following social marketing campaigns. The full model used a combination of all variables and had the highest explained variation in behavior change (71%). Our results highlight the importance of (a) incorporating behavioral theory and social marketing into traditional conservation programs to address threats to biodiversity across the globe; (b) designing interventions that leverage a combination of community knowledge, attitudes, and communication about a behavior; and (c) facilitating more opportunities for interpersonal communication as a main driver of behavior change. We conclude with potential applications for practitioners interested in behavior change campaigns.

Janmaimool, P., & Khajohnmanee, S. (2019). Roles of Environmental System Knowledge in Promoting University Students' Environmental Attitudes and Pro-Environmental Behaviors. *Sustainability*, 11(16), 18. <https://doi.org/10.3390/su11164270>



This study aims to investigate the role of environmental system knowledge in promoting pro-environmental behaviors. Relationships between environmental knowledge and environmental attitudes as well as environmental knowledge and pro-environmental behaviors were analyzed. Environmental system knowledge includes knowledge of political ecology, sustainable development, environment and ecology, and environmental situations. This study included 128 students enrolling in the elective course entitled "Environment and Development" provided by the King Mongkut's University of Technology Thonburi in Bangkok city of Thailand and 150 students who were not participating in this course. The results revealed that environmental attitudes of students participating in the course was significantly higher than that of students not attending the course. Only knowledge of the environment and ecology highly correlated with environmental attitudes; on the other hand, diverse environmental knowledge significantly correlated with pro-environmental behaviors. The result also demonstrated that indirect impact environmental behaviors reported by both groups were statistically different, but there was no significant difference in direct impact environmental behaviors. This study suggested that environmental knowledge provided through a formal education could promote environmental attitudes, but it may not contribute to students' engagement in direct impact environmental behaviors.

Jarreau, P. B., Altinay, Z., & Reynolds, A. (2017). Best Practices in Environmental Communication: A Case Study of Louisiana's Coastal Crisis. *Environmental Communication-A Journal of Nature and Culture*, 11(2), 143-165. <https://doi.org/10.1080/17524032.2015.1094103>

This mixed-method case study of environmental communication best practices in Louisiana, USA, identifies trends and approaches as informed by environmental psychology. The results provide key insights for environmental communicators, especially communicators in coastal regions. In-depth interviews with both environmental psychologists and environmental communicators showed that both groups emphasized knowing the audience, telling local stories, building relationships with target audiences and targeted messaging. Both psychologists and communicators also frequently mentioned general messaging concerns of source credibility, avoiding controversial terms and talking about issues, impacts and solutions to which the target audience can relate. A representative survey revealed that Louisiana residents are most interested in hearing about how environmental issues such as climate change, coastal land loss and flooding are affecting their own communities. This finding supports the idea that environmental communicators could do a better job tapping into strong place attachment and sense of community among coastal residents to promote action.

Kaiser, F. G., & Fuhrer, U. (2003). Ecological Behavior's Dependency on Different Forms of Knowledge. *Applied Psychology-an International Review-Psychologie Appliquee-Revue Internationale*, 52(4), 598-613. <https://doi.org/10.1111/1464-0597.00153>

The present paper argues for three reasons why knowledge's influence on ecological behavior is underestimated systematically. First, it is not the mere amount of knowledge available that determines behavior. Different forms of knowledge must work together in a convergent manner if they are to foster ecological behavior. Second, knowledge's effect remains undetected also, because some statistical procedures neither correct for measurement error attenuation nor uncover mediated influences accurately. Third, psychological factors such as knowledge apparently have a limited influence on ecological behavior when strong situational constraints are effective. When an ecological behavior

measure makes-as a performance test-systematic use of situational influences though, knowledge can be revealed as affecting ecological behavior significantly.

Levy, A., Orion, N., & Leshem, Y. (2018). Variables That Influence the Environmental Behavior of Adults. *Environmental Education Research*, 24(3), 307-325.  
<https://doi.org/10.1080/13504622.2016.1271865>

This study focuses on understanding the factors that encourage adults' environmental behavior. This mixed approach methodology study used 10 Likert type questionnaires to collect data about nine cognitive and affective components that might influence environmental behavior. The qualitative data was collected through open questions and interviews. The main sample included 656 participants from amongst Israel's working population. The questionnaires were found both reliable and valid. Most of the explored cognitive and affective aspects appeared to act as predictors of environmental behavior. The study indicates that environmental behavior is driven by egoistic' concerns rather than by altruistic views and motivations.

Lieflander, A. K., Bogner, F. X., Kibbe, A., & Kaiser, F. G. (2015). Evaluating Environmental Knowledge Dimension Convergence to Assess Educational Programme Effectiveness. *International Journal of Science Education*, 37(4), 684-702. <https://doi.org/10.1080/09500693.2015.1010628>

One aim of environmental education is fostering sustainable environmental action. Some environmental behaviour models suggest that this can be accomplished in part by improving people's knowledge. Recent studies have identified a distinct, psychometrically supported environmental knowledge structure consisting of system, action-related and effectiveness knowledge. Besides system knowledge, which is most often the focus of such studies, incorporating the other knowledge dimensions into these dimensions was suggested to enhance effectiveness. Our study is among the first to implement these dimensions together in an educational campaign and to use these dimensions to evaluate the effectiveness of a programme on water issues. We designed a four-day environmental education programme on water issues for students at an educational field centre. We applied a newly developed multiple-choice instrument using a pre-, post-, retention test design. The knowledge scales were calibrated with the Rasch model. In addition to the commonly assessed individual change in knowledge level, we also measured the change in knowledge convergence, the extent to which the knowledge dimensions merge as a person's environmental knowledge increases, as an innovative indicator of educational success. Following programme participation, students significantly improved in terms of amount learned in each knowledge dimension and in terms of integration of the knowledge dimensions. The effectiveness knowledge shows the least gain, persistence and convergence, which we explain by considering the dependence of the knowledge dimensions on each other. Finally, we discuss emerging challenges for educational researchers and practical implications for environmental educators.

Lieflander, A. K., Frohlich, G., Bogner, F. X., & Schultz, P. W. (2013). Promoting Connectedness with Nature through Environmental Education. *Environmental Education Research*, 19(3), 370-384.  
<https://doi.org/10.1080/13504622.2012.697545>



It has been suggested that a positive human-nature relationship is essential for countering today's environmental problems. Prior environmental education research has focused largely on knowledge or attitudinal outcomes, and few studies have examined the ability of environmental education programmes to promote connectedness with nature. Therefore, our goal was to (1) examine differences in connectedness with nature among a sample of children with differing ages and academic tracks, and (2) investigate whether environmental education can help promote and sustain connectedness with nature. With a pre-, post- and retention test design, we assessed a comprehensive four-day environmental education programme on water at a school field centre, using the inclusion of nature in self (INS) scale to identify the change in connectedness of 9-10-year-old pupils and 11-13-year-old pupils. We found that younger children and university-track pupils had higher INS scores than older children and general-education-track pupils, respectively. Participating in environmental education resulted in a robust short-term increase in connectedness with nature in both age groups. However, only the younger pupils' connectedness remained sustained four weeks following the treatment. Environmental educators should keep in mind that strengthening connectedness to nature is more sustainable before the age of 11.

Maurer, M., & Bogner, F. X. (2020). Modelling Environmental Literacy with Environmental Knowledge, Values and (Reported) Behaviour. *Studies in Educational Evaluation*, 65. <https://doi.org/10.1016/j.stueduc.2020.100863>

Environmental literacy integrates the variables cognitive knowledge, environmental values and ecological behaviour. We used three factors in our study: the first includes item-sets monitoring system-, action-related and effectiveness knowledge; the second examined the "Two Major Environmental Value model (2-MEV)"; and the third analysed General Ecological Behaviour (GEB) via an established behaviour scale. All participants were Greek sixth graders (N = 223, M = 11.7, SD +/- 1.3, 49.8 % = males). Results of the Confirmatory Factor Analysis (CFA) indicated a linear relationship between environmental knowledge and values ( $\chi^2 = 0.69$ ,  $p > .001$ ), values and (reported) behaviour ( $\chi^2 = 0.80$ ,  $p > .001$ ), as well as between environmental knowledge and (reported) behaviour ( $\chi^2 = 0.37$ ,  $p = .001$ ). We primarily used the theoretical environmental literacy model to holistically evaluate environmental education instead of applying isolated scales.

McDonald, R. I., Fielding, K. S., & Louis, W. R. (2014). Conflicting Social Norms and Community Conservation Compliance. *Journal for Nature Conservation*, 22(3), 212-216. <https://doi.org/10.1016/j.jnc.2013.11.005>

Though the success of conservation initiatives relies on changing behaviour, little social psychological research has examined factors such as attitudes and social norms in the context of actual conservation campaigns. In the context of reducing light pollution around sea turtle nesting habitats, researching technological solutions has clear merit. Problems such as light glow are, however, fundamentally about human behaviour, and so finding ways to effect behavioural change is critical. Social norms, or perceptions about what other people think and do, have been widely used in behaviour change campaigns across various domains, including campaigns to promote conservation behaviour. Here, we investigate how the norms of different groups may influence our behaviour in the context of a campaign to alter behavioural norms about light glow pollution in a community. We examine attitudes, social

norms, and the degree of conflict (versus congruence) between the behaviours of different groups, and their relationship with intentions to engage in conservation behaviours relevant to sea turtle conservation. We show that attitudes and norms are related to behavioural intentions, and conflicts between social norms influence intentions, over and above the norms themselves. This highlights an important consideration for conservation campaigns utilising social norms-based behaviour change appeals.

Miguens, M. J. L., Gonzalez, P. A., & Vazquez, E. G. (2015). Knowledge, Values and Intentions as Determinants of the Ecological Behavior. *Revista Internacional De Sociologia*, 73(3), 11. <https://doi.org/10.3989/ris.2015.73.3.e018>

The aim of this paper is to explain the ecological behavior of individuals. In particular, the role that knowledge about the environment, values and intentions played in the realization of an ecological behavior has been analyzed. Previously, the measurement scales of each construct have been validated. A structural equation modeling was used to a sample of 497 individuals. The tested model explained 87 per cent of the variance of ecological behavior. Our results show that knowledge and values are able to generate, indirectly, environmental actions, mediated by intentions, while intentions have a direct influence on behavior.

Miguens, M. J. L., Gonzalez, P. A., Vazquez, E. G., & Rodriguez, M. J. G. (2015). Measures of Ecological Behavior and Its Antecedents: Scales Conceptualization and Empirical Validation. *Universitas Psychologica*, 14(1), 189-204. Retrieved from [http://www.scielo.org.co/scielo.php?script=sci\\_abstract&pid=S1657-92672015000100017](http://www.scielo.org.co/scielo.php?script=sci_abstract&pid=S1657-92672015000100017)

This study validates using confirmatory factor analysis the scale of ecological behavior, which measures the implementation of actions that intend to protect and/or preserve the environment, and the scales of variables used in literature in order to explain that behavior: environmental knowledge, beliefs associated with environmental awareness, values and ecological behavior intention. Using a sample of 497 individuals in Spain selected by non-probability quota sampling, the psychometric properties of the scales were analyzed by exploratory and confirmatory factor analysis. The results show the multidimensional nature of knowledge (basic knowledge-CB and expert knowledge-CEX) and environmental behavior (waste management-GEB and environmental implication-IM) scales and the one-dimensional nature of the rest of measures. The validation, using confirmatory factor analysis of the selected variables, provides an important contribution to future research.

Milfont, T. L. (2012). The Interplay between Knowledge, Perceived Efficacy, and Concern About Global Warming and Climate Change: A One-Year Longitudinal Study. *Risk Analysis*, 32(6), 1003-1020. <https://doi.org/10.1111/j.1539-6924.2012.01800.x>

If the long-term goal of limiting warming to less than 2 degrees C is to be achieved, rapid and sustained reductions of greenhouse gas emissions are required. These reductions will demand political leadership and widespread public support for action on global warming and climate change. Public knowledge,

level of concern, and perceived personal efficacy, in positively affecting these issues are key variables in understanding public support for mitigation action. Previous research has documented some contradictory associations between knowledge, personal efficacy, and concern about global warming and climate change, but these cross-sectional findings limit inferences about temporal stability and direction of influence. This study examines the relationships between these three variables over a one-year period and three waves with national data from New Zealand. Results showed a positive association between the variables, and the pattern of findings was stable and consistent across the three data points. More importantly, results indicate that concern mediates the influence of knowledge on personal efficacy. Knowing more about global warming and climate change increases overall concern about the risks of these issues, and this increased concern leads to greater perceived efficacy and responsibility to help solving them. Implications for risk communication are discussed.

Nilsson, D., Fielding, K., & Dean, A. J. (2020). Achieving Conservation Impact by Shifting Focus from Human Attitudes to Behaviors. *Conservation Biology*, 34(1), 93-102.  
<https://doi.org/10.1111/cobi.13363>

Attitudes have been a commonly used psychological measure of program effectiveness in conservation social science research. The major limitation of this approach is that attitudes do not always translate into behavior and therefore may not provide an accurate assessment of program success. Given that achieving conservation goals generally relies on understanding and changing human behavior, we argue for the need to assess behavior rather than attitudes as an indicator of conservation outcomes. Psychological theory shows that attitudes and behavior are distinct, but related, concepts. Measuring conservation behaviors involves identifying the target behavior or behaviors and the optimal time to measure and then selecting the most appropriate method of measurement (i.e., direct observation, objective indicators, self-reported behavior, and behavioral intentions) that considers the strengths and weaknesses of each approach. We call for conservation programs to focus on influencing behavior rather than attitudes alone and encourage conservation practitioners and researchers to collect high-quality behavioral data to more effectively inform policy and programs.

Novacek, M. J. (2008). Engaging the Public in Biodiversity Issues. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 11571-11578.  
<https://doi.org/10.1073/pnas.0802599105>

To engage people in biodiversity and other environmental issues, one must provide the opportunity for enhanced understanding that empowers individuals to make choices and take action based on sound science and reliable recommendations. To this end, we must acknowledge some real challenges. Recent surveys show that, despite growing public concern, environmental issues still rank below many other problems, such as terrorism, health care, the economy, and (in the U.S.) family values. Moreover, much of the recent upswing in interest in the environment is due to the marked shift in attention to global warming away from other environmental problems such as destruction of ecosystems, water pollution, overpopulation, and biodiversity loss. Such a change in public focus often comes with a tendency to decouple various environmental problems and ignore their synergistic effects. Exacerbating this problem are arguments from the media and other sources that discourage public interest in environmental topics by characterizing the science behind them as overly complex, immersed in debate and controversy, and

detached from human interests. Educational programming, media, exhibitions, and other means of public outreach should build on the welcome increase in public interest in global warming by demonstrating the interplay of various environmental disruptions. In the case of biodiversity, the importance of species in providing ecosystem services, natural beauty and pleasure, and sustaining human lives is a message that requires constant attention and recrafting to impact diverse audiences.

Onwezen, M. C., Antonides, G., & Bartels, J. (2013). The Norm Activation Model: An Exploration of the Functions of Anticipated Pride and Guilt in Pro-Environmental Behaviour. *Journal of Economic Psychology*, 39, 141-153. <https://doi.org/10.1016/j.joep.2013.07.005>

The Norm Activation Model (NAM; Schwartz, 1977) is a vested model that explains altruistic and environmentally friendly behaviour. Although research states that anticipated pride and guilt are associated with the NAM, these associations are not yet fully understood. The current study provides an overview of the literature that refers to anticipated pride and guilt within the NAM. Moreover, we aim to increase our understanding of these associations through theoretical arguments and a study conducted in the Netherlands. We hypothesised that anticipated pride and guilt cause individuals to behave themselves in a manner that is in line with personal norms. This proposition regarding the self-regulatory function of anticipated pride and guilt was confirmed by our study; anticipated emotions mediate the effects of personal norms on behaviour. These associations remained after including the Theory of Planned Behaviour in the NAM, although in the integrated NAM–TPB model, anticipated emotions affected behaviour via behavioural intentions. Implications regarding these findings are discussed.

Osbaldiston, R. (2013). Synthesizing the Experiments and Theories of Conservation Psychology. *Sustainability*, 5(6), 2770-2795. <https://doi.org/10.3390/su5062770>

Within the field of environmental psychology, there are two distinct bodies of literature. First, there are experimental studies that have evaluated techniques for getting people to perform conservation behaviors. Second, there are theoretical studies that have surveyed people to create some type of theoretical model that explains conservation behaviors. These two types of research almost never overlap. This research project attempts to bridge these two literatures. Specifically, we coded over 100 environmental experiments for the type of treatment that each one employed and the effect size that was reported. Then we mapped the ten leading treatments on to the main components of six leading theoretical models. Our findings indicate that a moderate amount of variance in the effect sizes of the experimental literature is explained by the theoretical models and that one of the strongest predictors of conservation behavior is the situation or context. While we acknowledge the limitations of our method, this research raises a fundamentally important question: Why are our theories somewhat limited at predicting the behavior patterns that we see in our experiments? Are our theories built on the wrong set of psychological constructs, or are our experiments manipulating the wrong set of variables?

Osbaldiston, R., & Schott, J. P. (2011). Environmental Sustainability and Behavioral Science: Meta-Analysis of Proenvironmental Behavior Experiments. *Environment and Behavior*, 44(2), 257-299. <https://doi.org/10.1177/0013916511402673>

To provide practitioners with useful information about how to promote proenvironmental behavior (PEB), a meta-analysis was performed on 87 published reports containing 253 experimental treatments that measured an observed, not self-reported, behavioral outcome. Most studies combined multiple treatments, and this confounding precluded definitive conclusions about which individual treatments are most effective. Treatments that included cognitive dissonance, goal setting, social modeling, and prompts provided the overall largest effect sizes (Hedge's  $g > 0.60$ ). Further analyses indicated that different treatments have been more effective for certain behaviors. Although average effect sizes are based on small numbers of studies, effective combinations of treatments and behaviors are making it easy to recycle, setting goals for conserving gasoline, and modeling home energy conservation. The results also reveal several gaps in the literature that should guide further research, including both treatments and PEB that have not been tested.

Pearson, E., Tindle, H., Ferguson, M., Ryan, J., & Litchfield, C. (2016). Can We Tweet, Post, and Share Our Way to a More Sustainable Society? A Review of the Current Contributions and Future Potential of #SocialMediaForSustainability. In *Annual Review of Environment and Resources, Vol 41*. A. G. Gadgil, T. P. (Ed.), (Vol. 41, pp. 363-397). Palo Alto: Annual Reviews <https://doi.org/10.1146/annurev-environ-110615-090000>

Social media is changing how people connect, create, and share content and is an integral force shaping modern society. Given the significant environmental challenges society faces, this review considers (a) how social media is currently contributing to the development of a more sustainable society and (b) directions for future work such that researchers and practitioners may more effectively utilize this technology. At present, case studies, anecdotal evidence, and research demonstrate that social media is contributing to sustainability in diverse ways including behavioral interventions utilizing social media elements; social and political activism; supporting/generating sustainable business practices and addressing corporate "greenwashing"; increasing access to, and the potential quality of, environmental education; and through citizen science projects. Although this work is promising, there is an urgent need for further and more methodologically rigorous research, which evaluates the specific impacts of social media technology on sustainability outcomes, i.e., proenvironmental knowledge, attitudes, and-in-particular-behavior.

Schaffner, D., Demarmels, S., & Juettner, U. (2015). Promoting Biodiversity: Do Consumers Prefer Feelings, Facts, Advice or Appeals? *Journal of Consumer Marketing*, 32(4), 266-277. <https://doi.org/10.1108/JCM-11-2014-1220>

Purpose— The purpose of this paper is to explore consumers' responses to emotional and normative communication in comparison with traditional informational campaigns promoting pro-environmental behavior in the context of biodiversity. By adopting the approach of likeability of the communication, the paper identifies which type of communication strategy is liked by consumers' and which dimensions define likeability in the context of biodiversity. The goal is to improve the effectiveness of communication messages delivered by social marketers or public policy makers through a better

understanding of consumers' responses to different communication strategies.

**Design/methodology/approach**– To investigate which communications strategies are perceived as likeable in the context of promoting biodiversity and to explore the dimensions that underlie likeability of the communication a qualitative study was conducted. First, the information design with the different communication strategies has been developed. Second, focused interviews with 25 individuals have been conducted. **Findings**– Results indicate that communication strategies using positive emotions led to most favorable responses. Further, findings suggest that informational strategies seem to result in positive attitudes when they tap on procedural knowledge. Favorable judgments are linked with communication strategies that create awareness or which are relevant and informative. **Research limitations/implications**– Further empirical research is suggested exploring consumers' responses to communication strategies that combine emotions and facts. **Practical implications**– Based on the findings of this study, social marketers and public policy makers are recommended to use a combination of communication strategies that evoke positive emotions and provide consumers with the facts necessary to take action. **Originality/value**– The paper allows for an integrated view and contributes to an increased understanding of responses to communication strategies and provides valuable practical implications for social marketers and public policy makers.

Schultz, P. W. (2000). Empathizing with Nature: The Effects of Perspective Taking on Concern for Environmental Issues. *Journal of Social Issues*, 56(3), 391-406. <https://doi.org/10.1111/0022-4537.00174>

In this article, I propose that concern for environmental problems is fundamentally linked to the degree to which people view themselves as part of the natural environment. Two studies are reported that test aspects of this theory. The first study describes the structure of people's concern for environmental problems. Results from a confirmatory factor analysis showed a clear three-factor structure, which I labeled egoistic, altruistic and biospheric. A second study examined the effects of a perspective-taking manipulation on egoistic, social-altruistic, and biospheric environmental concerns. Results showed that participants instructed to take the perspective of an animal being harmed by pollution scored significantly higher in biospheric environmental concerns than participants instructed to remain objective.

Schultz, P. W. (2011). Conservation Means Behavior. *Conservation Biology*, 25(6), 1080-1083. <https://doi.org/10.1111/j.1523-1739.2011.01766.x>

Most instances of deteriorating environmental conditions are caused by human behavior. Although there are certainly instances of such environmental conditions developing from natural processes, most are largely the result of human activity. Drivers of phenomena such as climate change, loss of species' habitats, and ocean acidification rarely are the result of malicious intent, but rather the consequence of the lifestyles of billions of humans. Accordingly, efforts to promote conservation must change behavior (Ehrlich & Kennedy 2005; Schultz & Kaiser 2012).; ; This fundamental link between conservation and behavior has been noted in a number of recent publications. Mascia et al. (2003) state that "Biodiversity conservation is a human endeavor: initiated by humans, designed by humans, and intended to modify human behavior...." Cowling (2005) calls this realization "an epiphany for...natural scientists." And Balmford and Cowling (2006) note that "conservation is primarily not about biology but about people

and the choices they make.” Here I would go one step further and propose that conservation is a goal that can only be achieved by changing behavior.

Sellmann, D., & Bogner, F. X. (2013). Climate Change Education: Quantitatively Assessing the Impact of a Botanical Garden as an Informal Learning Environment. *Environmental Education Research*, 19(4), 415-429. <https://doi.org/10.1080/13504622.2012.700696>

Although informal learning environments have been studied extensively, ours is one of the first studies to quantitatively assess the impact of learning in botanical gardens on students' cognitive achievement. We observed a group of 10th graders participating in a one-day educational intervention on climate change implemented in a botanical garden. The students completed multiple-choice questionnaires in a pre-post-retention test design. Comparing the test scores revealed a significant short-term knowledge gain as well as a long-term knowledge gain. Consequently, our results show the potentials of botanical gardens as effective learning environments, and for complementing formal school-based learning settings regarding climate change education.

Sevillano, V., Aragonés, J. I., & Schultz, P. W. (2007). Perspective Taking, Environmental Concern, and the Moderating Role of Dispositional Empathy. *Environment and Behavior*, 39(5), 685-705. <https://doi.org/10.1177/0013916506292334>

This article examines the impact of visual images and perspective taking on concern for environmental problems. Participants in the experiment were 193 university students. Results replicated earlier results showing that perspective taking, combined with images of animals harmed by nature, caused an increase in biospheric environmental concerns. In addition, results showed that the empathic dimension of personal distress moderated the relationship between kind of image and kind of perspective on both biospheric and egoistic environmental concerns. Results about the lack of other moderating effects are discussed.

Shi, J., Visschers, V. H. M., Siegrist, M., & Arvai, J. (2016). Knowledge as a Driver of Public Perceptions About Climate Change Reassessed. *Nature Climate Change*, 6(8), 759-+. <https://doi.org/10.1038/nclimate2997>

It is intuitive to assume that concern about climate change should be preceded by knowledge about its effects(1,2). However, recent research suggests that knowledge about climate change has only a limited effect on shaping concern about climate change(3-6). Our view is that this counterintuitive finding is a function of how knowledge is typically measured in studies about climate change. We find that if it is measured in a domain-specific and multidimensional way, knowledge is indeed an important driver of concern about climate change-even when we control for human values. Likewise, different dimensions of knowledge play different roles in shaping concern about climate change. To illustrate these findings, we present the results from a survey deployed across six culturally and politically diverse countries. Higher levels of knowledge about the causes of climate change were related to a heightened concern. However, higher levels of knowledge about the physical characteristics of climate change had either a



negative or no significant effect on concern. Efforts aimed at improving public knowledge about climate change are therefore not the lost cause that some researchers claim they may be.

Steg, L., & Vlek, C. (2009). Encouraging Pro-Environmental Behaviour: An Integrative Review and Research Agenda. *Journal of Environmental Psychology*, 29(3), 309-317.  
<https://doi.org/10.1016/j.jenvp.2008.10.004>

Environmental quality strongly depends on human behaviour patterns. We review the contribution and the potential of environmental psychology for understanding and promoting pro-environmental behaviour. A general framework is proposed, comprising: (1) identification of the behaviour to be changed, (2) examination of the main factors underlying this behaviour, (3) design and application of interventions to change behaviour to reduce environmental impact, and (4) evaluation of the effects of interventions. We discuss how environmental psychologists empirically studied these four topics, identify apparent shortcomings so far, and indicate major issues for future research.



## Part 2.2 - Consumption, Waste, and Energy Use

Cerciello, M., Agovino, M., & Garofalo, A. (2019). Estimating Urban Food Waste at the Local Level: Are Good Practices in Food Consumption Persistent? *Economia Politica*, 36(3), 863-886. <https://doi.org/10.1007/s40888-017-0089-8>

Although the recent empirical literature provides a satisfactory range of estimates of food waste at the national and global level, little attention has been devoted to lower units of aggregation. This article tackles the phenomenon of urban food waste (UFW), proposing an analysis of consumer behaviour at the local level. Using institutional data for Italian provinces, over an 11-year time span (2004-2014), we estimate the amounts of UFW and subsequently investigate the extent of persistence and spatial spillovers using the local Moran transition probability matrix. Our results suggest that the good and bad practices in food consumption that determine the levels of UFW are persistent over time. Moreover, they produce a (though limited) spatial spillover, affecting consumption practices in the neighbouring areas. Two province clusters emerge, one in Northern and Central Italy, featuring negative behaviours and the other one in South-Central and Southern Italy, displaying virtuous behaviours. This situation calls for public policies aimed at promoting convergence in the levels of UFW.

Chen, C. F., Xu, X. J., & Frey, S. (2016). Who Wants Solar Water Heaters and Alternative Fuel Vehicles? Assessing Social-Psychological Predictors of Adoption Intention and Policy Support in China. *Energy Research & Social Science*, 15, 1-11. <https://doi.org/10.1016/j.erss.2016.02.006>

Renewable energy technologies, such as solar water heaters (SWHs) and alternative fuel vehicles (AFVs), have been widely adopted in China. Using an extended model of the Theory of Planned Behavior, we investigated how social-psychological factors (environmental attitudes, perceived behavioral control (PBC), subjective and descriptive norms, and renewable energy knowledge) affect individuals' intention to adopt SWHs and AFVs and support renewable energy policies for a sample of 655 Chinese university students. Results of structural equation models indicate that environmental attitudes have strong positive effects on the intention to adopt SWHs and AFVs and support renewable energy policies. Renewable energy knowledge has a positive impact on these two dependent variables. In addition, subjective and descriptive norms and PBC positively influence the intention to adopt renewable energy technologies, but have no significant effect on support for renewable energy policies. Implications of the results are discussed.

Cheung, T. Y., Fok, L., Cheang, C. C., Yeung, C. H., So, W. M. W., & Chow, C. F. (2018). University Halls Plastics Recycling: A Blended Intervention Study. *International Journal of Sustainability in Higher Education*, 19(6), 1038-1052. <https://doi.org/10.1108/ijshe-10-2017-0175>

**Purpose** The problem of plastic wastes is serious nowadays worldwide, although plastic wastes recycling is already in practice. To promote sustainability in plastic waste recycling, the quality of wastes collected should be maintained well, resulted from a good recycling practice. This paper aims to study a new plastic recycling bin (PRB) and poster interventions on the enhancement of university hall residential students' proenvironmental knowledge, attitudes and intended behaviours (KAB) and actual recycling behaviours; informative and feedback posters were used as interventions.

Design/methodology/approach This study adopted a quasi-experimental setting to examine the effects of the new PRB on students' KAB and actual behaviours in recycling, whereas the quality of the recycled plastic was measured according to the extent of cleanliness (CLE), separation (SEP), compression (COM) and sortedness (SOR). Findings Results showed that significant positive enhancements in KAB only happened with the use of blended interventions, which included promotion through the PRB and posters, suggesting that the use of the PRB and posters was useful in achieving better recycling behaviour. Originality/value Blended intervention study by using new design plastic recycling bin and poster on the effect of students' proenvironmental and recycling KAB.

Costanzo, M., Archer, D., Aronson, E., & Pettigrew, T. (1986). Energy-Conservation Behavior - the Difficult Path from Information to Action. *American Psychologist*, 41(5), 521-528.  
<https://doi.org/10.1037/0003-066x.41.5.521>

Presents a social-psychological model of energy-use behavior that draws on behavioral and social research to explain influence processes and behavioral change related to energy conservation behavior. The model consists of 2 interacting sets of factors: psychological factors that refer to how information is processed by individual decision makers and positional factors that relate to characteristics of the decision makers' situations that support or constrain action. Suggestions for maximizing the effectiveness of informational appeals to conserve energy by convincing the consumer that a pay-off will result from the use of energy conserving devices are discussed. It is suggested that the adoption of a conservatory attitude is influenced by the vividness of the argument to conserve energy, the credibility of the source, the understanding and retention of the message, and the degree to which an individual is able and willing to install conservation devices in his/her home. Alternatives to informational appeals through mass media to encourage energy conservation are proposed.

Cutts, B. B., Moore, N., Fox-Gowda, A., Knox, A. C., & Kinzig, A. (2013). Testing Neighborhood, Information Seeking, and Attitudes as Explanations of Environmental Knowledge Using Random Forest and Conditional Inference Models. *Professional Geographer*, 65(4), 561-579.  
<https://doi.org/10.1080/00330124.2012.724347>

This article tests the explanatory power and interactions among five alternative explanations of environmental knowledge: (1) local information availability, (2) neighborhood characteristics, (3) environmental attitudes, (4) personal empowerment, and (5) information seeking. Using random forest and conditional inference trees, the article analyzes survey responses and finds that attitudes about personal empowerment and frequent information seeking are the strongest predictors of knowledge. The study offers random forest and conditional inference trees as statistical tools for complex data sets and studies that test hypotheses generated from multiple theories. We discuss the influence of knowledge differences over inclusive sustainability discussions.

de Groot, J. I. M., Abrahamse, W., & Jones, K. (2013). Persuasive Normative Messages: The Influence of Injunctive and Personal Norms on Using Free Plastic Bags. *Sustainability*, 5(5), 1829-1844.  
<https://doi.org/10.3390/su5051829>

In this exploratory field-study, we examined how normative messages (i.e., activating an injunctive norm, personal norm, or both) could encourage shoppers to use fewer free plastic bags for their shopping in addition to the supermarket's standard environmental message aimed at reducing plastic bags. In a one-way subjects-design (N = 200) at a local supermarket, we showed that shoppers used significantly fewer free plastic bags in the injunctive, personal and combined normative message condition than in the condition where only an environmental message was present. The combined normative message did result in the smallest uptake of free plastic bags compared to the injunctive and personal normative-only message, although these differences were not significant. Our findings imply that re-wording the supermarket's environmental message by including normative information could be a promising way to reduce the use of free plastic bags, which will ultimately benefit the environment.

Dursun, I., Kabadayi, E. T., & Tuger, A. T. (2019). Overcoming the Psychological Barriers to Energy Conservation Behaviour: The Influence of Objective and Subjective Environmental Knowledge. *International Journal of Consumer Studies*, 43(4), 402-416. <https://doi.org/10.1111/ijcs.12519>

Energy conservation is a crucial aspect of responsible consumption which is the reflection of individual efforts for sustainability. However, especially young consumers are reluctant to reduce their energy consumption despite their pro-environmental attitudes. Resistance to behavioural change can be attributed to various psychological barriers that help consumer to avoid engaging in pro-environmental actions. In this context, the first aim of the study is to extend the theoretical and empirical evidence regarding impeding effects of psychological barriers on individual energy conservation behaviour. Secondly, the study investigates the alleviating role of environmental knowledge on those barriers that limit energy conservation. Proposed impeding effects of objective and subjective environmental knowledge on various denial mechanisms, which are in turn expected to hinder energy conservation, were tested using the survey data collected from young Turkish consumers. Results suggest that denial mechanisms hinder young consumers' energy conservation behaviour indirectly through diminishing feelings of moral obligations. Moreover, it was found that objective environmental knowledge's effect can be used to break down the psychological barriers and to facilitate the change towards more sustainable energy consumption patterns. Implications of the findings and directions for future research are discussed.

Kim, Y., Yun, S., Lee, J., & Ko, E. (2016). How Consumer Knowledge Shapes Green Consumption: An Empirical Study on Voluntary Carbon Offsetting. *International Journal of Advertising*, 35(1), 23-41. <https://doi.org/10.1080/02650487.2015.1096102>

This paper investigates how highly knowledgeable consumers differ from less knowledgeable consumers in their rational and emotional determinants of desire for green consumption, and derive distinct advertising implications for each group. We distinguish consumer knowledge into three categories (knowledge related to the environment, available action, and its effectiveness) and test them as moderating variables. A survey of 256 US consumers revealed that less knowledgeable consumers were driven primarily by their perceived behavioral control, while highly knowledgeable consumers exhibited a distinct influence from positive anticipated emotions on their desire. This distinction was brought upon only within low/high action/effectiveness knowledge groups, but not within low/high environment knowledge. Our findings highlight the importance of raising consumer's system, action-related, and

effective knowledge, as well as the need for targeted advertising strategies for consumers with differing knowledge levels in green consumption.

Klein, F., Emberger-Klein, A., Menrad, K., Mohring, W., & Blesin, J. M. (2019). Influencing Factors for the Purchase Intention of Consumers Choosing Bioplastic Products in Germany. *Sustainable Production and Consumption*, 19, 33-43. <https://doi.org/10.1016/j.spc.2019.01.004>

Plastic pollution is a massive global issue and it is increasing. However, there are possible solutions besides the abstinence of plastic-consumption. Particularly, bioplastics could be one part of the solution. So far, there has been little research on the consumption of bioplastic-products and consumer's choice behavior for bioplastics. We conducted the largest study so far, on preferences, choice, attitude, and perception in the context of bioplastics. Our sample of 1673 participants is representative of the German population including citizens 16 years of age and older, who were surveyed through an Online Access Panel. We conducted a logistic regression analysis combining the purchase intention for bioplastic-products as the dependent variable with 12 independent variables derived from the literature review. We found significant and comparably high influences on the purchase intention from the variables attitude towards bioplastics, green consumer values, product experience and interest in information on bioplastics. Politics and economic stakeholders promoting marketing and information activities related to bioplastic products can use the findings of this study.

Kovacs, J., Medves, D., & Pantya, J. (2020). To Shine or Not to Shine? - the Relationship between Environmental Knowledge of Preteens and Their Choice among Plastic and Non-Plastic Materials for a Manual Task. *Environmental Education Research*, 26(6), 849-863. <https://doi.org/10.1080/13504622.2020.1752363>

Since education aims to offer applicable knowledge, studying knowledge-behavior relationship is of key importance in promoting environmental education. But there is scarcity of studies addressing the relationship between knowledge and real behavior choices. We examined the connection between environmental knowledge and behavior (self-reported and measured in an operative way) among 10-12-year-old students, with special focus on the potential mediating role of attitudes. The main research question was whether knowledge (measured with an achievement test) correlates with actual environmental behavior, and how mental accessibility of environmentalism is related to the relationship between knowledge and actual behavior (i.e. choosing a material for completing a manual task). The study with 325 persons revealed that although the positive connection between knowledge and self-reported behavior was fully mediated by environmental attitudes, knowledge was just slightly related to actual behavior, even when the topic of environmentalism appeared before the behavior choice. However, behavior was related to school, suggesting that school-level socialization (beyond the knowledge transfer) is highly influential in forming environmental behavior. The difficulties of studying actual behavior and implications of our findings for practitioners from the field of environmental education are discussed.

Liao, C. H., & Li, H. (2019). Environmental Education, Knowledge, and High School Students' Intention toward Separation of Solid Waste on Campus. *International Journal of Environmental Research and Public Health*, 16(9), 15. <https://doi.org/10.3390/ijerph16091659>

To achieve substantial and sustainable levels of separation of municipal solid waste (MSW), it is essential to engage young people as they are important drivers of change and will have a major influence on the future of the world. This study aimed to understand Chinese high school students' intention toward the separation of solid waste on campus (SSWC). The study has used the Theory of Planned Behavior (TPB) as its theoretical framework, and further incorporates two additional constructs (environmental education and environmental knowledge) to explain the separation of solid waste (SSW) behavior of 562 high school students. The results indicate that environmental education is essential to ensure that students have required knowledge and positive attitudes toward SSWC. Knowledge was the best predictor of high school students' separation behavior. Moreover, a lack of subjective norm from the important people could prevent students from participating in this process, regardless of their positive attitudes. The implications for policy and scope for further research are discussed.

Liu, X. D., Liu, X. J., Luo, X., Wang, M. M., Fu, H. L., Wang, B. J., . . . Hu, W. (2020). Analysis on the Influencing Mechanism of Informational Policy Instrument on Adopting Energy Consumption Monitoring Technology in Public Buildings. *Energy Efficiency*, 13(7), 1485-1503. <https://doi.org/10.1007/s12053-020-09895-z>

Energy consumption monitoring technology plays a very important role in the realization of intelligent building energy saving, but it is not accepted widely in China. The main reasons for this are the low public energy-saving awareness and incomplete informational policy instruments; thus, studying how informational policy instruments affect the adoption of energy consumption monitoring technology and the impact of energy-saving awareness is of great significance to the widespread acceptance of energy consumption monitoring technology and its role in the realization of intelligent building energy saving. This paper introduces informational policy instruments and energy-saving awareness into technology acceptance model and builds an extended technology acceptance model. A questionnaire survey of 298 respondents who related to the operation and management of public buildings was used to explore the effect mechanism of informational policy instruments on adopting energy consumption monitoring technology. The results show that (1) informational policy instruments have no direct impact on the acceptance of energy consumption monitoring technology (2) and energy-saving awareness, attitudes, perceived usefulness, and perceived ease of use can mediate the relationship between informational policy instruments and behavioral intention of adopting energy consumption monitoring technology, namely, informational policy instruments can affect behavioral intention through six paths which are informational policy instruments energy-saving awareness behavioral intention, informational policy instruments energy-saving awareness attitudes behavioral intention, informational policy instruments attitudes behavioral intention, informational policy instruments perceived ease of use behavioral intention, informational policy instruments perceived ease of use perceived usefulness behavioral intention, informational policy instruments perceived usefulness behavioral intention. Finally, relevant policies and suggestions are put forward based on the results.

Maurer, M., Koulouris, P., & Bogner, F. X. (2020). Green Awareness in Action-How Energy Conservation Action Forces on Environmental Knowledge, Values and Behaviour in Adolescents' School Life. *Sustainability*, 12(3), 15. <https://doi.org/10.3390/su12030955>

Affordable, reliable, sustainable and modern energy consumption is a crucial goal of the Agenda 2030. To raise each citizen's awareness for more effective energy consumptions, proper education is necessary. The classroom project GAIA (Green Awareness in Action) was designed to change energy consumption patterns to pursue green behaviour. The class-wise aim was to improve schools' CO<sub>2</sub>-balance and to promote environmentally sustainable behaviour without impacting school life quality. Our target group were sixth graders (N = 132, M = 11.03, SD +/- 0.23, 53.4% = girls) of one Greek school. To monitor the project's effect, a pre- and post-test design was applied to measure environmental literacy regarding environmental knowledge, attitudes/values and behaviour. A regression analysis revealed that students with poor previous knowledge reached higher learning effects compared to those with good previous knowledge. Related to the environmental knowledge types, an ANCOVA analysis revealed a knowledge gain in action-related and effectiveness knowledge. The overall learning effect correlates positively with pro-environmental preference (high scores in preservation, low scores in utilisation) and negatively with weak pro-environmental preferences. Anthropocentric (utilitarian) preferences primarily focussing on nature exploitation have considerably decreased. The project illustrates how far individual behaviour can be targeted in green educational initiatives.

Mellish, S., Pearson, E. L., McLeod, E. M., Tuckey, M. R., & Ryan, J. C. (2019). What Goes up Must Come Down: An Evaluation of a Zoo Conservation-Education Program for Balloon Litter on Visitor Understanding, Attitudes, and Behaviour. *Journal of Sustainable Tourism*, 27(9), 1393-1415. <https://doi.org/10.1080/09669582.2019.1625908>

Balloons used outdoors can fly away, posing ingestion and entanglement hazards to wildlife. "When Balloons Fly" (WBF) conservation-education program seeks to educate zoo visitors about these threats and encourage the use of wildlife-friendly bubbles at outdoor events. We examined the effect of WBF on visitor knowledge, attitudes, and behaviours (intentions and actions) over 6 months (N = 624). We compared outcomes among visitors who viewed a presentation and exhibit, to viewing the exhibit-only, and investigated the priming influence of completing a survey before entering the exhibit (pre-survey). Visitors had greater depth of understanding about the impact of balloons immediately following the visit, but post-visit message recall was low. General Linear Models revealed that over 6 months WBF significantly ( $p < .05$ ) influenced positive attitudes concerning balloon use, increased likelihood to use bubbles, and reduced likelihood to use balloons. Completion of a pre-survey significantly influenced positive attitudes and reduced likelihood to use balloons. WBF is promoting conservation behaviour, with two-thirds of the follow-up sample reporting that behaviours they changed while hosting or attending an outdoor event since their visit were influenced by the zoo experience. Future work can investigate materials that might mimic a priming effect (e.g., worksheets).

Mir, H. M., Behrang, K., Isaai, M. T., & Nejat, P. (2016). The Impact of Outcome Framing and Psychological Distance of Air Pollution Consequences on Transportation Mode Choice. *Transportation Research Part D-Transport and Environment*, 46, 328-338. <https://doi.org/10.1016/j.trd.2016.04.012>



Recent years, air pollution phenomenon has become one of the crucial problems of Tehran, Iran. Due to main political and economic role of Tehran, population of this metropolis is high and increasing. Urban transportation of this highly populated city contributes more than 70% of air pollution problem in this city. Although a number of urban transport developments, policy measures and regulations have been employed, Tehran's air pollution has remained crucial thus far. Finding ways to encourage individuals to behave more sustainable can be considered as a substantial approach of tackling environmental problems such as air pollution, since it can be highly cost-effective and fast. This research attempt to evaluate the impacts of two factors of outcome framing and psychological distance of air pollution on citizen's willingness to behave environmental friendly, particularly to change the travel mode choice. Results illustrate that communicating the consequences of air pollution can provoke individuals' to act more environment friendly or in particular to change their intention for using more sustainable mode of transportation. Framing the positive consequences of mitigating air pollution take precedence over framing the negative consequences. Moreover the gains of mitigating air pollution have an impact on the willingness to use of bicycle and bus. Results also show that decreasing the psychological distance of air pollution in order to make manipulated frame more personally relevant has no significant impact on respondents.

Neubig, C. M., Vranken, L., Roosen, J., Grasso, S., Hieke, S., Knoepfle, S., . . . Masento, N. A. (2020). Action-Related Information Trumps System Information: Influencing Consumers' Intention to Reduce Food Waste. *Journal of Cleaner Production*, 261. <https://doi.org/10.1016/j.jclepro.2020.121126>

In order to substantially reduce food waste at the household level, it is essential to change consumer behavior. Informing consumers about the food waste issue is a promising means of bringing about behavior change: research confirms that information can increase food waste reduction behavior. However, it has yet to be determined what kind of information is most effective and exactly how that information affects consumer food waste behavior. This study compares the effects of system vs. action-related information (i.e., knowing what impacts specific actions entail vs. knowing how specific actions can help to accomplish a goal) on behavioral intention towards food waste. That is, the study focuses on the effect of information on the role of food waste in the food system versus information on actions that can be taken to avoid it. Moreover, an adapted model of the Theory of Planned Behavior is used to assess how these information effects are mediated by consumers' attitude, norms, and perceived behavioral control. Results from an online experiment with a between-subjects design (N = 2248) show that action-related information significantly increases respondents' intention to reduce food waste while system information has no significant effect. The change in behavioral intention in the action-related information group is ascribed to greater personal norm activation, more favorable attitudes towards food waste reduction, and higher perceived behavioral control of food waste behaviors. Even though system information does not significantly increase intention to reduce food waste, it results in more favorable attitudes towards food waste reduction. The findings provide insights for policy makers and NGOs on what type of information to consider when designing effective food waste reduction campaigns targeted at consumers, with action-related information supporting the opportunity for consumer behavior change.

Passafaro, P., & Livi, S. (2017). Comparing Determinants of Perceived and Actual Recycling Skills: The Role of Motivational, Behavioral and Dispositional Factors. *Journal of Environmental Education*, 48(5), 347-356. <https://doi.org/10.1080/00958964.2017.1320961>

An empirical investigation assessed the role of different factors of motivational, behavioral, and dispositional nature in the prediction of both perceived and actual skills concerning household waste recycling. A structured questionnaire (measuring attitudes, social norms, perceived control, need for cognitive closure, self-reported household recycling behavior and perceived recycling Skill's) and a simulation task (assessing actual recycling skills) were administered to 300 participants in Italy. Results indicate that, although positively related, perceived and actual skills are two distinct constructs differently related to motivational, behavioral, and dispositional factors. Implications for designing educational interventions to increase citizens' recycling skills are discussed.

Redman, E., & Redman, A. (2014). Transforming Sustainable Food and Waste Behaviors by Realigning Domains of Knowledge in Our Education System. *Journal of Cleaner Production*, 64, 147-157. <https://doi.org/10.1016/j.jclepro.2013.09.016>

Changing from current unsustainable production, consumption, and disposal patterns will clearly require technological, political and other structural changes, but also individual behavior change. Consumer demand and individuals' purchasing power exerts pressure on many parts of the production system, including how crops are produced (e.g., organic), products are packaged and labeled (e.g., rBGH-free labels on milk), and even where products are distributed and how they are disposed of. Individual consumer behaviors have even led to political and structural changes over time, such as the consumer boycott of tuna which led to 1990 US legislation creating the "Dolphin Safe" tuna label. One of the central ways to foster responsible citizenry and promote sustainable production is to harness the capacity of teachers and schools to create change. Educating for conscious consumerism is a critical part of creating changes in production, consumption and disposal systems, but our current education system and approaches often reinforce unsustainable practices that neglect subjective ways of knowing as well as action and change. Research and experience suggests that traditional, information intensive teaching about sustainability alone does not motivate the behavior change a transition to sustainability will require. Utilizing a previously developed framework that identifies four distinct types of knowledge declarative, procedural, effectiveness and social we hypothesize that procedural, effectiveness and social knowledge are important predictors of an individual's participation in sustainable behaviors, while declarative (information) knowledge is not. While the knowledge domain framework has been theoretically detailed by other researchers (Kaiser and Fuhrer, 2003; Frisk and Larson, 2011) and qualitatively assessed through an intensive case study education program (Redman, 2013), to date, this is the first quantitative assessment of the relationship between the four domains of knowledge and sustainability-related behaviors. We tested our hypothesis through an extensive survey of 346 current and future K-12 teachers about sustainable food and waste knowledge and behaviors. The survey results supported our hypothesis that high levels of declarative knowledge alone did not predict increased participation in sustainable behaviors while procedural and social knowledge were statistically significant predictors of sustainable food behaviors and procedural, effectiveness, and social knowledge were all statistically significant predictors of sustainable waste behaviors. Through active incorporation of appropriate forms of procedural, effectiveness, and social knowledge into the K-12 classroom, educators can empower the next generation to make individual changes based on their vision of the



future and insist on structural and institutional changes that are essential for a successful transition to sustainability.

Stockli, S., Niklaus, E., & Dorn, M. (2018). Call for Testing Interventions to Prevent Consumer Food Waste. *Resources Conservation and Recycling*, 136, 445-462.  
<https://doi.org/10.1016/j.resconrec.2018.03.029>

Over the last decade, practitioners have implemented various interventions against consumer food waste. In contrast, academics have only just started to examine how to prevent consumer food waste. This review synthesizes practical and academic evidence on anti-consumer-food-waste interventions. The basis for this synthesis was a systematic framework of antecedent interventions (informational intervention, prompts, modeling (social norms), commitment) and consequence interventions (feedback, rewards, penalties) that we have drawn from general behavioral change and intervention research. This review shows that (1) informational interventions are the most commonly used intervention type even though evidence indicates that this intervention type is relatively ineffective, and (2) there is a lack of evidence of the effectiveness of anti-consumer-food-waste interventions. With reference to general behavioral change and intervention literature, we suggest that (1) intervention types other than informational interventions should be considered, and (2) anti-consumer-food-waste interventions should be evaluated in a systematic manner; that is, by using a framework with standardized definitions and measurement methods that addresses specific behaviors and change processes and that allows accurate identification of short-term and long-term effects. Overall, this review outlines current conceptual and methodological challenges and sets an agenda for implementing effective anti-consumer-food-waste interventions.

Unal, A. B., Steg, L., & Gorsira, M. (2018). Values Versus Environmental Knowledge as Triggers of a Process of Activation of Personal Norms for Eco-Driving. *Environment and Behavior*, 50(10), 1092-1118. <https://doi.org/10.1177/0013916517728991>

Eco-driving can be an effective strategy to save fuel and reduce CO<sub>2</sub> emissions on the road. In the current study, we reason that personal norms are important predictors of eco-driving, and that they are activated when people are aware of environmental problems caused by behavior (problem awareness) and believe that they can contribute to the solution of the problem by changing behavior (outcome efficacy). Extending previous research, we aim at testing two antecedents of this norm activation process: values and environmental knowledge. Results revealed that in comparison with knowledge, values-in particular biospheric values-were strongly associated with the intention to eco-drive by being highly related to awareness of problems caused by car use, which in turn was associated with stronger outcome efficacy beliefs and personal norms for eco-driving. Findings indicate that values are more likely to be a motivational force for pro-environmental intentions than is environmental knowledge.

## Part 2.3 – Human-Wildlife Interaction

Abrams, K. M., Leong, K., Melena, S., & Teel, T. (2020). Encouraging Safe Wildlife Viewing in National Parks: Effects of a Communication Campaign on Visitors' Behavior. *Environmental Communication-A Journal of Nature and Culture*, 14(2), 255-270.

<https://doi.org/10.1080/17524032.2019.1649291>

Seeing wildlife in natural habitat is an exciting and powerful experience for national park visitors but is risky for visitors and wildlife alike. National parks have long used educational approaches to inspire visitors to engage in conservation behavior and protect themselves from harm. With record visitation in recent years, national parks must hone their communication strategies that support wildlife conservation and reduce wildlife-caused injuries to visitors. We tested a campaign that strongly promoted the visitor's experience as it aligns with wildlife protection. We measured its effect on how close people approached wildlife in four US national parks. The campaign resulted in fewer visitors observed within unsafe distances to wildlife in three of the four parks. We recommend parks use messages emphasizing the visitor experience gained by engaging in the desired behavior rather than messages that only highlight the importance of wildlife protection.

Bach, L., & Burton, M. (2017). Proximity and Animal Welfare in the Context of Tourist Interactions with Habituated Dolphins. *Journal of Sustainable Tourism*, 25(2), 181-197.

<https://doi.org/10.1080/09669582.2016.1195835>

The long-term sustainability of wildlife tourism depends on integrating visitor demands with resource management, requiring an understanding of tourist motivation. Managing the conflict between access to the animals and welfare, however, may diminish the experience for tourists. This paper identifies trade-offs tourists are willing to make between access and animal welfare, associated with feeding habituated bottlenose dolphins (*Tursiops sp.*) in Monkey Mia, Western Australia. Using a choice modelling technique, we were able to determine monetary values of visitor experiences. Compared to the current guaranteed interaction with dolphins (and a daily resort entrance fee), respondents were willing to pay significantly higher hypothetical entrance fees to avoid a decrease in proximity to, or probability of, the dolphin interaction. However, negative impacts on dolphin welfare had a negative impact on visitor utility. Over 80% of visitors (n = 244) accepted management regulations resulting in decreased time with and proximity to dolphins, if those addressed welfare concerns and were communicated clearly. Thus, while visitors placed the greatest value on the proximity and predictability, they were willing to trade off these aspects if they improved dolphin welfare. We provide management suggestions based on these results.

Ban, N. C., Kushneryk, K., Falk, J., Vachon, A., & Sleigh, L. (2019). Improving Compliance of Recreational Fishers with Rockfish Conservation Areas: Community–Academic Partnership to Achieve and Evaluate Conservation. *ICES Journal of Marine Science*. <https://doi.org/10.1093/icesjms/fsz134>

Compliance is a key factor in ensuring success of marine conservation. We describe a community–academic partnership that seeks to reduce non-compliance of recreational fishers with Rockfish Conservation Areas (RCAs) around Galiano Island in British Columbia, Canada. Previous work showed

mostly unintentional non-compliance by recreational fishers. From 2015 to 2018 we developed and implemented outreach and public education activities. We distributed information at community events, and installed 46 metal signs with maps of nearby RCAs at marinas, ferry terminals, and boat launches. During the summers of 2015, 2017, and 2018, we interviewed 86 recreational fishers to gauge their compliance with RCAs. Compared with a baseline in 2014, there was a reduction of 22% (from 25 to 3%) of people who unintentionally fished in RCAs with prohibited gears. In 2018, 67% of participants had seen our outreach materials. We used trail cameras overlooking RCAs to assess non-compliance in six locations on Galiano Island. Illegal fishing incidents within RCAs declined from 42% of days monitored in 2014 to 14% in 2018. Although our outreach efforts were limited in scale and scope, they appear to be making a difference. Our activities and findings can provide guidance for other regions seeking to improve compliance by recreational fishers.

Baruch-Mordo, S., Breck, S. W., Wilson, K. R., & Broderick, J. (2009). A Tool Box Half Full: How Social Science Can Help Solve Human–Wildlife Conflict. *Human Dimensions of Wildlife*, 14(3), 219-223. <https://doi.org/10.1080/10871200902839324>

There is a growing recognition among wildlife managers that focusing management on wildlife often provides a temporary fix to human-wildlife conflicts, whereas changing human behavior can provide long-term solutions. Human dimensions research of wildlife conflicts frequently focuses on stakeholders' characteristics, problem identification, and acceptability of management, and less frequently on human behavior and evaluation of management actions to change that behavior. Consequently, little information exists to assess overall success of management. We draw on our experience studying human-bear conflicts, and argue for more human dimensions studies that focus on change in human behavior to measure management success. We call for help from social scientists to conduct applied experiments utilizing two methods, direct observation and self-reported data, to measure change in behavior. We are optimistic these approaches will help fill the managers' tool box and lead to better integration of human dimensions into human-wildlife conflict management.

Baruch-Mordo, S., Breck, S. W., Wilson, K. R., & Broderick, J. (2011). The Carrot or the Stick? Evaluation of Education and Enforcement as Management Tools for Human-Wildlife Conflicts. *PLoS One*, 6(1), e15681. <https://doi.org/10.1371/journal.pone.0015681>

Evidence-based decision-making is critical for implementing conservation actions, especially for human-wildlife conflicts, which have been increasing worldwide. Conservation practitioners recognize that long-term solutions should include altering human behaviors, and public education and enforcement of wildlife-related laws are two management actions frequently implemented, but with little empirical evidence evaluating their success. We used a system where human-black bear conflicts were common, to experimentally test the efficacy of education and enforcement in altering human behavior to better secure attractants (garbage) from bears. We conducted 3 experiments in Aspen CO, USA to evaluate: 1) on-site education in communal dwellings and construction sites, 2) Bear Aware educational campaign in residential neighborhoods, and 3) elevated law enforcement at two levels in the core business area of Aspen. We measured human behaviors as the response including: violation of local wildlife ordinances, garbage availability to bears, and change in use of bear-resistance refuse containers. As implemented, we found little support for education, or enforcement in the form of daily patrolling in changing human

behavior, but found more support for proactive enforcement, i.e., dispensing warning notices. More broadly we demonstrated the value of gathering evidence before and after implementing conservation actions, and the dangers of measuring responses in the absence of ecological knowledge. We recommend development of more effective educational methods, application of proactive enforcement, and continued evaluation of tools by directly measuring change in human behavior. We provide empirical evidence adding to the conservation managers' toolbox, informing policy makers, and promoting solutions to human-wildlife conflicts.

Baynham-Herd, Z., Redpath, S., Bunnefeld, N., Molony, T., & Keane, A. (2018). Conservation Conflicts: Behavioural Threats, Frames, and Intervention Recommendations. *Biological Conservation*, 222, 180-188. <https://doi.org/10.1016/j.biocon.2018.04.012>

Conservation conflicts are widespread and are damaging for biodiversity, livelihoods and human well-being. Conflict management often occurs through interventions targeting human behaviour. Conservation interventions are thought to be made more effective if underpinned by evidence and a Theory of Change—a logical argument outlining the steps required to achieve goals. However, for conservation conflicts, the evidence and logic supporting different types of interventions has received little attention. Using conflict-related keywords, we reviewed trends in behavioural intervention recommendations across conflict contexts globally, as published in peer-reviewed literature. We developed typologies for conflict behaviours, intervention recommendations, and conflict frames and identified associations between them and other geographical variables using Pearson's Chi-squared tests of independence. Analysing 100 recent articles, we found that technical interventions (recommended in 38% of articles) are significantly associated with conflicts involving wildlife control and the human-wildlife conflict frame. Enforcement-based interventions (54% of articles) are significantly associated with conflicts over illegal resource use, while stakeholder-based interventions (37% of articles) are associated with the human-human conflict frame and very highly developed countries. Only 10% of articles offered "strong" evidence from the published scientific literature justifying recommendations, and only 15% outlined Theories of Change. We suggest that intervention recommendations are likely influenced by authors' perceptions of the social basis of conflicts, and possibly also by disciplinary silos.

Burgin, S., & Hardiman, N. (2015). Effects of Non-Consumptive Wildlife-Oriented Tourism on Marine Species and Prospects for Their Sustainable Management. *Journal of Environmental Management*, 151, 210-220. <https://doi.org/10.1016/j.jenvman.2014.12.018>

Marine non-consumptive wildlife-oriented tourism, whereby tourists observe and/or interact closely with animals, without purposely having a detrimental effect on them, has been growing globally in recent decades. Human-mediated feeding (provisioning) is widely used by tour operators to attract target species, facilitate viewing and interaction with tourists. Although potential effects of such provisioning on terrestrial fauna have been given moderate scientific research attention, equivalent research in the marine environment is limited. Effects of provisioning marine wildlife may include direct habituation, behavioural change, and/or dietary impacts among individuals and species. There may also be disruption to the species associated assemblage. It was found that the literature on the effects of nonconsumptive wildlife tourism is fragmented and results from different areas and taxa are frequently contradictory. Most studies appeared to be of a few years duration, at most. This reflects the relative

immaturity of the industry - many enterprises studied typically commenced within the 1990s. Studies (other than fish) tended to focus on a focal species with few addressing the wider implications for the associated assemblage. Supplementary feeding may also have impacts on the health and wellbeing of provisioned animals. It is concluded that such nature tourism is often not benign - focal species and their assemblage are often disrupted. We conclude that funding to better understand the impacts and thus address them is imperative. To supplement funding for the research and monitoring required, an additional charge could be incorporated into the fee charged to those engaging in marine wildlife tourism.

Cornelisse, T. M., & Duane, T. P. (2013). Effects of Knowledge of an Endangered Species on Recreationists' Attitudes and Stated Behaviors and the Significance of Management Compliance for Ohlone Tiger Beetle Conservation. *Conservation Biology*, 27(6), 1449-1457. <https://doi.org/10.1111/cobi.12117>

Recreation is a leading cause of species decline on public lands, yet sometimes it can be used as a tool for conservation. Engagement in recreational activities, such as hiking and biking, in endangered species habitats may even enhance public support for conservation efforts. We used the case of the endangered Ohlone tiger beetle (*Cicindela ohlone*) to investigate the effect of biking and hiking on the beetle's behavior and the role of recreationists' knowledge of and attitudes toward Ohlone tiger beetle in conservation of the species. In Inclusion Area A on the University of California Santa Cruz (U.S.A.) campus, adult Ohlone tiger beetles mate and forage in areas with bare ground, particularly on recreational trails; however, recreation disrupts these activities. We tested the effect of recreation on Ohlone tiger beetles by observing beetle behavior on trails as people walked and road bikes at slow and fast speed and on trails with no recreation. We also surveyed recreationists to investigate how their knowledge of the beetle affected their attitudes toward conservation of the beetle and stated compliance with regulations aimed at beetle conservation. Fast cycling caused the beetles to fly off the trail more often and to fly farther than slow cycling or hiking. Slow cycling and hiking did not differ in their effect on the number of times and distance the beetles flew off the trail. Recreationists' knowledge of the beetle led to increased stated compliance with regulations, and this stated compliance is likely to have tangible conservation outcomes for the beetle. Our results suggest management and education can mitigate the negative effect of recreation and promote conservation of endangered species.

Cornelisse, T. M., & Sagasta, J. (2018). The Effect of Conservation Knowledge on Attitudes and Stated Behaviors toward Arthropods of Urban and Suburban Elementary School Students. *Anthrozoos*, 31(3), 283-296. <https://doi.org/10.1080/08927936.2018.1455450>

Arthropods provide ecosystem services upon which humans depend, yet are declining across the globe. Arthropods are neglected from conservation efforts due to many factors that include a lack of understanding of their roles and conservation need. Knowledge gain of arthropod roles could therefore increase support for their conservation, albeit indirectly through attitude changes. Evidence suggests knowledge and attitudes are more highly correlated in children and that environmental attitudes are shaped before age 12 years. Differences in the connection between knowledge, attitudes, and behaviors toward arthropods may also be different in children from different cultures or from urban versus rural locations due to varying experiences with arthropods. We sought to understand if different types of knowledge increased positive attitudes and stated conservation-based behaviors toward insects in

children in both urban and suburban schools. We conducted either a basic biology lesson or a conservation lesson on ecosystem services in both urban and suburban 4th and 5th grade classes, and used pre- and post-questionnaires to detect changes in knowledge, attitudes, and stated behavior toward arthropods. We found that urban students had significantly lower knowledge of, less positive attitudes toward, and fewer stated conservation behaviors toward arthropods but also exhibited the greatest positive changes when presented the conservation-based lesson. In addition, we found that being able to identify the type of arthropod correctly was related to more positive attitudes and stated behaviors. Finally, we found that while attitudes did not change toward some species, stated conservation behaviors did increase with knowledge of the arthropod's role in the ecosystem. Education in urban schools, with a focus on both distinguishing arthropods as well as ecosystem services, provides the most change per effort for conservation. Arthropod lessons could be done by local professors and undergraduate students in urban classrooms or local green spaces.

Cox, D. T. C., & Gaston, K. J. (2018). Human-Nature Interactions and the Consequences and Drivers of Provisioning Wildlife. *Philosophical Transactions of the Royal Society B-Biological Sciences*, 373(1745), 9. <https://doi.org/10.1098/rstb.2017.0092>

Many human populations are undergoing an extinction of experience, with a progressive decline in interactions with nature. This is a consequence both of a loss of opportunity for, and orientation towards, such experiences. The trend is of concern in part because interactions with nature can be good for human health and wellbeing. One potential means of redressing these losses is through the intentional provision of resources to increase wildlife populations in close proximity to people, thereby increasing the potential for positive human-nature experiences, and thence the array of benefits that can result. In this paper, we review the evidence that these resource subsidies have such a cascade of effects. In some Westernized countries, the scale of provision is extraordinarily high, and doubtless leads to both positive and negative impacts for wildlife. In turn, these impacts often lead to more frequent, reliable and closer human-nature interactions, with a greater variety of species. The consequences for human wellbeing remain poorly understood, although benefits documented in the context of human-nature interactions more broadly seem likely to apply. There are also some important feedback loops that need to be better characterized if resource provisioning is to contribute effectively towards averting the extinction of experience. This article is part of the theme issue 'Anthropogenic resource subsidies and host-parasite dynamics in wildlife'.

Cunningham-Smith, P., Colbert, D. E., Wells, R. S., & Speakman, T. (2006). Evaluation of Human Interactions with a Provisioned Wild Bottlenose Dolphin (*Tursiops truncatus*) near Sarasota Bay, Florida, and Efforts to Curtail the Interactions. *Aquatic Mammals*, 32(3), 346-356. <https://doi.org/10.1578/AM.32.3.2006.346>

Boaters have provisioned a free-ranging bottlenose male dolphin (*Tursiops truncatus*) for more than 15 years near Nokomis, Florida. The dolphin is a well-known attraction to tourists and local boaters because of his predictable presence in a narrow section of the Intracoastal Waterway near the Albee Road Bridge. Observations and records collected since 1990 documented this animal being fed by and interacting with humans, sometimes resulting in injury to the humans attempting to touch, feed, or swim with it. We initiated a study in 1997 to document the dolphin's interactions with boaters, to



characterize the frequency and types of boater interactions with the animal, and to evaluate the effectiveness of public education and enforcement efforts to curtail these illegal activities. The project consisted of three phases: (1) a baseline study, (2) a docent program, and (3) a follow-up study. Approximately 26% of the 1,797 interactions observed during the baseline study involved touching, teasing, or splashing, and 11% of interactions involved feeding. The docent program involved increased signage and the operation of a marked vessel to shadow the dolphin, monitor the types and frequencies of interactions, and offer educational materials about responsible wildlife viewing. Only 1.3% of boaters interacted with the dolphin in the presence of the docents; more than half of those questioned indicated that they were aware of the illegality of their actions. During follow-up observations to assess the effectiveness of the docent program and minimally increased law enforcement efforts, boater interactions with the dolphin increased by 5% after docent discussions. The docent and follow-up studies demonstrated that a small segment of the boating public continue to interact with the dolphin in spite of highly visible public education efforts. Increased law enforcement efforts, including the application of well-publicized punitive sanctions, may be required to bring about a further reduction in dolphin-human interactions in this area.

Davey, G., Khor, M. M., & Zhao, X. (2019). Key Beliefs Underlying Public Feeding of Free-Roaming Cats in Malaysia and Management Suggestions. *Human Dimensions of Wildlife*, 24(1), 1-13. <https://doi.org/10.1080/10871209.2018.1522679>

Public feeding of free-roaming cats subsidizes their population growth, and has consequences in highly interconnected ecosystems including predation of native wildlife and alteration of their behavior and populations. Research is needed to explain, predict, and possibly curb public feeding. We conducted a theoretically informed analysis of key beliefs underlying intentions to feed free-roaming cats in Malaysia, offering new insights as well as management suggestions. Normative beliefs had the strongest associations with behavioral intentions. Management strategies should consider social influences from families and friends of those who feed free-roaming cats, especially cat owners and their significant others. Our results also suggest key behavioral beliefs regarding disadvantages of feeding free-roaming cats could be strengthened through education and other initiatives. The findings are particularly important for Malaysia, which is biodiversity-rich but has a large free-roaming cat population and a high incidence of public feeding.

Dietsch, A. M., Slagle, K. M., Baruch-Mordo, S., Breck, S. W., & Ciarniello, L. M. (2018). Education Is Not a Panacea for Reducing Human-Black Bear Conflicts. *Ecological Modelling*, 367, 10-12. <https://doi.org/10.1016/j.ecolmodel.2017.11.005>

No abstract.

Donaldson, R., Finn, H., Bejder, L., Lusseau, D., & Calver, M. (2012). Social Learning of Risky Behaviour: Importance for Impact Assessments, Conservation and Management of Human-Wildlife Interactions. *Animal Conservation*, 15(5), 442-444. <https://doi.org/10.1111/j.1469-1795.2012.00601.x>

The potential for social learning mechanisms to facilitate the spread of harmful behaviours through wildlife social networks has clear conservation significance, and is important to consider during impact assessments and management of wildlife tourism, food provisioning, human–wildlife conflicts and other human–wildlife interactions. The commentaries by Higham (2012), Krützen (2012) and Wells (2012) in response to Donaldson et al. (2012) identify a range of applications that such findings of social transmission of risky behaviours may have for wildlife conservation. Their comments, alongside other recent reports of social learning of risky behaviours by wildlife during human–wildlife interactions (e.g. Chiyo, Moss & Alberts, 2012), provide strong directions for future research and management.

Dubois, S., & Fraser, D. (2013). A Framework to Evaluate Wildlife Feeding in Research, Wildlife Management, Tourism and Recreation. *Animals*, 3(4), 978-994. Retrieved from <https://www.mdpi.com/2076-2615/3/4/978>

Feeding of wildlife occurs in the context of research, wildlife management, tourism and in opportunistic ways. A review of examples shows that although feeding is often motivated by good intentions, it can lead to problems of public safety and conservation and be detrimental to the welfare of the animals. Examples from British Columbia illustrate the problems (nuisance animal activity, public safety risk) and consequences (culling, translocation) that often arise from uncontrolled feeding. Three features of wildlife feeding can be distinguished: the feasibility of control, the effects on conservation and the effects on animal welfare. An evaluative framework incorporating these three features was applied to examples of feeding from the literature. The cases of feeding for research and management purposes were generally found to be acceptable, while cases of feeding for tourism or opportunistic feeding were generally unacceptable. The framework should allow managers and policy-makers to distinguish acceptable from unacceptable forms of wildlife feeding as a basis for policy, public education and enforcement. Many harmful forms of wildlife feeding seem unlikely to change until they come to be seen as socially unacceptable.

Duda, M. D., Beppler, T., & Horstman, S. C. (2013). Attitudes toward Illegal Feeding and Harassment of Wild Dolphins in Panama City. *Human Dimensions of Wildlife*, 18(3), 236-238. <https://doi.org/10.1080/10871209.2013.762566>

No abstract.

Gore, M. L., Barbara, A. K., Paul, D. C., & James, E. S. (2006). Education Programs for Reducing American Black Bear–Human Conflict: Indicators of Success? *Ursus*, 17(1), 75-80. [https://doi.org/10.2192/1537-6176\(2006\)17\[75:EPFRAB\]2.0.CO;2](https://doi.org/10.2192/1537-6176(2006)17[75:EPFRAB]2.0.CO;2)

Education programs designed to reduce conflicts between American black bears (*Ursus americanus*) and humans are often implemented by diverse groups of wildlife practitioners who may devote significant resources to these programs, yet little has been done to characterize the content, structure, and effectiveness of these programs. We review 6 education programs in North America. We build on a common performance indicator used in 5 of 6 programs—a reduction in the number of bear–related



complaints to wildlife authorities—and suggest that practitioners incorporate other explanatory variables such as human dimensions, weather, natural food, or number of bears harvested. Some of these explanatory variables draw on potentially existing databases; others require new databases. If education programs are to remain an integral part of bear conservation and management, evaluation is essential to understand the ability of such programs to reduce conflict and encourage coexistence between people and bears.

Gore, M. L., & Knuth, B. A. (2006). *Attitude and Behavior Change Associated with the New York Neighbearhood Watch Program*. Department of Natural Resources Human Dimensions Research Unit, Cornell University HDRU Series No. 06-14. Ithaca, NY. Retrieved from <https://ecommons.cornell.edu/bitstream/handle/1813/40409/HDRUReport06-14.pdf?sequence=1&isAllowed=y>

In many areas where people and black bears coexist, negative interactions are increasing in frequency and magnitude. Reducing the risks associated with human-black bear conflict is an important goal for diverse stakeholders. This research evaluated attitude and behavior change associated with an outreach intervention designed to change residential bear-related behavior and reduce conflict. Based on the Elaboration Likelihood Model of persuasive communication, the New York NeighBEARhood Watch (NYNW) pilot program aimed to change 6 residential human behaviors (i.e., bird feeding, pet feeding, composting, garbage storage, grill storage, hobby farming) and reduce human-black bear conflict.

Gore, M. L., Knuth, B. A., Scherer, C. W., & Curtis, P. D. (2008). Evaluating a Conservation Investment Designed to Reduce Human–Wildlife Conflict. *Conservation Letters*, 1(3), 136-145. <https://doi.org/10.1111/j.1755-263X.2008.00017.x>

Outreach programs are interventions that have the potential to influence the unique context of human-wildlife conflict as well as the political, economic, and social systems within which human-wildlife conflict occurs. However, evaluation of these programs is limited. The purpose of this research was to determine a human-wildlife conflict outreach intervention's effect on environmentally responsible behavior using the case of human-black bear conflict in New York, The New York NeighBEARhood Watch Program, and the Elaboration Likelihood Model. We found no short-term evidence of environmentally responsible behavior change after the program was implemented. We discuss inhibitors of desired program impact and the utility of our evaluation framework to measure program effect. Given the staying power of outreach interventions and their unknown effects on mitigating human-wildlife conflict, it is imperative that evaluation of programs be a required part of their implementation. Results presented herein can advance discussion about the role of outreach interventions by highlighting assumptions, realistic expectations, and outcome measures.

Guerra, A. S. (2019). Wolves of the Sea: Managing Human-Wildlife Conflict in an Increasingly Tense Ocean. *Marine Policy*, 99, 369-373. <https://doi.org/10.1016/j.marpol.2018.11.002>

Human-wildlife conflict has been receiving increased scientific and management attention, predominantly in terrestrial systems, as a side effect of successful predator conservation and recovery. These same conflicts exist in the ocean; however, they are mostly regarded in a region- or taxa-specific context despite evidence that human-wildlife conflict is prevalent across the global oceans and likely to increase as a result of successful conservation measures. Can the lessons learned from conflicts on land promote more sustainable success in the sea? Or, do ocean human-wildlife conflicts create unique challenges that require new solutions? This paper synthesizes evidence from human-wildlife conflicts in the ocean and provides initial suggestions for progressing with effective management in the ocean. Humans have extensive experience managing conflict with terrestrial predators and several of the strategies are transferable to marine predators, but several important differences between systems necessitate a marine-specific focus and evaluation of existing mitigation strategies. Further, in managing marine wildlife conflict, it is crucial to recognize that perceived conflicts can be just as important as actual conflict and that, in many cases, human-human conflict is at the root of human-wildlife conflict. As efforts to recover important predator populations continue, humans are faced with the exciting opportunity and a new necessity to constructively manage these recoveries to continue to meet goals for marine conservation while simultaneously promoting human safety and industry in the seas.

Johansson, M., Frank, J., Stoen, O. G., & Flykt, A. (2017). An Evaluation of Information Meetings as a Tool for Addressing Fear of Large Carnivores. *Society & Natural Resources*, 30(3), 281-298.  
<https://doi.org/10.1080/08941920.2016.1239290>

Managing authorities in Scandinavia arrange public information meetings when members of the public express fear because wolves or brown bears approach human settlements. This study aimed to increase the understanding of the potential effect of information meetings on self-reported fear of wolves and brown bears. In total, 198 participants completed questionnaires before and after the information meetings. Nine follow-up interviews were held 1 year later. The quantitative analyses revealed that participants who found the information credible reported a significant increase in social trust and a decrease in vulnerability and fear. The qualitative analyses pointed to the importance of information content and meta-communication, for example, nonverbal cues. It is proposed that, among participants who find the information credible, information meetings may change the appraisal of wolves and brown bears, and therefore they might prove useful as an intervention to address fear of these animals.

Johnson, H. E., Lewis, D. L., Lischka, S. A., & Breck, S. W. (2018). Assessing Ecological and Social Outcomes of a Bear-Proofing Experiment. *Journal of Wildlife Management*, 82(6), 1102-1114.  
<https://doi.org/10.1002/jwmg.21472>

Human-black bear conflicts within urban environments have been increasing throughout North America, becoming a high priority management issue. The main factor influencing these conflicts is black bears foraging on anthropogenic foods within areas of human development, primarily on residential garbage. Wildlife professionals have advocated for increased bear-proofing measures to decrease the accessibility of garbage to bears, but little research has been conducted to empirically test the effectiveness of this approach for reducing conflicts. Between 2011 and 2016, we conducted a before-after-control-impact experiment in Durango, Colorado where we distributed 1,110 bear-resistant trash containers, enhanced education, and increased enforcement to residents in 2 treatment areas, and

monitored 2 paired control areas. We examined the ecological and social outcomes of this experiment, assessing whether bear-resistant containers were effective at reducing conflicts; the level of public compliance (i.e., properly locking away garbage) needed to reduce conflicts; whether the effectiveness of bear-resistant containers increased over time; and if the distribution of bear-resistant containers changed residents' attitudes about bear management, support for ordinances that require bear-proofing, or perceptions of their future risk of garbage-related conflicts. After the bear-resistant containers were deployed, trash-related conflicts (i.e., observations of strewn trash) were 60% lower in treatment areas than control areas, resident compliance with local wildlife ordinances (properly locking away trash) was 39% higher in treatment areas than control areas, and the effectiveness of the new containers was immediate. Conflicts declined as resident compliance with wildlife ordinances increased to approximately 60% (by using a bear-resistant container or locking trash in a secure location), with minor additional declines in conflicts at higher levels of compliance. In addition to these ecological benefits, public mail surveys demonstrated that the deployment of bear-resistant containers was associated with increases in the perceived quality of bear management and support for ordinances that require bear-proofing, and declines in the perceived risk of future trash-related conflicts. Our results validate efforts by wildlife professionals and municipalities to reduce black bear access to human foods, and should encourage other entities of the merits of bear-proofing efforts for reducing human-bear conflicts and improving public attitudes about bears and their management.

Lu, H., McComas, K. A., Buttke, D. E., Roh, S., & Wild, M. A. (2016). A One Health Message About Bats Increases Intentions to Follow Public Health Guidance on Bat Rabies. *PloS One*, 11(5), 8. <https://doi.org/10.1371/journal.pone.0156205>

Since 1960, bat rabies variants have become the greatest source of human rabies deaths in the United States. Improving rabies awareness and preventing human exposure to rabid bats remains a national public health priority today. Concurrently, conservation of bats and the ecosystem benefits they provide is of increasing importance due to declining populations of many bat species. This study used a visitor-intercept experiment (N = 521) in two U. S. national parks where human and bat interactions occur on an occasional basis to examine the relative persuasiveness of four messages differing in the provision of benefit and uncertainty information on intentions to adopt a rabies exposure prevention behavior. We found that acknowledging benefits of bats in a risk message led to greater intentions to adopt the recommended rabies exposure prevention behavior without unnecessarily stigmatizing bats. These results signify the importance of communicating benefits of bats in bat rabies prevention messages to benefit both human and wildlife health.

Lu, H., Siemer, W. F., Baumer, M. S., Decker, D. J., & Gulde, A. (2016). Effects of Message Framing and Past Experience on Intentions to Prevent Human-Coyote Conflicts. *Human Dimensions of Wildlife*, 21(6), 506-521. <https://doi.org/10.1080/10871209.2016.1198852>

To test the effects of message framing on intentions to participate in seven behaviors to prevent coyote problems, we randomly assigned 461 participants to a control (no message) group or one of four experimental (message) conditions, as part of a 2 (gain versus loss) x 2 (family-referencing versus community-referencing) between-subjects factorial design. We found a significant three-way interaction between gain versus loss framing, point of reference, and past experience with coyotes on intentions to

prevent human-coyote conflicts. For people who had encountered coyotes before, the family-referencing, gain-framed message had superior persuasive power; the family-referencing, loss-framed message was more effective in stimulating problem-prevention behavioral intentions for those who had not encountered coyotes. In addition, fear fully mediated the relationship between the three-way interaction and behavioral intentions. Tailoring messages to audiences based on prior experience with coyote problems may improve the efficacy of communication campaigns designed to reduce problem interactions with coyotes.

Marion, J. L., Dvorak, R. G., & Manning, R. E. (2008). Wildlife Feeding in Parks: Methods for Monitoring the Effectiveness of Educational Interventions and Wildlife Food Attraction Behaviors. *Human Dimensions of Wildlife*, 13(6), 429-442. <https://doi.org/10.1080/10871200802270158>

Opportunities to view and interact with wildlife are often an important part of high quality recreational experiences. Such interactions frequently include wildlife feeding, resulting in food-conditioned behaviors that may cause harm to both wildlife and visitors. This study developed and applied efficient protocols for simultaneously evaluating wildlife feeding-related behaviors of visitors and related foraging behaviors of chipmunks along a trail in Zion National Park. Unobtrusive observation protocols permitted an evaluation of educational messages delivered, and documentation of wildlife success in obtaining human food and the strength of their food attraction behavior. Significant improvements were documented for some targeted visitor behaviors and human food available to chipmunks, with minor differences between treatments. Replication of these protocols as part of a long-term monitoring program can help protected area managers evaluate and improve the efficacy of their interventions and monitor the strength of food attraction behavior in wildlife.

Marzano, M., & Dandy, N. (2012). Recreationist Behaviour in Forests and the Disturbance of Wildlife. *Biodiversity and Conservation*, 21(11), 2967-2986. <https://doi.org/10.1007/s10531-012-0350-y>

Forests are popular locations for outdoor recreation and there is considerable evidence highlighting the positive social impacts of these activities. There is also a body of research outlining the range of potentially negative impacts of recreation on wildlife and habitats. This paper provides a summary of current social and natural scientific knowledge on disturbance caused by walking, cycling, mountain biking, horse riding, off-road vehicles use, camping, and some other recreational activities in forests. We identify more than 40 ecological studies of recreational impacts on forests. Greatest attention has been directed towards walking as an activity and the impacts upon birds, soils and flora although long-term ecological studies of wildlife or habitat disturbance are scarce. Impacts include trampling by foot, hoof and tyre, animal behaviour change and the spread of pests and pathogens. Considerably less work has been carried out on the social dimensions of recreational disturbance. In this article the authors draw on behaviour theory in an attempt to identify the key factors influencing human behaviour in the context of recreational disturbance. Cognitive theories highlight the importance of attitudes and behavioural control, whilst social practice theories emphasise the impact of behavioural routines and contexts. Management actions may be better targeted at promoting alternative behaviours rather than trying to prevent current 'problem' behaviours. We advocate greater engagement with these theories to better integrate social science with ecological studies, and improve understanding and management of interactions between recreation needs and conservation.

Murphy, R., Scyphers, S., & Grabowski, J. (2018). Perceptions Outweigh Knowledge in Predicting Support for Management Strategies in the Recreational Striped Bass (*Morone saxatilis*) Fishery. *Marine Policy*, 97, 44-50. <https://doi.org/10.1016/j.marpol.2018.08.007>

Considering that recreational fisheries represent tightly bound social-ecological systems, the development of effective and holistic policy should involve the consideration of stakeholder interests and behaviors. Yet, integrating stakeholders' input in fisheries management requires understanding and representing their different values, attitudes, and beliefs. Using survey data from recreational Striped Bass (*Morone saxatilis*) anglers in Massachusetts, this study examined relationships among angler knowledge and perceptions, fishing characteristics, and support for various fishery management measures (e.g., slot limit, reduced bag limits). Results revealed that most anglers underestimated the age at which female Striped Bass reach sexual maturity and the age at which Striped Bass grow to 40 " in length. Estimated ages for both metrics increased with fishing experience, but estimates were not influenced by other angler characteristics. Importantly, while precise knowledge of Striped Bass age at maturity (i.e., proximity to actual age at maturity according to the literature) was not correlated with support for more restrictive fishing policies, anglers that believed Striped Bass mature at older ages (i.e., angler perceptions) were more supportive of these policies. Given that a large majority of anglers underestimate Striped Bass age at maturity, initiatives to communicate Striped Bass biology to the angling public could further enhance support. Collectively, these findings illustrate how stakeholder perceptions may influence angler support for fisheries management policies.

Orams, M. B., & Hill, G. J. E. (1998). Controlling the Ecotourist in a Wild Dolphin Feeding Program: Is Education the Answer? *The Journal of Environmental Education*, 29(3), 33-38. <https://doi.org/10.1080/00958969809599116>

The effectiveness of an education program for tourists who hand-feed wild dolphins at Tangalooma, Moreton Island, in eastern Australia, was evaluated. Data were gathered on tourist behavior during feeding sessions before and after the education policy was implemented. Results demonstrated that, after implementation of the education program, inappropriate behaviors such as touching of dolphins were significantly reduced. The study supports the claim that education is an important strategy when compliance with management regulations is necessary to protect wildlife in ecotourism settings.

Senigaglia, V., New, L., & Hughes, M. (2020). Close Encounters of the Dolphin Kind: Contrasting Tourist Support for Feeding Based Interactions with Concern for Dolphin Welfare. *Tourism Management*, 77, 11. <https://doi.org/10.1016/j.tourman.2019.104007>

The tourism demand for close interactions with wildlife has increased in the last few decades. At the same time, public concern for animal welfare has also increased. Tourists are drawn to the thrill of close encounters with charismatic wildlife in their natural setting which depend on the reliability of wildlife being in a certain place at a given time. Food provisioning is a form of operant conditioning that uses food rewards to attract wildlife, promoting spatially and temporally reliable wildlife encounters that satisfy the desire for close encounters with wildlife. However, a range of effects counter to wildlife

welfare and conservation may result from both the provisioning and close encounters. Our study examines visitors' attitude and support towards regulated provisioning and identifies a gap between visitors' desire for close-up encounters, their concern for dolphin welfare and the documented negative impacts of close encounters and food-provisioning.

Swindall, J. E., Ober, H. K., Lamont, M. M., & Carthy, R. R. (2019). Informing Sea Turtle Outreach Efforts to Maximize Effectiveness. *Wildlife Society Bulletin*, 43(3), 436-446.

<https://doi.org/10.1002/wsb.1004>

Most sea turtle (Cheloniidae) species worldwide are endangered or threatened, with threats causing harm to sea turtles predominantly human-induced. Thus, prevention of further declines to these imperiled species will require alteration of human behaviors. Regulations, incentives, and environmental education are 3 strategies that could be used to alter human behavior. Our goal was to determine how to maximize effectiveness of one of these strategies?education efforts. We investigated knowledge deficiencies and light pollution behaviors of individuals living in a region with nesting sea turtles, in an effort to determine the best approach to promote sea turtle conservation. During 2014, we mailed a survey to 3,000 property owners in 4 coastal counties in Florida, USA, to achieve 3 objectives: assess what topic areas were misunderstood; discern who had knowledge deficiencies; and determine who had adopted turtle-friendly lighting practices. The best predictors of knowledge included geographic factors (county, proximity of residences to the beach), demographic characteristics (age), and behaviors (individual's beach visitation rates). One practice that can reduce harm to sea turtles was common: use of window treatments to reduce light pollution. However, other practices harmful to sea turtles were prevalent, including long durations of use of outdoor lighting and use of light bulbs with wavelengths that can disturb sea turtles. Our results suggest that educational efforts could be enhanced by specifically focusing on increasing awareness of the effects of human actions on sea turtles, targeting individuals who visit the beach infrequently and live far from it to foster greater connection with these ecosystems, and publicizing a variety of options that could reduce harm to sea turtles so individuals feel a sense of freedom of choice.

Triezenberg, H. A., Gore, M. L., Riley, S. J., & Lapinski, M. K. (2014). Persuasive Communication Aimed at Achieving Wildlife-Disease Management Goals. *Wildlife Society Bulletin*, 38(4), 734-740.

<https://doi.org/10.1002/wsb.462>

Achieving an adequate hunter harvest of game animals that meets wildlife-disease management objectives is a challenge if hunters perceive too few animals relative to expectations. Persuasive communication is a strategy commonly used to influence human perceptions, attitudes, and behaviors in public health. Research on effectiveness of persuasive communication in the context of wildlife-disease management is limited, however, which reduces the utility of communication as a management option. To gain insight into the effectiveness of persuasion in wildlife management, we experimentally evaluated a communication campaign aimed at influencing hunters' perceptions and behavioral intentions to harvest more antlerless white-tailed deer (*Odocoileus virginianus*). Reduction of deer density is a prevailing management technique where bovine tuberculosis (*Mycobacterium bovis*) exists in wild deer populations. In 2012, we conducted an experiment with pre-and post-exposure self-administered mail questionnaires to survey deer hunters in Michigan, USA. Campaign materials were



direct mailed with the post-exposure survey. Paired change score analysis was used to evaluate effects of exposure to campaign materials for an intervention relative to control group. Respondents exposed to persuasive communication materials (n = 480) reported changes in perceptions of what others are doing, perceptions of risks from bovine tuberculosis, and behavioral intentions toward hunting and harvesting more antlerless deer. Changes in perceptions of risks from disease management policies negatively affecting deer hunting also were reported in the exposure group. Our results reveal communication can be most persuasive when it focuses on the activity of interest (deer hunting), communicates goals of management (wildlife-disease management), and communicates actions individuals (deer hunters) can take to reduce risks.

Vail, C. S. (2016). An Overview of Increasing Incidents of Bottlenose Dolphin Harassment in the Gulf of Mexico and Possible Solutions. *Frontiers in Marine Science*, 3, 7.  
<https://doi.org/10.3389/fmars.2016.00110>

The panhandle region of the Gulf of Mexico is known by scientists, regulatory agencies and conservation organizations as a "hotbed" area of dolphin harassment. Interactions between humans and wild dolphins routinely occur through close vessel approaches or through direct contact associated with commercial or recreational fisheries, swim-with, or feeding activities. Such interactions are of serious concern for wild dolphin welfare and conservation under the U.S. Marine Mammal Protection Act, as well as for human safety. In recent years, an alarming number of dolphins in this region have been fatally wounded by gunshot, hunting arrows, or sharp tools (i.e., screwdriver). The potential to mitigate the detrimental impacts resulting from these human-dolphin encounters requires a comprehensive outreach strategy to address increasing incidents of harassment and vandalism, as well as an evaluation of the serious trends and challenges hampering dolphin protection in this region. In addition to the identification and conviction of perpetrators through the application of existing law, voluntary outreach programs offer real potential to educate and reform public attitudes and behaviors through community-based stewardship initiatives, which can foster dolphin protection in areas of high human-dolphin conflict. The development of these types of programs underlines the potential for non-regulatory approaches to serve as an effective means to reach and activate the public on some of the most pressing local and regional marine conservation issues. In tandem with regulations and enforcement, voluntary stewardship programs can provide stakeholders an opportunity to engage in local dolphin conservation efforts through a positive approach aimed to inspire accountability.

Ward, C., Taylor, J., & Martin, S. (2011). *Evaluation of Communication Strategies to Mitigate Visitor Use Impacts on Marbled Murrelets*. Humboldt State University Retrieved from  
<https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=46141>

Marbled murrelet and corvid interpretation effectiveness was studied in Redwood National and State Parks (RNSP). The Park is located along the northern coast of California, and it attracts visitors from all over the United States and the world. The summer months are the busiest time of year.; The National Park Service and California State Parks have put a great deal of effort into their murrelet messaging. The study objectives are to evaluate the murrelet interpretive materials using best practices in the field of interpretation and to gather information from visitors about what messages they remember and their attitudes toward murrelets.; On-site data collection occurred from May through July 2010. Three



instruments were used to collect data from visitors -- a survey was completed by 650 visitors, interviews were conducted with 179 visitors, and observations were made of 596 visitors.; Data was collected at Prairie Creek Redwoods State Park, Del Norte Coast Redwoods State Park, and Jedediah Smith Redwood State Park. There were several sampling sites within each of these parks.

Ward, C. J., Martin, S. R., & Taylor, J. (2011). *Design and Evaluate Communication Strategies to Mitigate Visitor Use Impacts at Pelican and Cormorant Non-Breeding Sites*. Humboldt State University Department of Environmental Science and Management, Retrieved from <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=45628>

The purpose of this study was to design, implement and evaluate communication strategies needed to effectively protect roosting and resting seabirds, primarily the brown pelican and cormorants, and meet the needs of both the visitors and land managers. The study occurred in three phases. Develop appropriate educational and interpretive messages and interventions to reduce depreciative behavior, educate the public, and promote positive attitudes toward protection of targeted species and habitats (Phase I), design and implement the interpretive interventions (Phase II), and assess the overall effectiveness of those interventions, and produce a final report with transferrable models for behavioral-modification techniques for wildlife-human interactions (Phase III).

Whitty, T. S. (2018). Conservationscapes: An Interdisciplinary Framework to Link Species-Focused Conservation to Human Systems. *Frontiers in Ecology and the Environment*, 16(1), 44-52. <https://doi.org/10.1002/fee.1750>

Effective conservation of species requires an understanding of both the ecological characteristics of threats to the species in question, as well as the social and governance context of those threats. However, data on such characteristics and context are often lacking. This paper proposes the conservationscape framework as a guide for filling these data gaps, through interdisciplinary research that links species-focused conservation to a broader, human-inclusive understanding of threats and possible solutions. This framework, adapted from other social?ecological system frameworks, outlines (1) basic characteristics of species and the threats they face, (2) social factors (including economic and cultural factors) that influence human activities linked to these threats, and (3) governance context, or how human activities are managed (eg through regulations or institutions). The accidental capture, or bycatch, of marine mammals specifically, Irrawaddy dolphins (*Orcaella brevirostris*) by small-scale fisheries offers a practical example of how this framework can be used to develop a holistic understanding of conservation threats and possible solutions. For many conservation issues, this framework could help provide critical information, elucidate patterns and priorities through cross-site comparisons, and reduce the gap between research and effective conservation by informing solutions that integrate the human dimension.

Zeppel, H., & Muloin, S. (2008). Conservation Benefits of Interpretation on Marine Wildlife Tours. *Human Dimensions of Wildlife*, 13(4), 280-294. <https://doi.org/10.1080/10871200802187105>

Marine wildlife tours provide a range of education and conservation benefits for visitors. These benefits derive from interpretation programs and close personal encounters with marine wildlife. Interpretive information covers the biology, ecology and behaviors of marine species, best practice guidelines, and human threats to marine life. There has been limited assessment of interpretation on marine wildlife tours to identify whether these increase tourist knowledge and promote changes in environmental attitudes. This article reviews the educational benefits of guided marine wildlife experiences with dolphins, whales, and marine turtles using Oram's (1999) framework of outcome indicators to manage marine tourism. The key indicators assessed in this article are education/learning and attitude/belief changes in visitors that benefit marine wildlife. This analysis found tourist learning during mediated encounters with marine wildlife contributes to pro-environmental attitudes and on-site behavior changes, with some longer-term intentions to support and engage in marine conservation actions. Areas of research are suggested to examine the causal links between wildlife interpretation and pro-environmental outcomes.

## Part 2.4 – Place Conservation

Abdullah, S., Samdin, Z., Ho, J. A., & Ng, S. I. (2019). Sustainability of Marine Parks: Is Knowledge-Attitude-Behaviour Still Relevant? *Environment Development and Sustainability*, 28. <https://doi.org/10.1007/s10668-019-00524-z>

Marine parks were established to protect the diverse marine ecosystem in Malaysia, and over the years, the islands have attracted an increasing number of tourists. These marine park islands have become not only one of the top ecotourism destinations in Malaysia but an important contributor to the socio-economic growth of the nation. Nonetheless, it is a constant challenge to maintain the marine parks' natural charm due to negative tourism impacts. Humans' consumption behaviour has been identified as a driver of climate change. Given that humans' contribution to the problem is closely related to sustainable behaviour, this study focuses on tourists' behaviour. With the growing awareness on global environmental challenges, environmental knowledge has often been prescribed as one of the main precursors of tourists' behaviour, yet few studies have attempted to assess this factor from different dimensions. This paper examines tourists' environmental knowledge from a multidimensional aspect of factual, conceptual and procedural dimensions to determine its role in influencing attitude and responsible environmental behaviour. A face-to-face survey was conducted among 85 domestic and international marine park tourists, and data were analysed using PLS-SEM method. This preliminary study revealed that environmental knowledge is formatively represented by factual, conceptual and procedural dimensions. Furthermore, results confirmed the linear relationships between knowledge, attitude and behaviour with knowledge as a strong predictor of attitude that leads to higher pro-environmental behaviours, hence highlighting the importance of promoting environmental knowledge among marine park tourists who drives pro-environmental attitude and responsible behaviour to achieve a sustainable ecotourism development.

Abrams, K. M., Leong, K., Melena, S., & Teel, T. (2020). Encouraging Safe Wildlife Viewing in National Parks: Effects of a Communication Campaign on Visitors' Behavior. *Environmental Communication-A Journal of Nature and Culture*, 14(2), 255-270. <https://doi.org/10.1080/17524032.2019.1649291>

Seeing wildlife in natural habitat is an exciting and powerful experience for national park visitors but is risky for visitors and wildlife alike. National parks have long used educational approaches to inspire visitors to engage in conservation behavior and protect themselves from harm. With record visitation in recent years, national parks must hone their communication strategies that support wildlife conservation and reduce wildlife-caused injuries to visitors. We tested a campaign that strongly promoted the visitor's experience as it aligns with wildlife protection. We measured its effect on how close people approached wildlife in four US national parks. The campaign resulted in fewer visitors observed within unsafe distances to wildlife in three of the four parks. We recommend parks use messages emphasizing the visitor experience gained by engaging in the desired behavior rather than messages that only highlight the importance of wildlife protection.

Cvitanovic, C., van Putten, E. I., Kelly, R., Feldman, H. R., van Steveninck, T. J., Mackay, M., . . . Gourlay, T. (2020). Engaging More Effectively with Visitors to Coastal Regions for Improved Management Outcomes: Insights from the Ningaloo Coast, Australia. *Frontiers in Marine Science*, 7, 14. <https://doi.org/10.3389/fmars.2020.00583>

A key component of successful coastal management efforts is an effective communication and engagement strategy focused on raising awareness of a region to different stakeholders to encourage more pro-environmental behaviors. Accordingly, in recent times there has been a proliferation of research focused on improving engagement and communication with different users of the coastal environment. Despite this effort, a paucity of evidence is available to guide better communication and engagement with visitors (i.e., tourists). Addressing this knowledge gap is critical given the adverse impacts of current global coastal tourism on ecosystem health, and projected future increases in coastal tourism. Using a case study of the Ningaloo Coast World Heritage Area (WHA) in Australia, we contribute toward filling this gap by identifying visitors' perception of the region and their self-reported and intended pro-environmental behaviors. We also identify the types of information they access and trust, and explore whether different message framings on the value of the WHA influence visitors' intended pro-environmental behavior. We determine that although visitors to the Ningaloo Coast WHA are optimistic about the future sustainability of the region, they have low understanding of the rules and regulations in place to support its management. Further, we find that visitors consider tourism to be a serious threat to the future of the region. However, most participants in our study considered the quality of their own environmental behavior to be high, and thus not contributing to these threats, although this did differ by gender. Finally, we highlight that visitors to the Ningaloo Coast WHA, for the most part, obtain their knowledge of the region during their visit, primarily through local signage and visitors centers. We discuss the implications of these results, and highlight future considerations for coastal managers when developing visitor-focused communication and engagement strategies.

Gkargkavouzi, A., Paraskevopoulos, S., & Matsiori, S. (2020). Public Perceptions of the Marine Environment and Behavioral Intentions to Preserve It: The Case of Three Coastal Cities in Greece. *Marine Policy*, 111, 18. <https://doi.org/10.1016/j.marpol.2019.103727>

This study explored public perceptions of the marine environment in three coastal communities in Greece and further investigated intentions to adopt behaviors that contribute to marine conservation. We used the Theory of Planned Behavior (TPB) to study the psychological determinants of behavioral intentions. The findings indicated that respondents have positive attitudes, moderate knowledge of marine issues, and they value the marine environment for the multiple ecosystem services that it provides. Litter and pollution from industry were considered as the most important marine threats, followed by fishing and farming. Participants suggested that informing the public and giving prominence to environmental education can contribute to marine conservation efforts. They felt that research centers and scientific community were more competent than governmental authorities and the private sector concerning the management and protection of the marine environment. Intention to adopt environmental behaviors was influenced by normative considerations, attitudes toward marine biodiversity and perceived behavioral control beliefs. The results may: 1) help inform policymakers to improve marine resource management towards a more sustainable relationship between people and the sea; 2) support the development of marine strategies that fit the social preferences, needs, and priorities to increase the likelihood of public support; and 3) support marine spatial planning efforts to uncover the intrinsic complexity of societal interactions with the marine environment. The findings

further support policymakers that wish to promote behavior change through communication strategies that deliver environmental messages that focus on enhancing normative considerations, behavioral control beliefs, and corresponding attitudes.

Hockett, K. S., Marion, J. L., & Leung, Y. F. (2017). The Efficacy of Combined Educational and Site Management Actions in Reducing Off-Trail Hiking in an Urban-Proximate Protected Area. *Journal of Environmental Management*, 203, 17-28. <https://doi.org/10.1016/j.jenvman.2017.06.073>

Park and protected area managers are tasked with protecting natural environments, a particularly daunting challenge in heavily visited urban-proximate areas where flora and fauna are already stressed by external threats. In this study, an adaptive management approach was taken to reduce extensive off trail hiking along a popular trail through an ecologically diverse and significant area in the Chesapeake and Ohio National Historical Park near Washington DC. Substantial amounts of off-trail hiking there had created an extensive 16.1 km network of informal (visitor-created) trails on a 39 ha island in the Potomac Gorge. A research design with additive treatments integrating educational and site management actions was applied and evaluated using self-reported behavior from an on-site visitor survey and unobtrusive observations of off-trail hiking behavior at two locations along the trail. Study treatments included: 1) trailhead educational signs developed using attribution theory and injunctive-proscriptive wording, 2) symbolic "no hiking" prompter signs attached to logs placed across all informal trails, 3) placement of concealing leaf litter and small branches along initial sections of informal trails, 4) restoration work on selected trails with low fencing, and 5) contact with a trail steward to personally communicate the trailhead sign information. The final, most comprehensive treatment reduced visitor-reported intentional off-trail hiking from 70.3% to 43.0%. Direct observations documented reduction in off-trail hiking from 25.9% to 2.0%. The educational message and site management actions both contributed to the decline in off-trail travel and the two evaluation methods enhanced our ability to describe the efficacy of the different treatments in reducing off-trail travel.

Kelly, R., Fleming, A., & Pecl, G. T. (2018). Social Licence for Marine Conservation Science. *Frontiers in Marine Science*, 5(414). <https://doi.org/10.3389/fmars.2018.00414>

Marine environments are complex and dynamic social-ecological systems, where social perceptions of ocean stewardship are diverse, resource use is potentially unsustainable, and conservation efforts rely strongly on public support or acceptance. Decreasing trust in science in recent years has led to weakened social acceptance and approval of marine conservation science. Social licence is a concept that reflects informal, unwritten public expectations about the impacts and benefits of industry and government practises, including research, on natural resources, including the ocean. Working toward improving social licence may provide opportunity to bolster support for marine conservation, by allowing communities to engage with marine issues and marine science, and voice their concerns and views. Here, we argue that marine conservation requires social licence and we highlight science advocacy, accomplished through outreach, as a means to achieve this. We identify a role for marine conservation science to engage with the public through advocacy to improve understanding and perceptions of conservation. Drawing from the literature, we describe how science advocacy can enhance social licence for marine conservation research and outline four steps that can advise marine

conservation scientists to achieve and promote social licence for their research and the wider marine conservation community.

Kelly, R., Fleming, A., & Pecl, G. T. (2019). Citizen Science and Social Licence: Improving Perceptions and Connecting Marine User Groups. *Ocean & Coastal Management*, 178, 9.  
<https://doi.org/10.1016/j.ocecoaman.2019.104855>

Marine stakeholder groups have diverse relationships with the ocean and life within it, which can create conflict and distrust between them. Citizen science and social licence present promising means to develop dialogue between these diverse marine stakeholders and improve outcomes for marine management. Citizen science can be defined as public engagement in scientific research and activities and amongst other benefits, has been demonstrated to improve communication and relationships amongst resource management and stakeholder groups. Social licence is a concept that reflects unwritten permission from the public for others to use and manage natural resources, and has become an important theme for development in the marine realm. We explore a case-study of the marine citizen science programme Redmap Australia, utilising a mixed-methods approach to understand community perceptions of other marine user groups. We explore how marine users legitimise one another, and how this relates to building relationships and developing social licence. Our results show that participation in citizen science can allow users to display their marine citizenship and shared concern about the marine environment, and that this can allow them to earn trust from other user groups. We conclude that participation in citizen science improves perceptions of trustworthiness and can enhance social licence for marine user groups, with positive implications for marine and coastal management. These outcomes provide fruitful insights on marine resource user groups' perceptions that can help to advise future developments in the growing fields of citizen science practice and citizen science research.

Kolandai-Matchett, K., & Armoudian, M. (2020). Message Framing Strategies for Effective Marine Conservation Communication. *Aquatic Conservation-Marine and Freshwater Ecosystems*, 23.  
<https://doi.org/10.1002/aqc.3349>

Human activities are a major source of threat to marine ecosystems. Solutions thus require changes to or cessation of those activities in addition to multiple restorative and conservation efforts - all of which, in turn, require public support for success. However, scientific understanding of threats to marine ecosystems has not paralleled public understanding of those threats in many jurisdictions. Highly complex, interwoven, distant, vulnerable to multiple stressors, and hosting biota that are biologically unfamiliar to people, marine ecosystems present unique communication challenges. The merits of effective communication capable of motivating behavioural change, policy action and support for marine conservation are often emphasized. To date, however, environmental communication, as a field, has largely focused on terrestrial ecosystems and more recently on climate change, leaving research-informed marine conservation communication neglected. Adding to the small compilation of marine conservation communication literature, this integrative review provides a new understanding of how six message frames (emotional, problem/solution, outcome, value-based, distance, and social norm) can interactively help enhance the effectuality of conservation messages. Insights from the framing-related literature are merged with those from relevant fields including the theoretical literature, and the behavioural, social, and environmental sciences to define concepts, provide examples and explain the

relevance of the six identified frames. The potential strength of these frames are discussed and suggestions on how they might be used to communicate different marine conservation issues are provided.

Lucrezi, S., Esfehiani, M. H., Ferretti, E., & Cerrano, C. (2019). The Effects of Stakeholder Education and Capacity Building in Marine Protected Areas: A Case Study from Southern Mozambique. *Marine Policy*, 108, 103645. <https://doi.org/10.1016/j.marpol.2019.103645>

Stakeholder engagement is a critical component of marine protected area (MPA) management. Education and capacity-building initiatives, in particular, have the potential to empower stakeholders, promote collaboration, create a culture of marine stewardship and encourage alternative and sustainable livelihoods. Empirical evidence on the impacts of these initiatives on stakeholders and MPAs is however still lacking. This study tested the impact of an ocean literacy, marine education and environmental monitoring initiative on stakeholders' views of conservation, community and livelihood in the Ponta do Ouro Partial Marine Reserve (PPMR) in southern Mozambique. Data were collected via two focus groups, one before and one after participation in the initiative. Stakeholders who participated in this research included representatives from governance, tourism and education sectors in the PPMR. Participation in the initiative had a positive effect on stakeholders' views of conservation, community and livelihood. Following the initiative, some of these views became more aligned with the goals of the PPMR, while others highlighted important issues to be addressed by management. This study demonstrates the bilateral nature of stakeholder engagement in MPAs, including stakeholder empowerment and steering management strategies.

Marion, J. L., Dvorak, R. G., & Manning, R. E. (2008). Wildlife Feeding in Parks: Methods for Monitoring the Effectiveness of Educational Interventions and Wildlife Food Attraction Behaviors. *Human Dimensions of Wildlife*, 13(6), 429-442. <https://doi.org/10.1080/10871200802270158>

Opportunities to view and interact with wildlife are often an important part of high quality recreational experiences. Such interactions frequently include wildlife feeding, resulting in food-conditioned behaviors that may cause harm to both wildlife and visitors. This study developed and applied efficient protocols for simultaneously evaluating wildlife feeding-related behaviors of visitors and related foraging behaviors of chipmunks along a trail in Zion National Park. Unobtrusive observation protocols permitted an evaluation of educational messages delivered, and documentation of wildlife success in obtaining human food and the strength of their food attraction behavior. Significant improvements were documented for some targeted visitor behaviors and human food available to chipmunks, with minor differences between treatments. Replication of these protocols as part of a long-term monitoring program can help protected area managers evaluate and improve the efficacy of their interventions and monitor the strength of food attraction behavior in wildlife.

National Park Service. (2016). *Towards an Adaptive Management Approach to Noncompliance in National Park Service Units*. (Natural Resource Report NPS/NRSS/BRD/NRR—2016/1125). Retrieved from <https://irma.nps.gov/DataStore/DownloadFile/546334>



In an effort to protect social and physical environments from the impacts of human behaviors, protected area managers often implement rules and regulations that outline acceptable behaviors in parks. Behaviors that are in violation of these rules and regulations (whether or not their existence is known by the perpetrator) are referred to as non-compliant behaviors. Such non-compliant behaviors are serious concerns to managers of protected areas because of their potential negative impacts on cultural resources, infrastructure, other visitors, and natural resources (Christensen, 1986; Clark, Hendee, & Campbell, 1971). In this literature review, we specifically focus on non-compliant behaviors that affect natural resources. First, we review broad classes of human behaviors that impact natural resources and, more specifically, categorize human behaviors that are non-compliant. Second, we outline different motivations for compliance and non-compliance (i.e., what drives human behavior). Third, we discuss current methods used to detect and monitor non-compliant behaviors in various contexts worldwide. Fourth, we summarize different avenues for addressing non-compliance, including the associated challenges with implementing such approaches. Finally, we suggest an adaptive management framework for identifying, tracking, and addressing non-compliance to help parks and protected areas managers reduce such activity.

Parsons, E. C. M., MacPherson, R., & Villagomez, A. (2017). Marine “Conservation”: You Keep Using That Word but I Don't Think It Means What You Think It Means. *Frontiers in Marine Science*, 4(299). <https://doi.org/10.3389/fmars.2017.00299>

What exactly does “doing conservation” or “incorporating conservation” into ocean science mean? Although today it is often coupled with the sustainable use of natural resources, by definition, conservation traditionally involves the preservation, protection, or restoration of the natural environment or natural ecosystems (Soulé and Wilcox, 1980). In other words, if the conservation intervention is successful then the ecosystem should reflect a better (or perhaps, more commonly, a “less worse”) state as a result. In this context, is simply conducting science conservation? Are outreach and advocacy conservation—whether through old school print and TV/radio broadcasts or through social media such as blogs or building a Twitter following? The field of modern marine conservation is an interdisciplinary one (e.g., van Dyke, 2008; Parsons and MacPherson, 2016) with a landscape that is populated with individuals engaged in science, education, social marketing, economics, resource management, and policy.; ; But how are we measuring our impact considering this diverse field? How do we know that the ecosystems toward which we direct our conservation efforts are “better” or at least “less worse” than they would be without them? Conservation needs to be more than just “being busy” or “feeling” that we are having an impact. And shouldn't we strive to ensure that conservation is not just conversation? How do we connect our actions to ecosystem responses in meaningful time frames?; ; This paper summarizes the results of a focus group discussion session on this topic held at the 2016 International Marine Conservation Congress, St John's, Newfoundland. It aims to assess ways to measure positive effects of marine conservation efforts beyond the “feel good” aspect to demonstrable impact.

Vagias, W. M., Powell, R. B., Moore, D. D., & Wright, B. A. (2014). Predicting Behavioral Intentions to Comply with Recommended Leave No Trace Practices. *Leisure Sciences*, 36(5), 439-457. <https://doi.org/10.1080/01490400.2014.912168>

The purpose of this study was to evaluate the effectiveness of an extended version of the Theory of Planned Behavior (Ajzen, 1991) for predicting backcountry visitors' behavioral intentions to comply with recommended Leave No Trace practices. Once confirmed, factors predictive of behavioral intentions can be used to inform the development of more effective persuasive communication strategies and educational messaging. Study participants were overnight backcountry visitors to either Olympic National Park, Washington, or Glacier National Park, Montana. The final model explained over 44% of the variance in the dependent variable, but significant predictors differed between the two parks. Discussion is provided as well as suggestions for those charged with disseminating Leave No Trace messaging.

Winter, P. L. (2008). Park Signs and Visitor Behavior: A Research Summary. *Park Science*, 25(1), 34-35. Retrieved from <https://www.fs.usda.gov/treearch/pubs/45278>

National park staffs rely on sign to inform visitors of a great variety of expected behaviors. Where park rangers or volunteers physically cannot be present to remind visitors of important rules, signs can be especially helpful. However, as any ranger will attest, signs vary in effectiveness. The reasons for this are numerous, but message content is a critical factor.; Many studies have examined the effectiveness of interventions to reduce the incidence of damage to natural and cultural resources and facilities in outdoor settings. Cialdini et al. (1990, 1991, and 2006) discuss the "Focus Theory of Normative Conduct," which stipulates that social norms can be a powerful influence on human behavior. Normative information either describes typical human behavior (descriptive) or relates desirable behavior in a particular situation (injunctive), and is framed positively (prescriptive) or negatively (proscriptive). Table 1 presents combinations of message patterns that follow this two-by-two conceptualization of norms. These patterns have served as the basis of a series of studies investigating the effectiveness of signs in directing human behavior.

Wyles, K. J., Pahl, S., & Thompson, R. C. (2014). Perceived Risks and Benefits of Recreational Visits to the Marine Environment: Integrating Impacts on the Environment and Impacts on the Visitor. *Ocean & Coastal Management*, 88, 53-63. <https://doi.org/10.1016/j.ocecoaman.2013.10.005>

Marine environments provide a range of important ecosystem goods and services. To ensure the sustainability of this environment, we require an integrated understanding of the activities taking place in coastal environments that takes into account the benefits to human visitors but also the risks to the environment. This paper presents two studies on the perceived risks and benefits associated with recreational visits to rocky shores in the UK and internationally. Marine experts and recreational users of the coast responded to questionnaires that explored the marine awareness and wellbeing effects of different activities on the visitor and, in turn, the perceived harmfulness of these activities to the environment. Two studies found that a visit to a rocky shore was seen to improve visitors' awareness regarding the marine environment as well as their wellbeing (with some activities being calming such as sunbathing and relaxing, and others exciting such as rock pooling). However, this was perceived to be at a cost to the environment, as some activities were noted to have detrimental effects on the habitat. Marine experts and coastal users gave very similar answers, as did British (Study 1) and international respondents (Study 2). Using an integrative approach, the perceived impacts on both the environment and visitor were then explored together. Walking and rock pooling were seen to provide considerable

wellbeing benefits but had high negative impacts on the environment. In contrast, resource focussed activities such as fishing, bait collecting and crabbing were perceived as less important for visitor wellbeing yet also had negative environmental impacts. Using this integrative approach, this analysis begins to suggest priorities for management that benefits both the environment and the recreational users.

Xue, Y. J., Deng, T., & Mao, K. R. (2018). Influencing Factors on the Ecological Protection Behaviors of Entrepreneurial Farmers in Chinese Forest Zones. *Sustainability*, 10(6), 15.  
<https://doi.org/10.3390/su10061827>

Following the collective forest tenure reforms in China, many households pursued entrepreneurial activities creating substantial pressure on the environment. This study examines data collected from 462 informants in 10 provinces in Southern China to understand how changes in attitudes toward ecological protection behavior occur. The internal mechanisms of ecological attitudes were explored using structural equation modeling to obtain a function path. Ecological emotion has a direct effect on ecological protection behavior by acting as an intermediary between ecological knowledge and ecological protection. Perceived ecological severity mediates between ecological knowledge and emotion influencing entrepreneurial farmers' ecological protection behavior. The perception of individual effect is mediated by perceptions of ecological severity and ecological emotion, eventually affecting ecological protection behavior. A model of cognition-emotion-practice is proposed based on the findings.

