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Managing Wildlife and Human Behavior to Address Human–Wildlife Interactions

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National Park Service (NPS) Management Policies (2006) state that the NPS will preserve animals' natural behaviors, and may manage recreational activities that impact park resources. This paper documents a workshop that engaged participants in applying theory to practice, to understand and manage changes in animal and human behavior that may negatively affect wildlife and human health and safety. Session leaders first presented a case study at Redwood National Park that used targeted biological and sociological studies to reduce negative impacts of visitor behavior on the marbled murrelet *(Brachyramphus marmoratus)*, an endangered seabird. We then provided an overview of key principles and foundational concepts of animal behavior and human behavior that can be used to develop management strategies to affect the behavior of animals and people in parks. Our ultimate goal is to synthesize information and recommendations to reduce risks to people and animals and improve management and consistency across the NPS.

Killer potato chips: Adaptive management and visitor behavior change to conserve an endangered seabird

At Redwood National and State Parks, adaptive management principles have been utilized to conserve the endangered marbled murrelet, seabirds which nest in old-growth forest. Marbled murrelets spend much of the year feeding in waters along the Pacific northwest coast. Their nesting behavior was essentially unknown until the 1970s when a nest was discovered high in a redwood tree. It is now known that the majority of California's marbled murrelets nest within Redwood Na-

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tional and State Parks (RNSP). In general, logging is a major threat to this species. However, protected areas such as RNSP have experienced unexplained marbled murrelet population declines.

Recently, park-permitted research using nest cameras revealed high rates of nest predation by corvids (members of the crow family), primarily Steller's jays *(Cyancitta stelleri*; Marzluff and Erik Neatherlin 2006). In addition, elevated Steller's jay densities, and subsequent elevated rates of predation on marbled murrelets, were shown to occur near high-use visitor areas (e.g., campgrounds and picnic areas) because of supplemental food supplied by park visitors (Marzluff and Erik Neatherlin 2006). An increasingly intensive corvid management program that uses visitor education, wildlife-proofing campground infrastructure, and conditioned taste aversion (CTA) has significantly changed over the past seven years, based on feedback from biological and sociological monitoring data as well as numerous targeted scientific studies.

When supplemental feeding of corvids was first identified as the largest threat to the breeding population of marbled murrelets at the park, natural resource managers worked with interpretation staff to develop materials that explained the importance of marbled murrelets, threats of predation from jays and crows, and how people could help by keeping a clean campsite. Nest predation continued, and alternate approaches were sought. The park funded social scientists from Humboldt State University to study people's behavior with respect to food and corvids. They surveyed park visitors, observed visitor behavior, and analyzed the content of interpretive materials.

Research revealed that most supplemental feeding was accidental rather than intentional, that is, from crumbs left on picnic tables, or food scraps in drains where dishes were washed (Ward, et al. 2011). Visitor attitudes were aligned with messages promoting the importance of protecting murrelets and refraining from feeding corvids. However, interpretive messages were too complex and did not include specific targeted behaviors; visitors were not sure what they were supposed to do. Based on this research, we realized we needed "regulatory messaging," which neither interpreters nor wildlife biologists are typically trained to produce.

As a result, the park adopted a new strategy that incorporated key concepts: don't bury the lead, tell people what to do, model the behavior you want to see, and make your messages consistent and ubiquitous. Because the most important behaviors were properly storing food and disposing of garbage, including crumbs, we developed a specific targeted message, "Keep it Crumb Clean," with a logo that illustrated the desired outcome (Figure 1). To make it easier for people to comply, the park provided food storage lockers and wildlife-resistant trash cans. We also installed covers on the drains. The logo and message are repeated on the park website, in newsletters, and in a video that visitors must watch before they can reserve a campsite (https://www.youtube.com/watch?v=8DUcA75bkiA). Visitors who do not comply with these actions are fined. People are also given stickers to wear to show that "I'm Crumb Clean," reminding themselves and others to follow through with their commitment.

To measure the effectiveness of the new strategy, the presence of Steller's jays near campgrounds, picnic areas, and control areas have been monitored. Numbers of jays near campgrounds are starting to decline, although effects are not yet statistically significant.

The park also has been conducting experiments with CTA, a technique that teaches an animal to associate illness with a specific food (Gabriel and Golightly 2011). Steller's jays were exposed to murrelet-colored and sized chicken eggs treated with carbachol, an emetic. In laboratory tests, CTA resulted in aversion to murrelet-mimic eggs that remained constant over eight weeks. In field trials, corvid attacks on murrelets were significantly reduced, indicating that CTA may be an efficient emergency management technique to improve murrelet productivity, used in concert with human behavior modification campaigns.

Figure 1. Keep It Crumb Clean logo. The core message adopted by Redwoods National and State Parks tells people what to do, is easy to remember, and shows the desired behavioral norm.

Managing human-wildlife interactions: Principles of animal behavior change and learning

Parks and protected areas often change the dynamic between people and wildlife. Animals may learn to approach people in search of food, or simply refuse to move when people approach. Managers are concerned about encounters that bring potential risks to both people and wildlife. The field of animal behavior provides crucial insights that can improve management. For example, two terms often used interchangeably, habituation and food conditioning, are actually very different learning processes. Animals that are habituated stop responding to people, whereas positively-conditioned animals seek out rewards from people, usually food (Hopkins et al. 2010; Figure 2).

To help park staff diagnose and manage effects on wildlife from interacting with people, we applied animal behavior principles to a series of steps that parallel established methods used to modify human behavior. For each of these steps, we also developed diagnostic questions and corresponding principles.

Step 1: Select behaviors. First ask whether the behavior you seek to affect is habituation or conditioning. Because food conditioning is associated with a reward, it is very difficult to use management to "unlearn" that behavior. Also, ask whether the behavior is a symptom of a systematic problem. For example, if animals have access to unsecured food, removing one food-conditioned animal will not resolve the underlying issue; other animals are likely to become food-conditioned in the future. From a management perspective, allowing this situation to persist would not be good conservation or stewardship. Key principles associated with this step include the following: have a plan before you act; be proactive, don't wait until an animal is food-conditioned to take action; and consider any parallel actions that must be taken to manage human behavior that is at the root of the problem.

Step 2: Identify attractants and deterrents. Identifying attractants and deterrents is closely related to step one. Because behaviors are responses to stimuli, it is important to ask "what is the

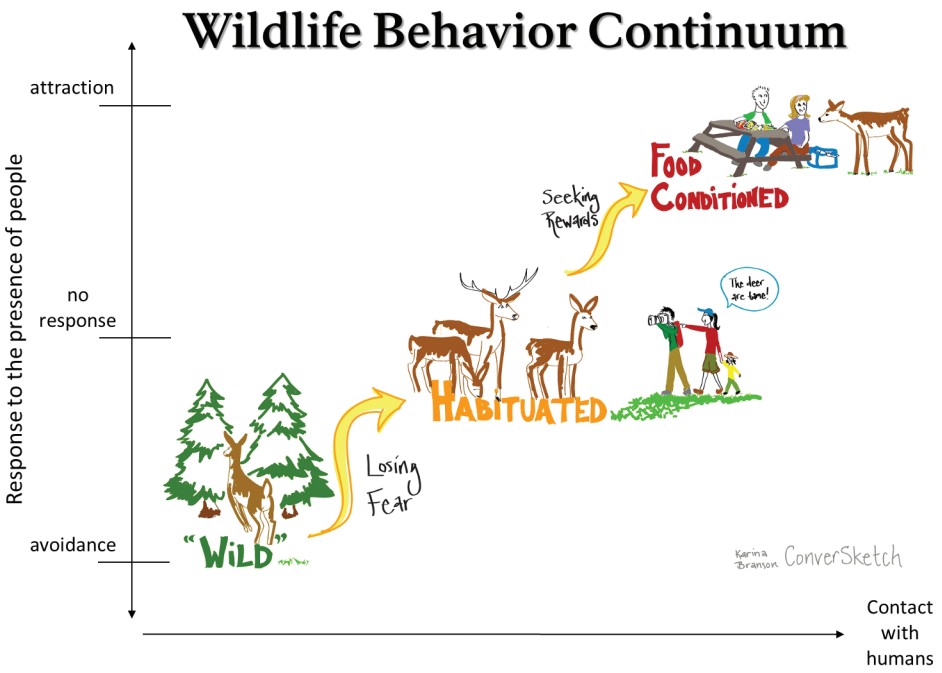

Figure 2. Wildlife behavior continuum. In the absence of active management, animals in parks may change their behavior from what we think of as a "wild" response (avoiding people). Habituation occurs when an animal is repeatedly exposed to a stimulus with neutral consequences and eventually stops responding to that stimulus, e.g., when an animal loses its fear of people. Conversely, conditioning occurs when the animal's response to a stimulus becomes more frequent or intense due to a reward or punishment associated with the stimulus (Hopkins et al. 2010). Food-conditioned animals are attracted to people because they have learned to associate people with food. Aversive conditioning is sometimes used as a management tool to teach animals to associate people or human spaces with negative consequences, regaining a "wild" avoidance response.

stimulus of interest?" Is it presence of people or presence of an attractant associated with people? Deterrents should be related to the stimulus of interest. Animals can form an association between taste and nausea and between sounds and pain, but have difficulty learning to associate pain with taste or sound with nausea (Garcia et al. 1974). This is why aversive conditioning using rubber bullets or bean bags typically will not affect food conditioning; animals may learn to avoid an area (or more likely, to avoid the people in white trucks and green and grey uniforms), but not to avoid human food. CTA can only teach an animal to avoid a specific food, it is not generalizable to other foods or the source of a specific food (e.g., a picnic area). Using CTA for all human foods (e.g., hot dogs, potato chips, sandwiches) is not practical, or safe for the animals. In addition, it is important to consider an individual animal's temperament. Individual animals may be more bold or shy compared to the average disposition in that animal population (Réale et al. 2007), based on their history of exposure to the stimulus, or any social learning they have undergone (e.g., cubs learning from their mothers to rely on human food). Principles associated with this step are matching the management action to the stimulus, and striving to identify the individuals involved in any interaction.

Step 3: Develop strategy. Management actions directed towards animals include CTA (which has limited applications in parks), hazing (aversive conditioning), capture and translocation, and lethal removal. Many of these result in high costs to the animals, may be logistically and socially challenging, and likely do not address the underlying causes of the problem. However, there

may be situations where managing the animal is necessary. In developing a strategy, consider the relative exposure of the animal to management actions versus visitor behavior. Can management actions have enough of a presence to counteract the volume of accidental or intentional visitor actions? Another crucial question is the degree to which human safety is at risk. How important is it to manage the animal immediately? Principles of this step include the following: consider the management context and individual animal's history; translocation or removal (including lethal removal) may be appropriate in certain cases, but must be carefully evaluated.

Steps 4 & 5: Pilot, implement, evaluate. Before putting your management actions into place, determine how you will evaluate whether your management actions are successful. Does your pilot strategy effectively reduce the undesired behavior, or the negative interactions resulting from that behavior? If so, implement more broadly and continue to evaluate. The key principle for these steps is this: good data help managers make good management decisions.

Managing human-wildlife interactions: Principles of human behavior change and learning

In 1943, Aldo Leopold remarked, "the real problem of wildlife management is not how we shall handle [wildlife] … the real problem is one of human management" (quoted in Kellert 1997). Fortunately, a significant amount of work in the fields of social psychology, communication, and human dimensions of natural resources can help managers approach human behavior management logically and effectively.

One approach that lends itself particularly well to managing human behavior is social marketing. Social marketing adapts principles used to entice people to purchase products and directs them at encouraging positive behaviors. Social marketing campaigns emphasize understanding what impedes and motivates a target audience to act in a certain way. Public health campaigns such as smoking cessation and heart disease prevention have been common applications of social marketing. Community-based social marketing (CBSM) focuses on initiatives delivered at the community level to foster sustainable environmental behaviors (McKenzie-Mohr 2011). Examples of community-based social marketing include recycling and composting campaigns, and adoption of water and energy saving practices. The CBSM approach has great potential for managing human behavior in parks. The same steps outlined in the previous section and used in the CBSM approach can be applied.

Step 1: Select behaviors. Consider which audiences are relevant to target and what behaviors you want to promote. To be effective, the selected behaviors need to produce the desired outcome or end-state. For example, you may want visitors to keep a clean campsite. However, keeping a clean campsite can include many different behaviors. Visitors need to collect trash from around the campsite, locate and open wildlife-resistant trash cans, put the trash in, and secure the lid. If they do each one of these behaviors, but do not secure the lid, you haven't reached the desired outcome—just a nice buffet for the bears. In this scenario securing the lid is the desired end-state behavior.

Step 2: Uncover barriers and benefits. The goal with this step is to remove as many barriers to the behavior and increase the perceived benefits. Barriers to a particular behavior maybe internal to an individual—lack of knowledge or motivation, or non-supportive attitudes. Barriers may also be external—without accessible wildlife-resistant trashcans, visitors may find it more convenient to leave their trash than to bring it home with them. Identifying barriers and benefits to the desired behaviors is key to developing a successful campaign. This allows you to carefully target your approach. Literature reviews and observations are two ways to gain a greater understanding of what is motivating and impeding visitor behavior.

Step 3: Develop strategies. The strategies you employ are determined by the behaviors you wish to affect and the identified barriers and benefits. Some activities that have been used effec-

tively in parks to manage behavior include commitments, prompts, and norms.

People who have committed to a small behavior change are more likely to agree to a larger request (McKenzie-Mohr, 2011). People have a strong desire to appear consistent to others. Commitments alter how people perceive themselves and subsequently behave. Point Reyes National Seashore implemented this strategy by alerting visitors to pet restrictions in plover habitats (Adams, et al, 2006). Visitors can make a small verbal commitment to keeping their pets out of plover habitat. They can make that commitment more visible and durable by accepting a leash that says "I love walking on leash at Point Reyes."

Prompts are visual or auditory aids that remind us to carry out an activity that we might forget. To use prompts effectively, they need to be noticeable and in close proximity to where the behavior needs to occur (e.g., signs on picnic tables reminding visitors to keep a clean site), and focus on positive actions so that people feel good about participating.

Norms are guides for how society behaves; we walk on the right side going up and down stairs, we shake hands with our right hand, we talk quietly before a movie starts. Cialdini (2003) studied the use of norms at Petrified Forest National Park. He found that when messages specified how to behave, visitors were less likely to remove petrified wood.

Step 4 & 5: Pilot, implement, evaluate. Test out your strategies to ensure you chose the most effective strategies and implemented them properly. If everything is going smoothly, implement and evaluate. For human behavior, it is important to recognize when the human behavior metric is an intermediate step towards something else, like resource protection. To measure the effectiveness of your behavior change campaign, you need to measure human behavior (which can be difficult), but to measure whether human behavior was the right target, you need to measure resource response.

Discussion

Managing human-wildlife interactions in parks often focuses on managing wildlife to reduce risks to people. Yet, many of the drivers of those interactions are caused by human behavior. By highlighting mechanisms of animal and human behavioral changes, we illustrate the importance of integrating "regulatory messaging" as a core management activity. We hope that the frameworks we provide help managers proactively develop integrative strategies that protect wildlife, and provide safe wildlife viewing opportunities in parks.

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