National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

# Status of Peer-Reviewed Literature on the Human Dimensions of Managing Wildlife Habituation and Food Conditioning in National Parks

Natural Resource Report NPS/BRMD/NRR—2013/628

**ON THE COVER**
Caribou and visitors touring Denali National Park and Preserve (“dena_km_wild_12”)
Photograph by: Kent Miller, courtesy of National Park Service, Denali National Park and Preserve

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February 2013

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

This report received formal peer review by staff in the NPS Biological Resource Management Division (BRMD) who had both biological and social science expertise, and were not directly involved in the collection, analysis, or reporting of the data.

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Please cite this publication as:

Wieczorek Hudenko, H., W. F. Siemer, and D. J. Decker. 2013. Status of peer-reviewed literature on the human dimensions of managing wildlife habituation and food conditioning in National Parks. Natural Resource Report NPS/BRMD/NRR—2013/628. National Park Service, Fort Collins, Colorado.

NPS 909/119761, February 2013

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# Abstract

In 2008 the Biological Resource Management Division of the National Park Service launched a multi-faceted inquiry to inform management of human-wildlife habituation across the National Park system. As part of the inquiry, a literature-based review on this topic was conducted. The goal of the review was to: examine key aspects of the human dimensions of human-wildlife habituation; identify knowledge gaps; and provide recommendations for application of this information to management.

We used keyword and targeted searches of peer-reviewed literature to identify papers for this review. Our search yielded many studies that addressed issues related to habituation, food-conditioning, and management interventions related to human-wildlife interactions. After review, we synthesized the findings and grouped them into categories under common themes: the human dimensions of interventions addressing human-wildlife interactions; the human dimensions of information and education campaigns designed to influence human behavior in other park contexts; recommendations to influence human-wildlife interactions; impacts of habituation, food conditioning, visitation.

Our literature review confirmed that little research has been conducted on the human dimensions of interventions designed to influence wildlife habituation and food conditioning in national parks. The majority of articles focused on wildlife and had human dimensions as a secondary component or discussed human dimensions cursorily in management implications and recommendations. We did, however, identify a substantial amount of literature that dealt with concepts, issues, or methodologies relevant to research and management of human-wildlife interactions in parks. The synthesis of this related work provides some insight to inform future human dimensions inquiry and management approaches.

# Acknowledgments

We sincerely thank all of the regional Natural Resource Chiefs and park staff at individual units who took time to identify and provide documents for this review. We are grateful to the NPS habituation steering committee (S. Bates, B. Connery, D. Foster, R. Gubler, B. Merkle, C. Ogden, P. Owen, J. Schaberl, D. Schirokauer, B. Stiver, and F. Turina) for their assistance coordinating with each region to collect documents. C. Ogden and L. Barish conducted online searches for additional documents and we appreciate their help. K. Leong, the technical advisor for the project, provided important guidance and support throughout the document collection and analysis.

This project was completed as part of Task Agreement J2340100030 of the Great Lakes-Northern Forest Cooperative Ecosystem Studies Unit under Cooperative Agreement H6000082000 between the National Park Service and the University of Minnesota.

Our research was conducted with approval from Cornell University's Institutional Review Board (Protocol ID 0910000976). Daniel J. Decker, Professor and Director, Human Dimensions Research Unit, was the Principal Investigator of this project.

# Introduction

A topic of growing importance within the National Park Service (NPS) is managing human-wildlife interactions on NPS lands. In recent years, the Biological Resource Management Division (BRMD) of NPS has initiated efforts to craft a coordinated (system-wide) approach for response to human-wildlife habituation in parks. BRMD leaders are considering peer-reviewed research and management experience as the foundation for recommendations on managing human-wildlife habituation.

In 2008, NPS entered into a Task Agreement[1] with Cornell University to address multiple information needs associated with management of human-wildlife habituation in national parks.

The task agreement was created to address five objectives:

1. Determine and examine the diversity of experience with, beliefs about, and management priorities related to wildlife habituation and food conditioning in parks and surrounding communities across the system;

2. Identify and prioritize the most urgent management needs related to the human dimensions of human-wildlife habituation in and around protected areas in the US;

3. Synthesize existing literature related to human-wildlife habituation in and around protected areas and identify knowledge gaps;

4. Develop a recommended strategy for initiatives that may best allow wildlife managers to address stakeholder beliefs, attitudes, and behavior that contribute to human-wildlife habituation;

5. Share these findings with other federal and state wildlife management agencies, universities, private land managers, and local municipalities.

This report represents a partial fulfillment of objective three (i.e., Synthesize existing literature related to human-wildlife habituation and identify knowledge gaps). Other activities associated with objective three (e.g., a literature review of human decision making under risk; and a content analysis of NPS management documents) are included in separate Natural Resource Reports.

Wildlife habituation and food conditioning[2] play a significant role in human-wildlife interactions in park units. The processes by which wildlife become habituated or food conditioned, and the

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[1] Task Agreement J2340100030 of the Great Lakes-Northern Forest Cooperative Ecosystem Studies Unit under Cooperative Agreement H6000082000 between the National Park Service and the University of Minnesota.

[2] The distinction between habituation and food conditioning often is not made clear in wildlife research and management. Under this TA, we define the terms as follows. Habituation is the waning of a behavioral response following exposure to a repeated stimulus. Food conditioning is

physiological and ecological consequences of those processes on wildlife have received considerable research attention, especially for a few species (e.g., grizzly bear, black bear, elk). The Cornell research team and NPS Habituation Steering Committee[3] believed that researched-based knowledge about the human dimensions of wildlife habituation and food conditioning (e.g., the relevant motivations, beliefs, attitudes and behaviors of park visitors, neighboring residents, and other park stakeholders) was less developed and had not been synthesized.

## Purpose

Based upon recommendations from the Habituation Steering Committee, guidance from NPS BRMD, and conclusions from exploratory work conducted as part of the habituation project, we conducted a comprehensive search for peer-reviewed literature pertaining to the human dimensions of interventions designed to influence wildlife habituation and food conditioning. The Steering Committee and project team members agreed that conducting such a search was needed to identify human dimensions research needs and to establish an agenda for future research.

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a process of classical conditioning through which animals learn to associate food with the presence of humans or human activity. For further explanation please see the report *Perspectives on human dimensions of wildlife habituation* Natural Resource Report NPS/BRMD/NRR—2013/630.

[3] The steering committee consists of NPS natural resource specialists from each region. The committee was formed in spring of 2008 to guide the exploration of habituation in the NPS context.

# Approach

## Approach to literature search

We developed a list of key search terms that might produce published papers relevant to the project's focus. We conducted keyword searches in three electronic databases: (1) Ecology & Wildlife Worldwide; (2) Web of Science; and (3) Yellowstone Park Science Bibliographic Database. We then conducted three additional steps to supplement our keyword searches: (1) we searched the table of contents for all issues of the Journal of Park & Recreation Administration; (2) we reviewed a database of articles related to habituation that was created for NPS in 2007; and (3) we pulled in citations for literature that we were aware of from our own professional experiences.

Table 1 shows a breakdown of key term combinations and the relevant results of those searches. We used the title and abstract of each document identified in a key word search to evaluate the paper for relevance. Many habituation-related articles identified in our search described neuropsychological and physiological experiments with lab animals or people and were not germane to our focus. Only publications focused on wildlife and some aspect of wildlife habituation or food conditioning were added to a catalog of articles. We cast a broad net under this topic however; we did not select human dimensions papers exclusively at this point.

Next, we read manuscript abstracts and placed publications into categories. We used an iterative process of manuscript searches, manuscript reading and grouping, and additional searches with new key words. We continued with searches until we reached a point of saturation (i.e., new searches were locating previously identified publications).

We prepared two products to address the recommendations of the Habituation Steering Committee: (1) a brief synthesis of research identified in searches of peer-reviewed literature; and (2) a catalog of articles related to the topic and identified in the literature. The catalog is presented here as an appendix.

## Limitations

Our goal was to review published literature on the topic of management interventions (e.g. education programs, signage, regulations) to address the human dimensions of human-wildlife interactions in parks. Given this relatively narrow focus, our search necessarily excluded information that may be available in gray literature. While we did not actively search for papers or reports in this literature, we nevertheless identified a number of items potentially relevant to our topic of interest. When these items were accessible, we examined them and included a citation for them in the catalog of articles.

We also recognize that other peer-reviewed literature on our topic may be available, but simply was not found using our keyword search method. We made every effort within the confines of our protocol to pursue search paths that might lead us to our target literature. For instance, we explored broader categories, such as bear management, for studies that might address our topic but perhaps did not directly include an intervention, or specific examination of habituation and human-wildlife interactions. We used this technique when we had reason to believe it would produce relevant literature and when the topic was able to produce search results we could reasonably examine. To expand this effort further (i.e., to review all papers on educational

interventions in parks, or human-wildlife interactions) would stray too far beyond the scope of this activity.

Table 1. Literature review on wildlife habituation and food conditioning in national parks.

| Database used | Key words | # articles identified | # relevant articles |
|---|---|---|---|
| Wildlife and Ecology Worldwide | Habituation | 799 | 60 |
| Yellowstone Park Science Bibliographic Database | Habituation | 8 | 8 |
| Wildlife and Ecology Worldwide | Habituation AND intervention | 6 | 2 |
| Web of Science | Habituation AND intervention | 64 | 1 |
| Yellowstone Park Science Bibliographic Database | Habituation AND intervention | 0 | 0 |
| Wildlife and Ecology Worldwide | Habituation AND education | 10 | 4 |
| Web of Science | Habituation AND education | 41 | 3 |
| Wildlife and Ecology Worldwide | Habituation AND communication | 60 | 1 |
| Web of Science | Habituation AND communication | 118 | 0 |
| Web of Science | Habituation AND wildlife | 10 | 3 |
| Wildlife and Ecology Worldwide | Habituation AND wildlife | 126 | 23 |
| Wildlife and Ecology Worldwide | Bear AND habituation[4] | 23 | 19 |
| Wildlife and Ecology Worldwide | Bear AND education AND national park | 14 | 4 |
| Wildlife and Ecology Worldwide | Ground squirrel AND habituation | 4 | 1 |
| Wildlife and Ecology Worldwide | Marmot AND habituation | 9 | 1 |
| Yellowstone Park Science Bibliographic Database | Food conditioning | 1 | 1 |
| Wildlife and Ecology Worldwide | Food conditioning AND intervention | 364 | 6 |
| Web of Science | Food conditioning AND communication | 28 | 0 |
| Wildlife and Ecology Worldwide | Food conditioning AND communication | 392 | 5 |
| Web of Science | Food conditioning AND education | 9 | 2 |
| Wildlife and Ecology Worldwide | Food conditioning AND education | 362 | 8 |
| Web of Science | Food conditioning AND national park | 6 | 5 |
| Wildlife and Ecology Worldwide | Food conditioning AND national park | 3 | 3 |
| Web of Science | Wildlife management AND national park | 247 | 3 |

[4] We conducted a few representative species-specific searches to ensure the comprehensiveness of our general term searches. We were aware that bears are often the focus of studies in parks, so we searched using this term to verify that we had captured the relevant articles. Other work on the project identified small mammals as animals visitors frequently interact with, yet our general searches turned up relatively few articles on these species. Thus, we conducted focused searches using "ground squirrel" and "marmot" to determine that we had identified the relevant articles.

## Approach to report

During our search of the published literature, we identified many studies that addressed issues related to habituation, food-conditioning, and management interventions related to human-wildlife interactions. The specific focus of the articles spanned a broad spectrum. For this synthesis report, we concentrated only on published articles that we identified under our search protocol that had direct relevance to our topic. After reviewing the articles, we synthesized the findings and grouped them into categories under common themes. The amount of literature available under each theme was inversely related to the relevance of the theme to our specific topic. The topic of our review (i.e., the human dimensions of interventions addressing human-wildlife interactions) was the category for which we found the fewest articles. We identified literature that could be grouped under a theme closely related to the purpose of this review: the human dimensions of information and education campaigns designed to influence human behavior in other park contexts (e.g., trail use, sign compliance). This category comprised a slightly larger body of research. Papers that made recommendations about human-wildlife interactions based on their findings comprised the next most relevant and substantive body of work. Finally, a large number of studies have been published on research that explores impacts related to human-wildlife interactions (e.g., habituation, food conditioning, visitation), a theme conceptually related to our topic. We review the literature under each of these themes in decreasing order of relevance to our topic; and as the themes become more general, the amount of literature contributing to our synthesis of each theme increases. Figure 1 provides a visual representation of this organization and the relationship between the theme and the amount of literature available on the topic. We describe the studies that directly relate to our topic (i.e., those in the first category) in detail and identify authors and publication year. Thereafter, we discuss conclusions from the studies holistically and do not include individual citations in the text. Instead, we placed examples of references along with specific study findings in the accompanying tables.

In addition to peer-reviewed literature, the target of our review, we identified various pieces of gray literature relevant to the topic of habituation. These include conceptual papers, agency reports, work not published in the formal academic literature, and meeting notes and abstracts. While an examination of this area of the literature was not in the purview of this review, we believe these documents may contribute to knowledge about human-wildlife interactions in parks. We wanted to capture these additional references and abstracts that might be of interest to someone exploring human-wildlife interactions in parks, so we created a separate and distinct catalog of articles. The catalog contains peer-reviewed literature as well as additional resources that we identified. We separated the synthesis report and the catalog of articles to distinguish between our review of literature directly relevant to this activity and the collection of other topically relevant papers.

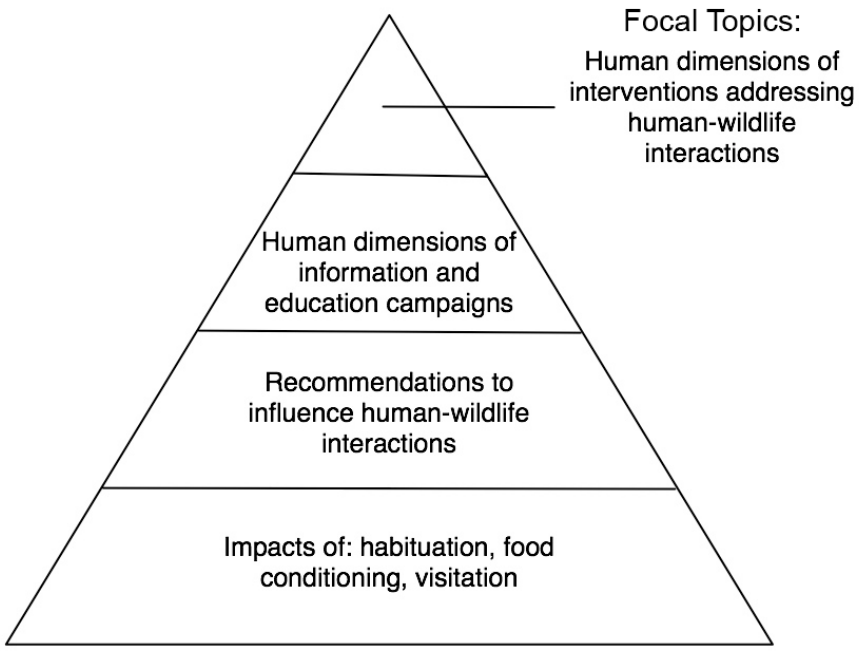


Figure 1. Organization of themes from the literature in decreasing order of relevance to target topic and increasing volume of literature.

The steps we took to organize and synthesize the information we found are summarized below.

1. Articles in the published literature that directly focus on interventions designed to address human dimensions related to human-wildlife interactions in parks are described in detail.

2. Articles that we identified in the published literature and that are conceptually related to our topic (e.g., wildlife-focused studies that address human-wildlife interactions; studies of human interventions that address issues other than encounters between people and wildlife; studies that make recommendations for human dimensions interventions; impacts associated with human-wildlife interactions) are organized into categories by theme and discussed synthetically. Corresponding tables are included in this report with specific citations and examples under each theme.

3. Papers and reports identified in the gray literature, and published literature only marginally related to our topic, but nonetheless of interest, are included in the catalog of articles appendix. The catalog also contains the references from this report and is organized by topic area.

# Findings

Findings are reported under headings developed during the publication synthesis process.

### Human dimensions of interventions addressing human-wildlife interactions

Our literature review identified nine studies that examined the initial focus of our search: the human dimensions of management interventions designed to influence human-wildlife interactions in parks. The interventions discussed in the papers we found include management activities that attempt to modify the beliefs or behaviors of park visitors and evaluate the effects of such interventions. Below, we discuss these papers in detail.

Marion et al. (2008) evaluated the success of efforts to reduce food conditioning in chipmunks in Zion National Park. The authors note that both visitors and managers tend to prefer indirect management actions (e.g., education) rather than direct actions (e.g., regulation) to address issues such as food conditioning. They cite previous work (Marion et al. 1993), however, concluding there is a lack of established monitoring protocols to evaluate visitor behavior related to wildlife feeding in response to indirect management. The study therefore evaluated the effectiveness of two treatments designed to discourage visitor feeding of chipmunks. One treatment used signage to communicate about the Park's anti-feeding regulation and the other used personal contact as a means to inform visitors about the regulation. The authors then conducted a survey to determine visitor awareness, knowledge, and behavior related to the regulation. They also conducted behavioral observations of visitor activity near chipmunks and chipmunk foraging success. Intentional attraction and feeding of chipmunks by visitors declined in both treatments. Visitors in the personal contact treatments also demonstrated increased efforts to deliberately discourage chipmunks. Chipmunks continued to forage near people regardless of treatment. Results suggest that the timing, location, and source of information may be more important to program success than the mechanism for message delivery (e.g., in print or personal contact).

Hockett and Hall (2007) examined message efficacy associated with deer feeding in Shenandoah National Park. They used both a fear appeal (i.e., risks to visitors) and a moral appeal (i.e., impacts to deer) in written messages designed to change camper's beliefs about feeding deer in the park. While both appeals altered visitors' self-reported deer feeding behaviors, only the fear appeal was associated with a change in beliefs about the risks of feeding deer. The authors suggest that this could be related to lack of visitor knowledge about the risks to humans associated with feeding deer. Additionally, the fear appeal messages presented novel information directly related to the threat and personally relevant to the visitors. Neither the fear nor the moral message reduced the percentage of people who reported approaching or following deer (presumably for photographs). The authors found that message effectiveness was dependent upon visitor motivations and knowledge. Messages most proximate to the time and place of the target behavior were most successful; and behaviors that were uninformed and unintentional were most likely to be altered.

Hughes et al. (2009) used a survey of visitor beliefs and the theory of planned behavior to design an intervention to discourage visitors from feeding birds in a picnic area in an Australian park. The authors identified behavioral beliefs, isolated those most likely to be susceptible to persuasive communication and developed signs to address those beliefs. The signs used two different approaches, a wildlife-based appeal (i.e., protect and conserve wildlife by not feeding)

and a social appeal (i.e., don't ruin fellow visitors' experience by drawing bothersome birds). Results indicated a slight increase in compliance, but beliefs and attitudes about bird feeding did not change. The compliance change was among visitors new to the park and not among regular visitors. The authors note that persuasive communication efforts often are unsuccessful for habitual behaviors. In other words, it will be difficult to change the behavior of individuals with prior experience engaging in an "undesirable" behavior in a park through education because it is a habitual behavior.

In contrast to education programs designed to reduce or prevent habituation or food conditioning, Orams (1997) explored the possibility of using an educational intervention to maximize the conservation benefits and visitor enjoyment from visitors' interactions with bottlenose dolphins in Tangalooma, Australia. The author suggests that the pervasive belief that positive experiences with wildlife alone will foster conservation-oriented attitudes and behaviors is erroneous. Rather, these experiences need to be augmented with appropriate educational programming to see the desired changes. The goal of this study was to create an educational program that would increase visitors' enjoyment, knowledge, and pro-environmental attitudes and behaviors. The work was grounded in a conceptual model the author developed (Orams 1996) that identified effective strategies for promoting behavior change in the context of human-wildlife interactions. A follow-up study found that after interacting with the dolphins and participating in an education program, visitors had changed their behaviors and acted in a more environmentally friendly way.

To foster ecotourism benefits compatible with grizzly bear conservation and to address bear-human conflicts in the Brooks River region of Katmai National Park, a bear viewing platform and boardwalk were installed. This management action was directed at addressing both the visitor enjoyment and the resource preservation elements of the NPS's mission. While this intervention manipulated the structural environment, it was nonetheless designed to influence human behavior associated with human-wildlife interactions. DeBruyn et al. (2004) evaluated the effects of the platform and human traffic on the boardwalk on bear behavior. Researchers used bear behavior data from before and after the construction of the platforms. They found that the platform structure and visitor behavior on the platform influenced more sensitive (i.e., less habituated) bears. Some bears avoided the boardwalk and bears that passed under it were more likely to do so at times of low human use. The authors conclude that enhanced public education regarding visitor conduct on the boardwalk, as well as visitor management and monitoring, would reduce impacts on bears. While some additional management interventions may be required to minimize impacts to bears, the platform preserved viewing opportunities. Requiring visitors to use the viewing platforms removed the chance for direct bear-human interactions that had previously occurred, and visitors reported feeling safer.

Schirokauer and Boyd (1998) provide an update on NPS actions to manage bear-human conflict (black and grizzly) in Denali National Park and Preserve from 1982-94. They report changes in numbers of conflict incidents (e.g., bear-inflicted human injury; property damage; bears consuming anthropogenic foods) after Denali NP implemented a comprehensive bear-human conflict management plan in 1982. The components of Denali's bear-human conflict management plan included staff and visitor education, food-storage regulations, backcountry closures, and experimental aversive conditioning. Staff education included training in bear safety, and a subset of staff were trained in monitoring and investigating human-bear conflicts. The diverse visitor education strategies included: signage, brochures, videos, an interactive

module on how to respond to bear encounters, personal contact by NPS staff, articles in a park newspaper, and information at the park hotel. In addition to education about bear safety and food storage, the program also enforced fines for non-compliance with food storage regulations. Under the management plan, areas where problems had occurred were temporarily closed while staff investigated the incident and took management actions (e.g., aversive conditioning, hazing). The authors report a decline in bear-inflicted injuries, property damage, and bears obtaining anthropogenic food after implementation of the bear-human conflict management plan. To evaluate the education programs, the authors asked visitors who experienced interactions with bears where they had learned about appropriate behaviors. They found that many people did not know about bear-appropriate behavior upon entering the park and that most reported obtaining that information in the park through various mechanisms. The authors suggest that this finding emphasizes the importance of using multiple avenues to communicate with visitors. Finally, the authors note that the road restrictions and other enforcement actions allowed the park to better manage visitor behavior ultimately leading to a reduction in problematic bear-human encounters.

A study by Lackey and Ham (2004) empirically evaluated various avenues of visitor-directed communication aimed at addressing human-bear conflict in Yosemite National Park. The study examined a host of factors including message location, media channel, visitor recall, and knowledge of message sources. Ninety-eight percent of visitors surveyed reported seeing or hearing food storage and/or bear safety messages. Visitors reported that they found messages easy to read but uninteresting. The message most commonly recalled was information related to food storage (as opposed to other categories of messages such as bear facts, what to do when one encounters a bear, or the message "don't feed the bears"). While visitors recalled messages about recommended behaviors (e.g., food storage and bear encounters) in proportion to the number of messages provided by the park, this did not hold true for messages about the consequences of encounters for humans or bears. The authors suggest that this lack of consequence-related recall could lead to less compliance with recommended behaviors because visitors may not appreciate potential impacts or risks. Brochures and videos were the most effective non-personal communication channels and visitors' overnight location was most predictive of the messages recalled. The level of effort the park allocated to message delivery in specific locations did not coincide with the number of incidents in each location. Given the link between visitor's message recall and overnight location, the authors suggest the park may wish to change the emphasis of message location. A survey of park employees found that people in a variety of positions throughout the park are potential sources of information for visitors (i.e., are asked about bears frequently). The survey and observations of programming revealed that employee knowledge about park bear management policy was lacking and that messages were not consistently used in programming. The authors suggest that more rigorous employee training across various positions (e.g, interpretation, maintenance, concessions) may be needed. The authors conclude the park's interpretation programming needs to be more targeted (e.g., location and delivery mechanism) and suggest research is needed to understand why visitor's high level of knowledge recall does not translate to high compliance.

Martin and McCurdy (2009) also examined Yosemite National Park's efforts to reduce bear-human incidents, and specifically evaluate the compliance issue identified by Lackey and Ham (2004). In the late 1990s, park managers found voluntary compliance with the use of bear resistant containers did not decrease human-bear incidents to desired levels. Consequently, in 2004 the park created a regulation, requiring most backcountry campers to use a container. This

study examined camper compliance with the regulation and visitor attitudes, beliefs, and behaviors associated with canister use. Eighty-seven percent of respondents to a camper survey reported using a canister on their trip although 38% did not achieve "full compliance" (i.e., all food and toiletry items contained in the canister) on all nights of their trip. Under half of those surveyed who did not use containers had planned their trip for areas where canisters were not required. The remainder of backpackers not using canisters cited convenience reasons for not doing so (e.g., weight, bulk, expense, size) or believed they would not encounter a bear. The authors used the theory of planned behavior framework and found that attitudes toward canister use and subjective norms for canister use predicted 43% of backpackers' intentions to use canisters on future visits when it was required and 38% of intentions when canister use was voluntary. Backpackers with more positive attitudes about bears also were more likely to use containers. Subjective norms influenced intentions to comply more strongly in areas where canister use is required. These findings led the authors to suggest that enforcement would help to strengthen the norms around canister use and increase compliance.

Greenleaf et al. (2009) did not specifically examine the effectiveness of human-focused interventions, but included them in a discussion evaluating the overall success of efforts to reduce human-bear conflict in Yosemite National Park. The Park implemented a Human-Bear Management Plan in 1975 to reduce negative human-bear interactions. "Goals of the program included restoring and maintaining the natural distribution, abundance, and behavior of the black bear population; providing for the safety of visitors and their property; and providing opportunities for visitors to understand, observe, and appreciate black bears in their natural habitat." To achieve this the park: installed bear-resistant garbage cans; increased the frequency of garbage pick-up; provided bear-resistant food storage containers at campsites and backcountry trailheads; required backpackers to use bear-resistant food storage containers; prohibited food storage in cars overnight; implemented "diverse" public education and information campaigns; and hired additional education and law enforcement staff. This study used the presence of anthropogenic food in bear scat as well as reports of human-bear conflict to measure success of the Park's efforts. Results indicated a significant reduction in anthropogenic food in bear diet from monitoring in 1974-1978 to that in 2000-2002. The documented reduction in the incidence of human-bear conflict led researchers to conclude the effort was a success. Researchers note that the success was possible due to increased Congressional funding for the program that allowed interpretive rangers to patrol campgrounds, officers to enforce regulations, and park staff to conduct 24-hour bear management patrol. The authors also discuss the controversial apple orchard in the park. The orchard is an important cultural resource but contributes to bear habituation to people as bears forage near the orchard and to food conditioning of bears because the orchard draws bears near developed areas where they find other sources of food. This tension in the Park's responsibilities was echoed in other studies.

## Human dimensions of communication interventions

### *Influencing knowledge, attitudes or behavior*

Related to the impacts of visitation on wildlife, a body of work in the leisure research literature may provide insights for the design of information/education interventions to address wildlife habituation or food conditioning in national parks. The leisure research literature contains few studies that focus directly on wildlife, however, and these studies typically center on communication interventions to minimize human disturbance of particular wildlife species (not habituation or food conditioning of wildlife). These studies specifically examining wildlife, but

not addressing a habituation or food-conditioning context, as well as the non-wildlife recreation literature may be helpful. This literature offers some evidence that communication interventions can influence attitudes, knowledge and behavior, and offers some general principles for designing communication interventions. Examples from this body of literature can be found in Table 2. These studies suggest that communication interventions should be theoretically grounded and give careful consideration to audience characteristics, message content and delivery mechanisms. Recent work on emotions in persuasive appeals may be particularly relevant to visitor behavior associated with human-wildlife interactions.

### *Acceptability of management actions*

We identified a few studies that point out that natural resource managers need to be aware of and consider stakeholder acceptance of management interventions as part of the decision-making environment. In particular, understanding the acceptability of management actions aids managers when they design information and education programs. For instance, knowledge about the reasons for stakeholder backlash related to the lethal control or introduction of animals can help managers to tailor messages to address stakeholder concerns. In addition, some research has been done on the acceptability of management actions for species outside of national park contexts (e.g., at the state or local level) that may provide insights for park managers considering or already utilizing various strategies to manage habituated wildlife. Park and non-park examples of empirical studies related to the acceptance of management strategies can be found in Table 2.

### *Recommendations for interventions*

Though few studies have directly evaluated the effectiveness of human-focused interventions, numerous researchers have offered recommendations about human or wildlife-focused interventions based on their findings. Recommendations for management interventions to address habituation and food conditioning include a litany of approaches that target both people and wildlife. Most interventions focused on modifying human or wildlife behavior (Tables 3-4). Recommendations also range in intensity from passive approaches such as signage to active interventions such as removal of individual wildlife. Commonly suggested strategies that target humans include: education (commonly for park visitors, but also education of park employees); signage; regulations to reduce anthropogenic sources of food for wildlife; and visitor use of specific areas.

Table 2. Human dimensions of communication interventions.

| Topic | Focus of intervention or article | Conclusions |
|---|---|---|
| Background HD information to inform wildlife-related communication | Visitor perceptions of wildlife responses to recreation (Taylor and Knight 2003). | Half of recreationists do not feel that recreation negatively impacts wildlife. Respondents have closer approach distances than wildlife will tolerate. "Other" user groups are responsible for threats to wildlife. |
| | Social influences and backcountry visitor behavior in occupied grizzly habitat (Braithwaite and McCool 1989). | Backcountry rangers and group members are most influential and reliable sources of information. Social and informational influence on behavior varies. |
| Reducing impacts to natural resources and conflicts between visitors | Message attention and retention relative to quantity and quality (Cole et al 1997). | Attention increased with increased message number, but retention of content declined. |
| | Review of education programs to minimize visitor impacts (Marion and Reid 2007). | Important elements of programs include message content, delivery, audience characteristics and theoretical grounding. |
| | Use of indirect (information and education) and direct (fence) management practices to influence trail use (Park et al. 2008). | Direct methods most effective. "Aggressive" indirect methods were most effective, but not effective enough to reduce resource impact. |
| | Review of persuasive communication to reduce resource impacts and visitor conflicts (Roggenbuck 1992). | Success of persuasion influenced by message source, content, channel, timing and audience characteristics. |
| General use of information/education programs | General summary of theory and empirical studies related to wilderness management (Manning 2003).<br>A model for assessing the effects of communication on recreationists (Manfredo and Bright 1991). | |
| Tourism | Influence of education on enjoyment, knowledge and environmental attitudes, intentions, and behavior (Orams 1997). | Education can influence visitors' experience and conservation orientation. |

Table 2. Human dimensions of communication interventions (continued).

| Topic | Focus of intervention or article | Conclusions |
|---|---|---|
| Acceptance of management actions in parks | Public reaction to dingo cull after a human fatality (Burns and Howard 2003). | Public believed that managers should focus on changing/regulating human behavior rather than just lethal control for dingoes. |
| | Attitudes toward restoring wolves to Adirondack Park (Enck and Brown 2002). | A wide array of factors influence attitudes toward restoration and residents were split in their support of restoration. |
| | Attitudes and knowledge about restored bobcats on Cumberland Island National Seashore (Brooks et al. 1999). | Public opposition to reintroduction was high because of perceived impacts. After an intensive communication campaign attitudes became non-negative. |
| Acceptance of management actions in parks | Acceptance of management actions for a variety of species in Serengeti National Park, Tanzania (Kaltenborn et al. 2006). | Greater problem acceptance for well-liked species when problems are moderate. If human life is threatened, species preferences do not affect acceptance of management actions. |
| Acceptance of management actions not in parks | Suburban homeowners' acceptance of deer management strategies (Kilpatrick et al. 2007). | Most suburban homeowners support lethal deer control, prefer bowhunting. |
| | Acceptance of lethal control of bears in Georgia (Agee et al. 2009). | Perceived threat and gender influenced acceptance of lethal control of bears that were in urban areas or that caused repeat problems. |
| | Acceptance of mountain lion management in Colorado (Manfredo et al. 1998). | Acceptance of management strategies is situation-specific. |
| | Acceptance of lethal coyote control (Martinez-Espineira 2006). | Public accepts lethal when coyote cause damage. Method of lethal control varies in acceptance. |

Table 3. Recommended interventions focused on managing human behavior inside parks.

| Species | Recommendations | To address this impact |
|---|---|---|
| Grizzly bear | • Minimize human-bear interactions (Albert & Bowyer 1991).<br>• Limit human activity and human numbers in occupied grizzly habitat<br>• (Herrero 1985, Herrero and Fleck 1990, Bader 1989, Mattson et al. 1996); reduce human activity in habitats used by bears (Mace and Waller 1996).<br>• Limit human access to grizzly bear habitat by road and trail<br>• (Herrero 1985, Herrero and Fleck 1990, Mattson et al. 1996, McLellan and Shackleton 1989).<br>• Reduce number of armed people in grizzly habitat outside hunting season,<br>• especially in combination with foods or odors that attract bears<br>• (Herrero 1985, Herrero and Fleck 1990, Mattson et al. 1996).<br>• Educate park personnel, concession employees, local residents,<br>• back-country users, and other park visitors how to minimize<br>• undesired interactions with bears (Mattson et al. 1996, Gunther et al 1994, Schirokauer and Boyd 1998, Mace and Waller 1996).<br>• Allow brown bear viewing to promote conservation of bears, but do so based<br>• on scientific evidence of overt reaction distance by bears (Herrero 2005).<br>• Enhance public education regarding visitor conduct on bear-viewing platforms; increase visitor management and monitoring on viewing platforms (DeBruyn et al. 2004).<br>• Ask hikers to wear bear bells (i.e., habituate bears to the sound of an approaching<br>• hiker, so that bears are less likely to charge hikers out of fear) (Jope 1985).<br>• Increase visitor and employee education on precautions to take when hiking in bear habitat (Gunther and Hoekstra 1998).<br>• Systematically monitor “the human dimensions of grizzly bear habitat: the<br>• Numbers, armament, values and behavior of people, as well as dynamic<br>• Biophysical attributes such as grizzly bear food and shelter” (Mattson et al. 1996). | Human safety<br>Bear habituation<br>Bear safety<br>Conservation of bears, bear pop., habitats, ecosystem |
| Grizzly bear, elk | • Define a public safety goal that limits the proximity of humans to wildlife, based on overt reaction distance as metric to quantify animal tolerance for humans under particular circumstances. | Human, wildlife, and ecosystem health. |
| Black bear | • Continue use of educational campaigns (Matthews et al. 2006).<br>• Strengthen law enforcement (Matthews et al. 2006).<br>• Improve food storage containers for campers, hikers (Matthews et al. 2006). | Natural black bear Behavior<br>Human safety |
| Mountain sheep | • Restrict hikers to trails, especially during lambing and rut (Papouchis et al. 2001).<br>• Confine human use to trails only; restrict dogs to areas not occupied by mountain sheep (MacArthur et al. 1982). | Conservation of sheep |

Table 3. Recommended interventions focused on managing human behavior inside parks (continued).

| Species | Recommendations | To address this impact |
|---|---|---|
| Waterbirds | • Concentrate ecotourism in certain areas to allow wading birds to become habituated to disturbance there, and to isolate sources of disturbance (Stolen 2003).<br>• Close some areas to ecotourism<br>• Educate visitors about the effects of their behavior on wading birds and how to reduce their negative impacts | Effect of ecotourism on bird foraging |
| Coyotes | • More strictly enforce existing park policies to minimize the potential for conflicts between coyotes and humans (Bounds and Shaw 1994).<br>• Educate the public about wildlife habituation to feeding (Bounds and Shaw 1994). | Human safety |
| Bald eagle | • Create buffers and restricted activity zones around eagle wintering grounds (Stalmaster and Newman 1978).<br>• On river sections with eagle nesting, create temporal restrictions on river use, rather than spatial restrictions (Steidl and Anthony 1996). | Nesting success |
| Penguins | • Restrict ecotourism visitation to small areas of colony, reducing stress on birds who habituate to repeated consistent, nonthreatening behavior of humans, while preventing exposure to humans for most of the breeding colony (Fowler 1999, Walker et al. 1999). | Breeding success |
| Dolphins | • Provide education opportunities to visitors before they participate in wildlife feeding, to encourage development of conservation knowledge, attitudes and behaviors (Orams 1997). | Knowledge of wildlife<br>Conservation attitudes and behaviors |

Table 4. Recommended interventions focused on wildlife.

| Species | Recommendations | To address this impact |
|---|---|---|
| Grizzly bear | • Remove potentially hazardous bears (Gunther 1994).<br>• "Preserve" (avoid lethal control of) habituated grizzly bears that come into conflict with people. | • Human safety<br>• Grizzly population viability |
| Alaskan Brown (Grizzly Bears) | • An active program of negative conditioning of bears, to reinforce mutual fear and respect that minimizes bear-human interactions in parks (McCullough 1982, Schirokauer and Boyd 1998, Mace and Waller 1996).<br>• Develop a better understanding of the forces that shape bear social interactions within populations and with humans that mingle with them (e.g., improve understanding of bear-to bear, bear-to-human, and human-to-bear habituation), and use that understanding to manage human activities to minimize bear-human conflict (Smith et al. 2005). | • Human safety<br>• Bear safety<br>• Human-bear conflicts |
| Black bear | • Capture and on-site release of black bears (Clark et al. 2002).<br>• Destroy individual animals involved in a human-bear conflict (Gunther 1994)<br>• More aggressive aversive conditioning of bears (Schirokauer and Boyd 1998). | • Human safety<br>• Natural bear behavior<br>• |
| Elk | • Destroy individual animals habituated to human presence and living in close proximity to people (e.g., residential areas, golf courses, shopping areas).<br>• Use aversive conditioning techniques to reduce or reverse habituation process in elk and haze animals away from locations where the probability of human-elk conflict is high.<br>• Re-establish wolf population to reverse or eliminate habituation process in elk. | • Human safety<br>• Human safety<br>• Habitat restoration |
| Chipmunks | • Use educational messages on park trails to discourage wildlife feeding by park visitors. | • Wildlife health |

The wildlife-focused recommendation most often suggested in the papers reviewed was aversive conditioning of individual animals involved in a human-wildlife interaction deemed problematic by park staff (e.g., a bear repeatedly in a campground). Research on aversive conditioning is dominated by work focused on bears and ungulates. Most studies in this area evaluate the success of different strategies or examine particular factors likely to influence the effectiveness or permanence of aversive conditioning methods. For example, studies addressing aversive conditioning of bears in parks have found that projectiles and on-site release can be particularly effective deterrents; and predator-resembling techniques have been shown to reduce habituation in elk. Invariably these studies identify an important caveat to aversive conditioning, no matter the method: the importance of removing food attractants and identifying problem behaviors before animals become food-conditioned. The literature suggests successful aversive conditioning is more likely with habituated animals rather than food-conditioned ones. Most of the recommendations for interventions are intended to address just a few impacts produced by human-wildlife interactions: human safety, natural wildlife behavior, and population viability. While this is relevant to a number of threatened and endangered species, most of the work in the published literature focuses on grizzly bear populations in National Parks.

A few recommendations focused on reducing habituation or food conditioning by modifying human activities at a habitat or landscape level (Table 5). Reference was made to more general planning strategies such as trail and building placement, or seasonal use of particular areas to accommodate certain wildlife behavioral patterns.

While many studies note a "typical" list of recommendations for interventions, other papers point out the relative lack of empirical data to support different intervention techniques. Researchers identify key information needed to inform future management strategies. They suggest research is needed on human and wildlife spatial and temporal use of areas, and motivations of people for engaging in specific behaviors in a park (e.g., wildlife viewing, wildlife feeding, approaching wildlife).

## Impacts

Many studies in the published literature on the topic of habituation, food conditioning, and human-wildlife interactions describe the extent and nature of problems and the potential impacts.

### *Impacts of habituation*

A number of studies address the potential impacts of habituation on people and wildlife (Table 6). Effects on human safety and wildlife population viability are the most common impacts that seem to have motivated research.

Authors identify both positive and negative impacts as well as a range of impact types. A primary focus is ecological impacts to species of interest. These include impacts associated with species distribution, physiology, reproductive success, behavior, and mortality due to management actions directed at habituated animals. Another impact category often addressed is human health and safety. Most studies examine the relation between habituation and negative human-wildlife interactions that may result in injury to people. Positive impacts include benefits to both people and wildlife. For example, the literature notes that habituated animals allow more

Table 5. Recommended interventions focused on habitat.

| Species | Recommendations | To address this impact |
|---|---|---|
| Grizzly bear | • Limit number and extent of human facilities in occupied grizzly bear habitat (Mattson and Blanchard 1992, Bader 1989).<br>• Trail placement to minimize human-bear interaction (Mace and Waller 1996).<br>• Locate or relocate facilities in areas that receive little grizzly bear use, either for travel, bedding, foraging, or security from other bears (Herrero et al. 1986).<br>• Sanitize human facilities wherever humans and grizzly bears come in contact (Herrero 1985, Herrero and Fleck 1990, Mattson et al. 1996).<br>• More effective waste management within parks (reduce availability of anthropogenic food sources) (Gunther 1994, Schirokauer and Boyd 1998).<br>• Eliminate sources of human food and garbage specifically in developed areas and along roadsides (Gunther 1994, Schirokauer and Boyd 1998).<br>• Identify local grizzly bear use patterns and design campground components to accommodate these patterns (e.g., locate vulnerable facilities (tent pads) furthest from bear travel corridors and food preparation areas; design buffer zones and barriers to help direct bear travel around campgrounds; consolidate food storage facilities, garbage facilities, cooking sites, and other bear attractants); incorporate structural controls on human access into bear travel zones) (Creachbaum et al. 1998).<br>• Increase protection of bear habitat in backcountry (Gunther 1994), backcountry closures (Schirokauer and Boyd 1998).<br>• Maintain access to high quality habitat, especially for female bears, so that bears that avoid human activity near roads and in high-traffic areas, have sufficient food for survival and reproduction (Gilbeau et al. 2002). | • Bear pop. Viability<br>• Bear conservation<br>• Minimize food conditioning<br>• Minimize bear habituation |
| Black bear | • More effective waste management within parks (reduce availability of anthropogenic food sources) (Greenleaf et al. 2009).<br>• Eliminate sources of human food and garbage specifically in developed areas and along roadsides (Gunther 1994). | • Human safety<br>• Natural bear behavior |

Table 6. Impacts of habituation.

| Species | Human-wildlife interaction of interest | Potential impacts |
|---|---|---|
| Gray wolf | • Attack on child (McNay and Mooney 2005)<br>• | • Human safety<br>• |
| Grizzly bear | • Bear viewing promotes bear conservation actions (Herrero et al. 2005)<br>• Habituation alters the distribution of bears in parks (Keating 1986).<br>• Habituation varies by sex and age class. This produces differential use of fish resources at bear viewing areas by adult males and females. Adult females may be affected negatively (Olson and Gilbert 1994) or positively (Nevin et al. 2005).<br>• Habituated bears more likely to use habitat near roads, range closer to humans, increasing exposure to mortality risks (Mattson and Blanchard 1992, Chruszcz 2003, Wielgus et al. 2002, McLellan and Shackleton 1989).<br>• | • Bear population<br>• viability<br>•<br>• |
| Elk | • Authors assert that habituation of elk in urban areas can disrupt natural ecological processes, destroy habitat, and threaten public safety, and discuss such effects in Banff, Canada (Kloppers et al. 2005).<br>• High elk density, human presence in elk winter range, sanctuary from hunting, maximization of reproductive fitness all lead to habituation and persistent concentrations of elk in suburban and urban settings (Thompson and Henderson 1998).<br>• Elk in Rocky Mountain National Park were found to habituate readily to park visitor disturbances did not alter in distribution or observability (Schultz and Bailey 1978).<br>• Elk habituate and gradual increase use of an area after ski area development, but long-term effects on such development on elk are unknown (Morrison et al. 1995). | • Human, pet injury<br>• Habitat degradation<br>• Disruption of natural ecological processes<br>• Property damage<br>• Disease transmission<br>• Stakeholder conflicts<br>• Damage to credibility of wildlife professionals<br>• Lower public support<br>• for elk conservation |
| Mule deer | • Snowmobiles and hikers cause a significant flight response in mule deer (Freddy et al. 1986, Yarmoloy et al. 1988). | • Winter survival, reproduction |

Table 6. Impacts of habituation (continued).

| Species | Human-wildlife interaction of interest | Potential impacts |
|---|---|---|
| Ungulates | • Studies show differential effects of aircraft noise on various ungulates; response to military, commercial, and ecotourist overflights by rotating or fixed-wing aircraft varies by species and context (Weisenberger et al. 1996). | • Wildlife habitat use, physiological stress |
| Red wolf | • Wolf habituation influences reintroduction success (Van Manen and Crawford 2000) | • Wolf pop. viability |
| Polar bear | • Up to 10,000 people arriving in the fall to view bears on the tundra create potential disturbance of polar bears which have been fasting for up to four months; this could be energetically costly to individual bears (Eckhardt et al. 1994). | • Bear mortality rate |
| Waterbirds | • Bird viewing promotes bird conservation actions (Nisbet 2000).<br>• Some species show signs of habituating to human disturbance, which allows them to nest on water bodies with high human use; feeding or nesting success may be reduced, however (Keller 1989, Scott et al. 1996, Stolen 2003, Titus and Vandruff 1981, Urfi et al. 1996).<br>• A Florida study of 38 species of birds found that species could be placed into two groups: one habituated to humans and one easily disturbed by wildlife refuge visitors, with implications for refuge design (Klein et al. 1995). | • Bird pop. viability |
| Bald eagle | • Human activity near nests caused clear and consistent changes in behaviors of breeding eagles, suggesting that frequent human activities near nests could adversely affect nestling survival, and therefore reproductive success despite some eagle habituation to disturbance (Steidl and Anthony 2000). | • Bird reproductive success |
| Penguins | • Ecotourism at penguin breeding grounds raises concerns about disturbance-related stress in penguins and how or if penguins habituate to human visitors (Fowler 1999, Walker et al. 1999, Walker 2005). | • Wildlife health and reproductive success |

viewing opportunities and study authors speculate (but research has not convincingly established) that visitors who interact with wildlife in national parks (even habituated wildlife) may later develop conservation attitudes and express conservation behaviors. Studies that mention positive impacts of habituation on wildlife focus on physiological benefits such as reduced stress.

### *Impacts of food conditioning*

In contrast to impacts from habituation, research studies primarily indicate negative impacts of food conditioning for both people and wildlife (Table 7). While feeding is against NPS policy, it is permitted in some international parks and protected areas. In addition, it is allowed on some private lands and tour operators may use food resources to draw wildlife to a particular area for viewing. One study identified in our search notes that despite the negative impacts of food conditioning highlighted by most studies, some benefits may exist. Examples include opportunities for people to interact with wildlife in close proximity, and support for local economies through tourism income. Despite this claim, however, the author notes that the lack of research about potential benefits, as well as management and policy inconsistencies (historically and across boundaries) leave much room for debate regarding possible impacts of food conditioning.

### *Impacts of wildlife watchers and other park visitors on wildlife*

Studies on this theme dominated the literature we identified in our search (Table 8). Papers addressing visitation echoed the impacts discussed in studies focused more specifically on habituation and food conditioning. They note that impacts may be positive or negative for people or wildlife. For the most part, this work is descriptive and emphasizes physiological and behavioral responses such as species' overt reaction distance. Researchers highlight the need to understand that outward signs of tolerance or habituation do not indicate a complete lack of physiological response. Most studies in this category have a negative frame and discuss impacts to foraging opportunities, habitat use, and reproductive success. Research documents that some species are quite sensitive to visitor presence or ecotourism and others can tolerate such disturbance without suffering effects to reproduction or population viability. Most of the studies we identified concentrated on a small group of species (e.g., bears, waterbirds, and ungulates).

Table 7. Impacts of food conditioning.

| Species | Human-wildlife interaction of interest | Potential impacts |
|---|---|---|
| Coyote | • Food conditioning may create habituation and has been associated with bold / aggressive behavior (Bounds and Shaw 1994, Carbyn 1989). | • Human safety |
| Dolphin | • Dolphin feeding (associated with ecotourism) leads to habituation, food conditioning and emboldens dolphins to "beg for food," "bump" humans harass fishermen (Orams 2002). | • Human-dolphin conflicts<br>• Safety risks to dolphins, humans |
| Black bear | • The rate of bear-inflicted human injuries decreased from 2.7/million visitors from 1970 through 1979 to 0.5/million visitors from 1980 through 1994. This was primarily due to decreased roadside injuries from black bears as public education increased and food conditioned bears were removed from roadsides and developed areas (Gunther and Hoekstra 1998).<br>• The impacts of tourism, most notably food resource enrichment and harassment, have led to alterations in natural bear (Ursus sp.) behavior in many National Parks throughout the United States (Matthews et al. 2006). | • Human safety<br>• Reduced wildness of species |
| Grizzly bear | • Lethal removal of food-conditioned bears can compromise long-term population viability of bears unless sources of food attraction are controlled (Mattson et al. 1996). | • Species population viability |
| Multiple species | • Wildlife feeding makes a range of species more available for viewing, but also creates potential for additional negative interactions with wildlife (Knight 2009) | • Wildlife viewing, photography and nature-based tourism opportunities<br>• Human-wildlife conflict |

Table 8. Impacts of wildlife watchers and other park visitors on wildlife.

| Species | Human-wildlife interaction of interest | Potential impacts |
|---|---|---|
| Park ungulates | • Snowmobile use impacts elk and bison in Yellowstone NP (Borkowski et al. 2006)<br>• Moose habituate to road use and developed areas in Denali NP (Belant et al. 2006); One investigator found that increased traffic on the park road apparently did not cause significant changes in abundance, distribution, or behavior of caribou, grizzly bear, Dall sheep, and moose in the park road corridor (Burson et al. 1999).<br>• Elk are displaced by skiers in Yellowstone. Recommend that trails should be located so as to minimize skier overlap with elk winter range (Cassirer et al. 1992).<br>• Ungulate flight distance in response to human visitation – 5 primary influencing factors (Stankowich 2009).<br>• Recreational use of trails impacts pronghorn in Utah State Park. They do not habituate. Management should address immediate effects of human presence on pronghorn (Fairbanks and Tallous 2002). | • Potential effects on<br>• winter survival rate<br>• Ungulate disturbance<br>•<br>•<br>• |
| Ungulates in Europe, Africa | • Wildlife viewing and poaching contribute to herbivore flight distance in Africa (Nyahongo 2008).<br>• Chamois were found to alter habitat use due to disturbance by hikers, joggers and mountain bikers (Gander and Ingold 1997). | • Quality of viewing opportunities<br>• Ungulate disturbance |
| Passerine birds | • Bird diversity, species composition, and behavior changes related to rock climbing intensity in Joshua Tree NP. Less diverse in high use areas (Camp and Knight 1998).<br>• Risk allocation, not habituation, influences anti-predator behavior in blackbirds (Rodreguez-Prieto et al. 2009). | • Species diversity<br>• Anti-predator behavior |
| Waterbirds | • Nest disturbance declines as terns habituate to visitors (Dunlop 1996).<br>• Effects of recreation on foraging behavior of waterbirds differ by species (Fitzpatrick and Bouchez 1998).<br>• Habituation of whooper swans to disturbance was temporary and normal activity patterns returned after disturbance frequency declined (Rees et al. 2005). | • Nesting success<br>• Migration, migratory foraging success<br>• Feeding behavior. |

Table 8. Impacts of wildlife watchers and other park visitors on wildlife (continued).

| Species | Human-wildlife interaction of interest | Potential impacts |
|---|---|---|
| Bald eagle | • Operating watercraft disturbs eagles in Voyageurs NP (Grubb et al. 2002).<br>• Human activity near nests reduces nesting success (Steidl and Anthony 2000). | • Reduced nesting success |
| Wolves | • Wolves near developed areas show more tolerance for human presence near their dens (Thiel et al. 1998). | • Reproductive success |
| Whales | • Australian study found that sperm whales often respond to whale-watching activities, but concluded that the changes are small and most likely not of biological importance. However, resident whales responded less to these activities compared to transient whales, possibly indicating *habituation* and, more importantly, the need to monitor continued activities closely (Richter et al. 2006). | • Habitat use and disturbance |
| Sharks | • Australian study concluded that moderate levels of ecotourism probably have only a minor impact on the behavior of white sharks, and are therefore unlikely to create behavioral effects at the ecosystem level (Laroche et al. 2007). | • Natural behavior of white sharks. |
| Olympic marmot | • Olympic marmots habituate to human presence (tourists) with no apparent negative demographic consequences (Griffin et al. 2007). | • Survival rate for a threatened species |

# Conclusions

### Reflections on the review

Our literature review confirmed that little research has been conducted on the human dimensions of interventions designed to influence wildlife habituation and food conditioning in national parks. The majority of articles we identified focused on wildlife and had human dimensions as a secondary component or discussed human dimensions cursorily in management implications and recommendations. We did, however, identify a substantial amount of literature that dealt with concepts, issues, or methodologies relevant to research and management of human-wildlife interactions in parks. The synthesis of this related work provides some insight to inform future human dimensions inquiry and management approaches.

A survey of NPS managers in 2008 identified a list of 87 wildlife species for which habituation and/or food conditioning may be a management consideration in national parks (Wieczorek Hudenko and Connery, in prep). Only a handful of those species have been the subject of peer-reviewed research publications; the majority of published research addresses just a few species (e.g., grizzly bear, black bear, elk, deer, wolf). With the exception of management interventions focused on bears and elk, the peer-reviewed literature contains few systematic evaluations of management interventions implemented for the explicit purpose of managing wildlife habituation or food conditioning in national parks.

Peer-reviewed literature reflects the fact that many types of management actions have been implemented in parks to help manage human-wildlife interactions, including: separating people and wildlife at certain times and places; and allowing people and wildlife to be in same place at particular times, but restricting visitor behavior (e.g., keeping visitors on trails or viewing platforms, keeping visitors on tour buses, asking hikers to wear bells, requiring visitors to store food or pack out garbage). Yet, a review of the published literature suggests that few parks have systematically evaluated the success of these interventions, particularly the human component. As Mazur (2010) noted, little work has been done to determine the appropriate factors to monitor to measure successful interventions in these settings. Based on input from the Habituation Steering Committee and our experience, we presume that most parks monitor human-wildlife interactions within their boundaries, but they lack adequate resources for more comprehensive evaluations of interventions. Additionally, it may be the case that when systematic monitoring or evaluation occurs, it is not published in the formal academic literature and therefore not available to a wide audience. In other words, our review of literature turned up a number of white papers and agency reports that are not easily accessible but may contain relevant information. A systematic collection and review of such documents (i.e., gray literature) may be useful for the NPS.

Contradictions are inherent in the way human-wildlife interactions have been managed in different parks and at different points in the history of NPS. Manuscript authors point out that this can complicate current attempts to address the issue. For example, wildlife feeding was encouraged in parks and was often part of standard park operations during the early twentieth century. A history of wildlife feeding may create barriers or impediments when park personnel attempt to change and implement new policies. Furthermore, some commonly employed strategies, such as aversive conditioning, may conflict with the parks' mission of preservation and park stakeholders' beliefs about acceptable management actions. While studies examining

human-related interventions such as fencing or enforcement of regulations in other contexts find these direct approaches most effective, parks may have concerns about how such strategies may influence visitor expectations and satisfactions determined by their interactions with wildlife while in a park.

## HD information needs associated with wildlife management planning

The literature reviewed in this document can be placed in one of four categories that reflect stages in a cyclical process of management. Any team of managers facing a habituation or food conditioning issue will go through one or more of these stages to address the issue. Table 9 identifies these stages and offers a few examples of the HD information needs in each stage[5]. We offer Table 9 as a starting point for discussion among NPS managers and researchers who have decided that they need to address a specific habituation or food conditioning issue in a park.

### *Stage I—Identify impacts of habituation and food conditioning*

The first stage in a management decision cycle includes situation analysis to define one's problem and make a determination about whether that problem requires management intervention. In this case, situation analysis would include some effort by managers to determine whether habituation and/or food conditioning are occurring, and to what degree. As was pointed out by several authors of literature reviewed here, doing so requires managers to carefully define concepts such as habituation, food conditioning, and tolerance, as well as how those concepts will be measured.

To the degree that habituation and food conditioning are taking place, managers next would make an effort to characterize or quantify what positive and negative impacts are occurring due to habituation or food conditioning. Assessment of both the effects on wildlife and on humans is needed as input for subsequent management decisions. This information provides the foundation for all subsequent discussion of the issue. If effects on wildlife and people are relatively limited then further management attention may be unwarranted. If significant impacts are identified, managers would continue into Stage II. Information on effects and impacts will help managers make subsequent decisions and will provide a basis for communication messages to park visitors and other stakeholders (e.g., documenting levels of ecological, economic, psychological, social and human safety impacts will give managers information they need to support program actions, including the decision not to intervene in some instances).

[5] Though equally important for management, ecological and biological information needs are not the central focus of this report and are not addressed in Table 8.

Table 9. Stages of planning related to interventions to manage impacts of wildlife habituation and food conditioning in national parks, and examples of human dimensions information needs associated with each stage.

| Stage of wildlife management planning | HD information needs associated with stage |
|---|---|
| Stage I: Identify impacts on humans, wildlife | • ID health and safety impacts<br>• ID economic impacts<br>• ID psychological (e.g., recreation satisfactions)<br>• ID social impacts |
| Stage II: Identify park goals | • ID internal NPS interests, concerns<br>• ID local stakeholder interests, concerns<br>• ID user group interests, concerns<br>• ID national stakeholder interests, concerns<br>• |
| Stage III: Identify factors that produce impacts | • Park visitor beliefs, attitudes, norms<br>• Park visitor behaviors (e.g., the role of<br>• visitor behavior in human-wildlife interactions)<br>• Behaviors within key user groups<br>• (e.g., hikers, campers, ORV operators)<br>• Actions, policies of local communities<br>• Local land use activities<br>• |
| Stage IV: Assess/evaluate efficacy of interventions | • Evaluate educational interventions<br>• Evaluate human behavior change interventions<br>• Evaluate policies aimed at changing<br>• collective actions, community behavior |

***Stage II—Identify park goals related to habituation and food conditioning***

Authors of several papers (Herrero et al. 2005, Orams 2002, Whittaker and Knight 1998) pointed out that identification of a park's goals related to habituation is a critical information need. Whittaker and Knight (1998) clearly articulated that simply documenting habituation effects is inadequate; parks also need a clearly defined goal regarding what level and type of effects are tolerable or desirable in any given context.

> Wildlife management is often concerned with how humans will coexist with wild animals, but there are many variations on the coexistence ideal. In an urban setting like Anchorage, Alaska, the ideal might include brown bear populations that demonstrate avoidance behavior; in a protected area like Alaska's Katmai National Park, habituation responses may be preferred. Either situation allows coexistence, but each has different consequences for bears and for people. Improved management requires better information about how human actions affect wildlife responses, as well as clarity about which coexistence ideal is appropriate for the area. In research, the need is for models that

> explore the complexity of wildlife responses and relate those responses to human management regimes. In management, the need is for explicit statements about the desired coexistence ideal and the development of standards that define acceptable consequences. (Whittaker and Knight 1998:316)

Herrero et al. (2005) offer recommendations that echo those made by Whittaker and Knight (1998). They proposed a new term, Overt Reaction Distance[6], and conceptualized bear viewing in terms of benefits and risks to people and bears. They recommended that managers and policy-makers develop site-specific plans that identify the extent to which bear-to-human habituation and tolerance will be permitted. They emphasized that "the proposed management needs scientific underpinning." In order to make scientifically-based decisions about "the extent to which bear-to-human habituation and tolerance will be permitted," an understanding of effects on bears, effects on humans, and stakeholder and managerial views on what constitutes the preferred/ideal level of bear-to-human habituation and tolerance is needed.

Establishing a park goal for desired or tolerable levels of wildlife habituation in specific contexts could be a daunting challenge, due in part to the diversity of stakeholders in decisions about wildlife management in national parks. Goals related to habituation have been established as part of grizzly bear management in parks (e.g., as early as 1960, NPS had created a national bear management program that included the goal of reestablishing grizzly bears to a natural state in national parks). Goals related to tolerable levels of habituation for other species may be absent or poorly defined in a given park unit.

The overall HD information need at this stage is input that identifies the concerns and interests of various stakeholders. This would include the need for information about multiple audiences, such as residents adjacent to a park, wildlife user groups, park visitors, and others. Depending on the complexity of a situation, as well as the level of human-wildlife interactions and human-human conflict involved, managers may need to use multiple methods to collect this information (e.g., survey research, focus groups, task forces).

***Stage III—Identify factors that produce habituation/habituation-related impacts***

Understanding the factors that contribute to human behavior in the context of human-wildlife interactions in parks is necessary to design interventions that will help managers effectively reach their goals related to habituation. Human dimensions research can help managers understand what motivates visitor behaviors, and can identify particular beliefs, attitudes, and expectations that managers need to address to manage visitor behaviors.

Researchers might ask questions such as, (1) which human beliefs, attitudes and behaviors may contribute to wildlife habituation (and which do not); or (2) how might social norms promote or hinder human behavior that leads to habituation?

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[6] Researchers recognize that an overt reaction distance may not reflect all effects on an animal (e.g., physiological stressors) and therefore this measure may be more suitable for some species than others.

### *Stage IV—Develop, implement, and assess/evaluate efficacy of interventions to manage related impacts*

Interventions to modify human attitudes, perceptions, norms, and behaviors may be used by NPS managers to move toward their goals for wildlife habituation in a given setting. Establishing protocols for systematic monitoring of intervention success is always a recommended management practice. In this case, interventions to modify human behavior are the main focus.

Though we have some information about the components of successful behavioral interventions in other contexts, identification of those components for the habituation context is needed. This knowledge, synthesized with information from stages 1-3, will allow managers to develop action alternatives. Building on this process, implementation will create a need for additional HD inquiry. Experimental manipulation of various interventions will provide managers knowledge about the type of intervention, or combination of interventions, that can ensure human-wildlife interactions in parks occur in a way that helps parks to achieve their mission of preservation and visitor enjoyment.

Studies from the bear management literature offer examples of the types of inquiry that will be needed to assess efficacy of educational interventions. Researchers in that field have identified information needs that are applicable to any management situation in which an educational intervention is under consideration. For example, Lackey and Ham (2004) suggested a need for research to test the effectiveness of message content and the effects of visitor familiarity on attention paying, perception of risk, and compliance with food storage regulations.

## Implications

The practical utility of this literature review comes as a synthesis across individual studies that reveals general information needs that any team of wildlife professionals within NPS will need to consider when faced with an emerging issue related to habituation or food conditioning. We found that researchers and managers have created a comparatively robust biological and HD information base on which to base grizzly and black bear management decisions and actions in national parks. This body of information may serve as a model for the types of work that can be done for a variety of other species and contexts of interest to NPS managers. Additionally, we identified studies on a range of other species that provide examples of context-specific HD information at particular stages within a cyclical process of natural resource management (a process that includes problem identification, setting goals and objectives, selecting and implementing actions, and evaluating outcomes). These studies help to round out the knowledge base about particular aspects of the management of habituation and food conditioning (e.g., the effectiveness of various anti-feeding messages for small mammals in picnic areas). The lack of studies on other important topics (e.g., understanding the drivers of visitor behavior and the effectiveness of interpretive programs on behavior change) highlights the types of research still needed. A synthesis across that entire body of literature generates a set of "big picture" HD information needs associated with planning and decision making to manage the impacts of habituation and food conditioning in national parks. Managers can use this HD information needs framework to identify relevant studies and research needs relative to the stage of management in which they are operating.

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# Appendix A: Catalogue of Literature on Wildlife Habituation and Food Conditioning

In 2010, Cornell University's Human Dimensions Research staff conducted keyword searches of three electronic databases (Ecology & Wildlife Worldwide; Web of Science; and Yellowstone Park Science Bibliographic Database) to identify peer-reviewed literature related to the human dimensions of interventions to address wildlife habituation and food conditioning. After completing the series of keyword searches, we reviewed a database of articles related to habituation that was created for NPS in 2007. We also reviewed all issues of the Journal of Park & Recreation Administration for articles relevant to our topic. This appendix represents a catalogue of all the materials we identified as related to habituation and food conditioning. It includes references to gray literature, conference presentations, and concept papers. We created this document as a record of the results of our literature review. It contains many references that while not central to the task of identifying human dimensions literature on management of wildlife habituation and food conditioning in national parks, are nonetheless useful to managers. Central findings of our literature review are reported elsewhere (Wieczorek Hudenko, H. W. F. Siemer, and D J. Decker. 2010. Status of Peer-Reviewed Literature on the Human Dimensions of Managing Wildlife Habituation and Food Conditioning in National Parks. Whitepaper, Human Dimensions Research Unit, Dept. Natural Resources, Cornell University, Ithaca, NY).

We have organized the literature we found into broad categories. The catalogue begins with several conceptual categories on park management, habituation, and food conditioning. We follow that with species-specific categories; where appropriate we have further separated references into park and non-park related categories. All of these resources focus on some aspect of habituation, food conditioning, or human disturbance to wildlife. Most references include an abstract or content summary. We noted articles that report primarily on a human dimension of habituation or food conditioning (only 28 of the documents were primarily human dimensions papers). We also noted that some manuscripts had a secondary focus on human dimensions. The majority of articles we identified were exclusively focused on ecological questions and had no direct human dimensions component.

## Table of Contents

## Protected Area Management

***1. Clevenger, A. P. and N. Waltho. 2000. Factors Influencing the Effectiveness of Wildlife Underpasses in Banff National Park, Alberta, Canada. Conservation Biology 14(1): 47-56.***

Abstract: Wildlife crossing structures are intended to increase permeability and habitat connectivity across roads. Few studies, however, have assessed the effectiveness of these mitigation measures in multispecies or community level context. We used a null model to test whether wildlife crossing structures serve large mammal species equally or whether such structures limit habitat connectivity across roads in species-specific ways. We also modeled species responses to 14 variables related to underpass structure, landscape features, and human activity. Species performance ratios (observed crossing frequency to expected crossing frequency) were evaluated for four large carnivore and three ungulate species in 11 underpass structures in Banff National Park, Alberta, Canada. Observed crossing frequencies were collected in 35 months of underpass monitoring. Expected frequencies were developed from three independent models: radio telemetry, pellet counts, and habitat-suitability indices. The null model showed that species responded to underpasses differently. In the presence of human activity carnivores were less likely to use underpasses than were ungulates. Apart from human activity, carnivore performance ratios were better correlated to landscape variables, and ungulate performance ratios were better correlated to structural variables. We suggest that future underpasses designed around topography, habitat quality, and location will be minimally successful if human activity is not managed.

***2. Cole, D., Hammond, T., and S. McCool. 1997. Information quality and communication effectiveness: Low-impact messages on wilderness trailhead bulletin boards. Leisure Sciences 19: 59–72.***

(Notes: HD focus-Effects of communication program)

Abstract: This study assessed the attention wilderness visitors gave to environmental messages encouraging low-impact practices posted on trailside bulletin boards at a national wilderness area, the ability of visitors to retain message content, and their ability to correctly identify agency-recommended practices. The number of posted messages was varied from two to eight, as well as whether there was a map posted beside the messages, to assess the effect of information quantity and a message attractant. Hikers experienced a significant increase in knowledge levels following exposure to messages, but there was evidence of information overload when numerous messages were posted. As the number of messages increased, total message attention increased, but the attention devoted to each message and the ability to retain message content declined. This finding helps explain why hikers exposed to all eight messages could not identify any more of the agency-recommended low-impact practices than those exposed to only two messages. Posting a map had no effect on message attention or message content retention.

***3. Kaltenborn, B. P., T. Bjerke, J. W. Nyahongo, D. R. Williams. 2006. Animal preferences and acceptability of wildlife management actions around Serengeti National Park, Tanzania. Biodiversity and Conservation 15(14): 4633-4649.***

Abstract: Wildlife management policies are often based on expert perceptions of the ecological importance of certain species and poorly informed perceptions of how public attitudes toward management are formed. Little is known about why preferences vary greatly and how this affects support for management actions. This paper explores preferences for a range of wildlife species among a sample of the rural population adjacent to Serengeti National Park in Tanzania. We also examine the degree of acceptance for alternative management interventions when potentially dangerous animals pose different levels of problems to human beings, and the extent to which these attitudes are related to species preferences. Gender has a significant effect on species preferences. Men like most species better than women. Age has no significant effect, but level of education affects preference level for some species. Species preferences have a positive effect on support for management intervention when dangerous animals cause small or moderate problems to humans, i.e. there is a higher degree of acceptance of problems caused by animals that are well liked. In situations where human life is threatened, species preferences have no effect on preferred management actions. Appreciation of animals is a combination of functional, consumptive and cultural dimensions, and there is no simple link between species preferences and attitudes toward management actions. The local context and concrete experience with wildlife encounters is more important for shaping normative beliefs like attitudes towards management actions than global wildlife attitudes.

***4. Manfredo, M. J., and A. D. Bright. 1991. A model for assessing the effects of communication on recreationists. Journal of Leisure Research 23(1): 1-20.***

***5. Manning, R. 2003. Emerging principles for using information/education in wilderness management. International Journal of Wilderness 9: 20–27.***
(Notes: HD focus-Effects of communication program)

Abstract: Studies on information/education as a wilderness management practice are highly diverse, providing both theoretical and empirical understanding, employing a variety of message types and media, and addressing a variety of management issues and target audiences. Generally, these studies suggest that information/education can be an effective and desirable management tool. Moreover, a number of principles for using information/education tools are emerging from this literature.

***6. Marion, J., and S. Reid. 2007. Minimising visitor impacts to protected areas: The efficacy of low impact education programmes. Journal of Sustainable Tourism 15: 5–27.***
(Notes: HD focus-Effects of educational programs)

Abstract: Protected area managers, tourism providers, and other organisations commonly employ education programmes to address visitation-related impairment of natural and cultural resources, social conditions, and neighbouring communities. These programmes have different names (Leave No Trace, Codes of Conduct, Environmental Guidelines for Tourists) but share common objectives: to sustain opportunities for high quality visitor experiences while avoiding or minimising associated negative impacts to protected area resources, visitor experiences, and park neighbours. Theoretical and empirical research studies in the United States are reviewed to evaluate the efficacy of educational efforts that seek to encourage adoption of low impact behaviors. Findings reveal that most of the visitor education efforts evaluated did effectively alter visitor knowledge, behavior and/or resource and social conditions in the intended direction.

These findings, including discussions of message content, delivery, audience characteristics and theoretical grounding, provide insights for improving the efficacy of future educational efforts.

***7. Peterson, G., and D. Lime. 1979. People and their behavior: A challenge for recreation management. Journal of Forestry 77: 343–346.***
(Notes: HD focus-Understanding human behavior)

Abstract: Management of people in forest recreation areas should be based on analysis of the behavioral systems that may be producing undesirable effects, on careful consideration of managerial objectives, and on close examination of the possible courses of action. Incomplete problem analysis may have undesirable consequences. Methods for changing the behavior of recreationists include regulation, licensing, manipulation of fees, site design, delivery of services, and information and training. When seeking to modify behavior, it is important to consider the directness of intervention in free choice and the resultant effect on quality of the recreational experience.

***8. Roggenbuck, J. 1992. Use of persuasion to reduce resource impacts and visitor conflicts. Pages 149-208 in M.J. Manfredo (Ed.), Influencing human behavior: Theory and applications in recreation, tourism, and natural resources. Champaign, IL: Sagamore Publishing.***
(Notes: HD focus-Understanding factors that influence persuasive communication in recreation settings)

Introduction: This chapter reviews the use of persuasive communication as a management tool to reduce resource impacts and visitor conflicts in recreation settings. Specifically, the chapter provides: (1) a review of the nature, amount, causes and trends of impacts and conflicts in recreation settings; (2) a classification of conceptual routes to persuasion; (3) a classification of conceptual routes to persuasion; (4) an evaluation of the appropriateness and feasibility of persuasive communication in reducing impacts and conflicts in park settings. The influence of key elements in the communication process such as message source, content, channel, timing and audience characteristics on the success of persuasion is also examined.

## Wildlife Feeding Issues in Parks

***9. Hughes, M., S. H. Ham, and T. Brown. 2009. Influencing Park Visitor Behavior: A Belief-based Approach. Journal of Park and Recreation Administration 27(4): 38-53.***
(Notes: Human focus-attitudes and behaviors)

Executive summary: Communication is a key component in management strategies designed to influence park visitor behavior and minimize social and ecological impacts. However, messages targeting management problems are often delivered without a real understanding of the specific underlying visitor beliefs. This paper applies the theory of planned behavior in the design and evaluation of messages targeting park visitor induced management problems. The method enables specific identification of how messages influence visitor beliefs and behavior. This enables managers to target and refine their messages in a measured, purposeful way for maximum effectiveness. Belief elicitation and measurement surveys were conducted at two Australian park sites, Badger Weir picnic area and Yellagonga Regional Park. The survey results informed the content of messages targeting specific problem behaviors at each site. Message

interventions were installed at each site and their effectiveness evaluated based on a second belief measurement survey, and observations of visitor behavior. While the interventions were effective, repeat visitors with strong intentions and habitual behaviors seemed less prone to influence using this method. Despite overall increases in compliance at the two sites, the tested interventions were not successful in influencing salient beliefs or corresponding attitudes of these highly experienced visitors. This presents an additional challenge to parks managers. Visitors who engage in habitual behavior require an alternative approach involving different messages and different message delivery systems relative to their counter-parts. While more overt enforcement could be applied to address entrenched behaviors, alternative efforts might begin in the communities where local repeat visitors live, using a campaign style of communication.

***10. Orams, M. B. 1996. A conceptual model of tourist-wildlife interaction: The case for education as a management strategy. Australian Geographer 27(1): 39-51.***
(Notes: Human focus-tourist-wildlife interaction opportunities conceptual model)

Abstract: There are a wide variety of opportunities for people to interact with wildlife and the demand for these opportunities is growing rapidly. This range of opportunities can be viewed as a Spectrum of Tourist-Wildlife Interaction Opportunities (SoTWIO). Within this spectrum are both situations where tourists view captive wildlife in facilities such as toes and circuses and ones where tourists interact with wildlife in the wild, for example, in national parks or the marine environment. There are a wide range of management regimes and structures which are used to control the interaction between tourists and wildlife, and these regimes can be categorised as physical, regulatory, economic and educational. Currently, the management of interaction is dominated by physical and regulatory strategies, but considerable potential exists to increase the role of education-based management strategies. The development of a conceptual model which clarifies the range of wildlife interaction opportunities and the management regimes used, and which specifies the outcomes desired, establishes a basis upon which the effectiveness of education can be tested.

***11. Orams M. B. 2002. Feeding wildlife as a tourism attraction: a review of issues and impacts. Tourism Management 23(3): 281-293.***
(Notes: Human focus-wildlife-related tourism)

Abstract: 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 behavior 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.

***12. Marion, J. L., R. G. Dvorak, and R. E. Manning. 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.***
(Notes: Human focus-educational interventions to change human behavior)

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.

***13. Schwarzkopf, S. K. 1984. Feeding of golden-mantled ground squirrels by park visitors at Crater Lake National Park. Research Paper CPSU/OSU 84-9. Corvallis, Oregon: National Park Service Cooperative Park Studies Unit.***

## Habituation Concept

***14. Bejder, L., A. Samuels, H. Whitehead, H. Finn, and S. Allen. 2009. Impact assessment research: use and misuse of habituation, sensitisation and tolerance in describing wildlife responses to anthropogenic stimuli. Marine Ecology Progress Series Vol. 395:177-185.***

Abstract: Studies on the effects of anthropogenic activity on wildlife aim to provide a sound scientific basis for management. However, misinterpretation of the theoretical basis for these studies can jeopardise this objective and lead to management outcomes that are detrimental to the wildlife they are intended to protect. Misapplication of the terms ‘habituation’, ‘sensitisation’ and ‘tolerance’ in impact studies, for example, can lead to fundamental misinterpretations of research findings. Habituation is often used incorrectly to refer to any form of moderation in wildlife response to human disturbance, rather than to describe a progressive reduction in response to stimuli that are perceived as neither aversive nor beneficial. This misinterpretation, when coupled with the widely held assumption that habituation has a positive or neutral outcome for animals, can lead to inappropriate decisions about the threats human interactions pose to wildlife. We review the conceptual framework for the use of habituation, sensitisation and tolerance, and provide a set of principles for their appropriate application in studies of behavioral responses to anthropogenic stimuli. We describe how cases of presumed habituation or sensitisation may actually represent differences in the tolerance levels of wildlife to anthropogenic activity. This distinction is vital because impact studies must address (1) the

various mechanisms by which differing tolerance levels can occur; and (2) the range of explanations for habituation and sensitisation-type responses. We show that only one mechanism leads to true behavioral habituation (or sensitisation), while a range of mechanisms can lead to changes in tolerance.

***15. Brown, T. L., S. A. Jonker, C. A. Jacobson, and D. J. Decker. 2005. Psychological bases for human behavior leading to wildlife habituation. Presentation Abstract. Wildlife Habituation - Advances in understanding and management applications, Annual meeting of The Wildlife Society, September 27, 2005.***
(Notes: human focus-human habituation)

Abstract: The 'causes' of *habituation* typically are tied directly or indirectly to interactions of wildlife with humans or human environments. Most discussions of wildlife *habituation* are concerned in part about human activities that lead to *habituation*; i.e., human behavior that leads to changes or responses in wildlife behavior. Thus, a comprehensive treatment of the topic of wildlife *habituation* includes understanding human behavior with respect to wildlife and related facets of the natural environment. This specialized area of inquiry is encompassed within the human dimensions of natural resources management. Over the last 30 years, social scientists have learned much about the social psychology of humans and their interactions with wildlife, in habitats that often are shared with wildlife. Studies of values, beliefs, attitudes, and norms have revealed insight regarding how people think about and care to interact with wildlife. This paper will review these concepts, and apply them to address two questions: Which human beliefs, attitudes and behaviors may contribute to wildlife *habituation* (and which do not)? How might social norms promote or hinder human behavior that leads to *habituation*? Exploring these questions may reveal insights about how policy and management could affect the human bases for wildlife *habituation*

***16. DeVos, J. C. 2005. Wildlife habituation: a source of social conflict for wildlife management agencies. Presentation Abstract. Wildlife Habituation - Advances in understanding and management applications, Annual meeting of The Wildlife Society, September 27, 2005.***
(Notes: Human focus-social conflict)

Abstract: One consequence of an ever-growing human population in the United States is conversion of formerly intact wildlife to areas of human concentration. This in turn increases the frequency of wildlife-human encounters that are often neutral or positive to wildlife. Positive encounters result when humans provide resources such as access to food resources, either purposely via wildlife feeders or inadvertently by planting vegetation consumed by wildlife or by poor garbage and pet food management. Both of these situation facilitate habituation of wildlife to humans, and in some cases, human habitation of wildlife. As mutual habituation occurs, both people and wildlife can benefit. People tend to benefit from increased contact with wildlife; a situation that may be limited to many urbanites. Wildlife can also benefit as additional food and water resources are available. Conversely, both wildlife and people can have negative consequences from the habituation. There is concern that wildlife can be exposed to pathogens at a higher race as they are concentrated at sources such as backyard drinkers or feeding stations. Wildlife that live in urban areas can be more prone to being killed by vehicles. While wildlife such as birds are welcomed in these urban areas, there are many instances where the presence of wildlife such as pumas (Puma concolor), bears (Ursus americanus), coyotes (Canis latrans),

collared peccary (Pecari tajacu), or white-tailed deer (Odocoileus virginianus) are cause for considerable conflict among neighbors. Some humans are thrilled to see these animals and purposely provide food or water to attract them, while other express high concern for injury or loss of human life or pets. Wildlife management agencies are then places squarely in the midst of conflict over management of these issues. Further complicating this management challenges is a growing concern by segments of society that are advocates for animal rights, which in some cases necessitate that wildlife management agencies develop new strategies to manage the conflict over habituated wildlife. There have been several recent or on-going human-wildlife conflicts over habituated wildlife. There have been several recent or on-going human wildlife conflicts in Arizona that will be discussed relative to the approach taken to reduce the conflict over habituated wildlife.

***17. Geist, V. 2005. Habituation of wildlife to humans: research and recreation opportunity and common curse for wildlife and hapless humans. Presentation Abstract. Wildlife Habituation - Advances in understanding and management applications, Annual meeting of The Wildlife Society, September 27, 2005.***

Abstract: Habituation of wildlife is a double edged sword. It has been enormously useful in studying and filming free-living animals in their natural environment and providing a recreational opportunity. However, it is also a source of mortal danger to its practitioners, to habituated animals, as well as to hapless third parties. Attraction - or positive habituation, in which wildlife seeks out the presence of humans in order to benefit from food, shelter and security, heightens the risk to both animals and humans. It also poses unique management and public relations problems for government agencies. Avoidance or negative habituation in which human activities lead to a systematic aversion of humans by wildlife also has benefits and costs. It allows us to use natural sites freely for creation purposes without danger from wildlife. However, this can result in physiologic costs, lost opportunities for foraging, and loss of important areas of habitat. Distinct from attraction or avoidance, habituation as we will use it in this symposium, is a waning response to a repeated neutral stimulus. Habituation allows recreationists and researchers to observe and record typical behaviors of wildlife in natural settings. It can be unsafe unless the practitioner has a fair understanding of the signals communicated by the habituated species. Further, habituation is not without subtle costs to animals, as indicated by elevated heart rates in behaviorally habituated mountain sheep. Moreover, misinterpretation of habituation has played a role in confrontations between large predators and humans, to the detriment of large predators, particularly in national parks and in rural areas. In the last century wildlife was restored continentally bringing large prey and predators to our places of residence and work. In order to coexist with large mammals, especially large predators, we must better understand the human and the wildlife role in habituation.

***18. Gill, R. Bruce. 2005. Wildlife habituation: the dark side, the light side and the prospects. Presentation Abstract. Wildlife Habituation - Advances in understanding and management applications, Annual meeting of The Wildlife Society, September 27, 2005.***

(Notes: Human focus-human costs and benefits associated with habituation)

Abstract: Like Greek theater, wildlife habituation has two faces, a dark face representing the problems society and wildlife accrue when wildlife habituate and a light face representing the physical and psychological benefits people and wildlife derive from habituated animals. The dark face of habituation is reflected in an abundant professional and popular literature. People

have been injured or died from attacks by bear, coyotes, wapiti, moose and other wildlife. Property damage and injuries result when wildlife, such as foxes, raccoons, skunks, and deer, habituate to the extent they invade urban and suburban habitats. Wildlife and human diseases spread more rapidly when habituated wildlife interact with people. Habituated wildlife are prone to injury or death when they no longer regard people or their cultural artifacts as threats to be avoided. The light face is reflected in the millions of people who enjoy viewing habituated wildlife up close and personal. Birds become so habituated at feeders that they will alight on the feeder while feeders are being recharged. Hummingbirds have been coaxed to land on the fingers of human feeders and have been banded while otherwise occupied with foraging at artificial feeders. Red foxes, coyotes, even wolves have been known to den in proximity to human residences and business, affording remarkable viewing opportunities. Finally, research into animal behavior has been hugely augmented by the use of habituated wildlife. Habituation per se is neither good nor bad. Rather, the value (negative or positive) of habituation to both people and wildlife depends upon context and perception. The future of habituation management will require an objective evaluation of context and perception to encourage habituation when and where it is a benefit and discourage habituation when and where it is a detriment.

***19. Graber, D., S. Gniadek, D. Jansen, and L. Chow. 2005. The quandry of wildlife habituation in a national park setting. Presentation Abstract. Wildlife Habituation - Advances in understanding and management applications, Annual meeting of The Wildlife Society, September 27, 2005.***
(Notes: Human focus-wildlife viewing)

Abstract: People visit national parks and similar preserves in very large part to view animals. Habituation makes that viewing easier and often more pleasurable, and increases the opportunity to observe natural wildlife behavior indifferent to viewer presence. There are in many cases, however, disadvantages to habituation, either to the animals in question or to people. For example, cougars (Puma concolor) have been observed to habituate in some parks, resulting in dangerous proximity to children, which are potential prey. Not infrequently, the benefits and costs of habituation are confounded. This is notably the case with large cervids such as elk (Cervus elaphus) or moose (Alces alces), or large carnivores such as black and brown bears (Ursus americanus, U. arctos). These species all have the potential to become habituated to park visitors, providing for more viewing opportunities and reduced likelihood of accidental encounters leading to defensive aggression. On the other hand, by permitting frequent close proximity of humans to these large animals, naive actions by people often lead to injury to one species or the other. If such proximity occurs in developed areas, it can lead to increase in collisions with motor vehicles or inadvertent entry into structures. Moreover, habituation and resulting close proximity all too often lead in turn to anthropogenic food, whether intentionally provided or inadvertently so. Lastly, habituation may be considered to reduce 'wildness,' which many consider an important element of national parks. On the other hand, where avoidance of humans is the result of human predation, habituation in a park setting might be construed as a more desirable inter-specific relationship. Such a view, however, will unavoidably result in rare encounters between humans and wildlife that are serious and sometimes fatal.

***20. Hinde, R. A., G. Horn, and R. A. Hinde. 1970. Behavioral habituation. Pages 3-40 in G. Horn and R. A. Hinde (eds) Short-term Changes in Neural Activity and Behavior: a conference. Cambridge: Cambridge Univ. Press.***

***21. Hume, R. A. 1992. Habituation. British Birds 85:248.***

***22. Knight, J. 2009. Making Wildlife Viewable: Habituation and Attraction. Society & Animals 17(2):167-185.***

Abstract: The activity of wildlife viewing rests on an underlying contradiction. Wild animals are generally human-averse; they avoid humans and respond to human encounters by fleeing and retreating to cover. One would therefore expect human viewing of wild animals to be at best unpredictable, intermittent, and fleeting. Yet in recent decades, wildlife viewing has become a major recreational activity for millions of people around the world and has emerged as a thriving commercial industry. How can these two things—widespread wildlife intolerance of humans and large-scale human observation of wildlife—be squared? The answer is that wild animals are only viewed on this scale because they have been made viewable through human intervention. This article examines two kinds of intervention—habituation and attraction—that change wildlife behavior toward humans and render hitherto elusive animals susceptible to regular, proximate, and protracted human viewing.

***23. Millspaugh, J. J., E. F. Cassirer, K. Gunther, and B. E. Washburn. 2005. Consideration and use of physiological measures to assess costs of wildlife habituation. Presentation Abstract. Advances in understanding and management applications, annual meeting of the wildlife society, September 27, 2005***

Abstract: In many national parks and protected areas, wildlife become habituated to high levels of human activity. On National Park lands, trumpeter swans and large mammals such as grizzly bears, black bears, wolves, coyotes, bison, elk, pronghorn antelope, and bighorn sheep commonly habituate to people. In African parks, elephants and other wildlife tolerate people and vehicles at close distances. Although negative consequences of *habituation* are often described, there are some benefits to humans and wildlife. *Habituation* increases wildlife viewing opportunities for park visitors, which provides economic returns and in turn promotes conservation of species such as elephants. *Habituation* to human activity may also increase the amount of habitat available for wildlife that must share space with people and may allow protection from non-habituated predators. However, despite these tangible benefits, we should also consider less obvious but potentially important impacts to wildlife, such as physiological costs (e.g., stress). Physiological measures may forewarn of possible behavioral modification (e.g., reduced visibility) and therefore help us understand whether animals experience less visible impacts from *habituation* and human interaction. In this paper we discuss case studies from Yellowstone National Park and South African National Parks that highlight the benefits of *habituation* to humans and wildlife. We also describe the use of physiological measures, such as stress hormones in feces, when considering the impacts of *habituation* and discuss 'stress' as related to wildlife. We concluded with a critical review of methods to evaluate physiological responses in wildlife with an emphasis on non-invasive procedures. We believe that physiological measures complement behavioral data by providing data by providing a means to evaluate subtle costs associated with *habituation.*

***24. Ridder, B. 2007. The Naturalness versus Wildness Debate: Ambiguity, Inconsistency, and Unattainable Objectivity. Restoration Ecology 15(1): 8-12.***

Abstract: The naturalness versus wildness debate has gained some prominence in recent years and has seen considerable discussion of issues akin to those that have generated such tension between restorationists and preservationists. This debate is hampered by the terms in which it is framed. The primary meaning of both naturalness and wildness relates to the description of processes or behavior that lack human intervention. This enables human activities and artifacts (such as childbirth, food, and medicine) to be rated according to naturalness. However, when the terms are applied to the description of species and ecosystems, process-oriented definitions are forgotten in favor of historical benchmarks. This can result in serious inconsistencies between those who adhere to the different interpretations, exemplified by the tendency of conservationists to view "naturalness" as being consistent with human intervention in natural processes. The choice of one or the other interpretation is motivated by whether one prioritizes the conservation of biodiversity or minimizing human intervention. There have been claims that naturalness provides an objective measure for assessing biodiversity and calls for value-laden terms to be avoided. Yet, the values are central, and the best that can be hoped for is that the debate be framed using terms that are more indicative of these underlying values. It is suggested here that naturalness versus wildness be recast as "protecting biodiversity" versus "respect for nature's autonomy." Not only do these terms avoid the ambiguities of their forebears but they also expose the debate as the result of slight shifts in value priorities rather than fundamentally opposed worldviews.

***25. St. Clair, C. C., S. Herrero, and T. E. Hurd. 2005. Finding the middle ground for managing habituated wildlife. Presentation Abstract. Advances in understanding and management applications, annual meeting of The Wildlife Society, September 27, 2005.***

***26. Supernaugh, W. 2005. Federal protected areas: perspectives on wildlife habituation, policy and actions. Presentation Abstract. Wildlife Habituation - Advances in understanding and management applications, Annual meeting of The Wildlife Society, September 27, 2005.***
(Notes: Human focus-communicating with stakeholders)

Abstract: Federal land managers, wildlife biologists and policy officials increasingly must deal not only with the direct issue of wildlife that have become accustomed to human presence but must also contend with the public's reaction to management solutions. Today's wildlife managers must not only possess the administrative familiarity with agency and bureau policy as well as the biological knowledge to describe and implement a prescriptive course of action to deal with habituated wildlife but must also have the ability to work through the public involvement process and understand the sociological biases present in today's society. Habituated wildlife come in many species and occupy a wide range of environments shared by humans. Well documented incidents involve large numbers of Canada geese present on recreational sites but some surprising examples of habituation such as bighorn sheep in high mountain wilderness areas, and deer at the bottom of the Grand Canyon also occur. The session will present examples of these and other human-wildlife interactions that required management intervention and the public's reaction to it. Successes - and failures - in communicating the necessity of management actions ranging from education and awareness to aversive conditioning, relocation or lethal removal of

problem animals will be discussed. Suggested methods for graining public understanding and support will be shared.

***27. Whittaker, D., and R. L. Knight. 1998. Understanding wildlife response to humans. Wildlife Society Bulletin 26(2): 312-317.***

Summary: In this commentary, the authors offer their opinion on the need for better research and understanding of the human-wildlife interface. They provide definitions of relevant reaction terms, including habituation. They also explore some positive and negative consequences of habituated wildlife. This paper offers useful general guidance on research and management needs related to habituation.

***28. Zinn, H., M. J. Manfredo, and D. J. Decker. 2005. Habituation of humans to wildlife - a different perspective. Presentation Abstract. Wildlife Habituation - Advances in understanding and management applications, Annual meeting of The Wildlife Society, September 27, 2005.***

(Notes: Human focus-human habituation)

Abstract: The focus of inquiry about wildlife habituation has been on the physiology and behavior of wildlife with respect to interactions with humans and human-dominated environments. However, if policy and management concerns are paramount, it may be important to take a broader view of habituation. We believe that a human-centric rather than wildlife-centric perspective leads to a question, do people habituate to wildlife? Furthermore, can wildlife habituate to humans without human habituation to wildlife? No study we are aware of had addressed this topic directly, so we approach it by assuming that humans can habituate to wildlife and then seeking evidence for the phenomenon. A simple stimulus-response framework can explain wildlife habituation to humans, but human learning is far more complex. Therefore, we look for ways that different human learning processes and opportunities might influence values, risk perception, wildlife acceptance capacity, and habituation of wildlife. For example, to what extent can different learning processes and opportunities explain why some people interpret a human-wildlife interaction positively while others interpret the same interaction negatively? Similarly, to what extent can different learning processes and opportunities explain why people sometimes from strikingly disparate perceptions of risk from human-wildlife interactions? And, how might individual differences in the interpretation of interactions and perception of risk reflect habituation to wildlife? Finally, and of particular importance to wildlife managers, does human habituation to wildlife result in higher objective risk of negative impact to or from wildlife? We do not have definitive answers to these questions. Our intent is to stimulate thinking about wildlife habituation from an unconventional perspective, one that we hope will augment the wildlife-centric perspectives that has traditionally been brought to bear on habituation issues

***29. Zinn, H., M. J. Manfredo, and D. J. Decker. 2008. Human Conditioning to Wildlife: Steps Toward Theory and Research. Human Dimensions of Wildlife 13(6): 388-339.***

(Notes: Human focus-human habituation)

Abstract: Wildlife conditioning and habitation to humans are frequently studied, but human conditioning and habituation to wildlife have received little attention. We propose that human-wildlife interaction can be better understood and managed if conditioning and habituation are examined in both humans and wildlife. We review what is known about human conditioning and

habituation and their relationships to four aspects of human learning (i.e., enactive learning, behavior modeling, expectancy, tutelage) and conclude that human conditioning to wildlife occurs more often than habituation. The results of human conditioning vary among individuals because the process is shaped by pre-existing expectations, attitudes and values, knowledge, skills, and situational differences. An improved understanding of human conditioning to wildlife has the potential to improve our ability to predict, understand, and influence human beliefs about and behavior toward wildlife, minimize negative aspects of wildlife-human interaction, and protect the viability of wildlife conservation as a widely shared social goal.

## Impacts of Recreationists, Visitors, and Neighbors on Park Wildlife

***30. Burson III, S. L., J. L. Belant, K. A. Fortier and W. C. Tomkiewicz III. 1999. The Effect of Vehicle Traffic on Wildlife in Denali National Park. Arctic 53(2): 146–151.***

Abstract. We recorded observations of caribou (*Rangifer tarandus*), grizzly bear (*Ursus arctos*), Dall sheep (*Ovis dalli*) and moose (*Alces alces*) along the Denali National Park and Preserve road corridor during 1995–97. We compared these observations to similar data from previous studies to evaluate the effect of an increase in traffic on the number of animals sighted and their behavior. Between 1972 and 1997, annual visitation to Denali National Park increased from about 45 000 to 350 000, with attendant increases in traffic on the park road. The mean number of caribou, grizzly bear, and Dall sheep observed did not decline ($p > 0.301$) from 1973 to 1997. The number of moose observed declined by more than 50% ($R2 = 0.529$, $p < 0.001$). The estimated population of moose also declined over the same period ($R2 = 0.374$, $p = 0.002$). The distance from the park road at which caribou and grizzly bears were sighted did not change ($p > 0.787$), but fewer moose ($p < 0.031$) were observed within 100 m of the road and fewer sheep ($p < 0.011$) were observed between 400 and 500 m from the road. Adverse behavioral responses to traffic (e.g., running from vehicles) occurred in less than 1.3% of observations for each species. Increased traffic on the park road apparently has not caused significant changes in abundance, distribution, or behavior of caribou, grizzly bear, Dall sheep, and moose in the park road corridor.

Key words: Alaska, behavior, caribou (*Rangifer tarandus*), Dall sheep (*Ovis dalli*), Denali National Park, grizzly bear (*Ursus arctos*), human disturbance, moose (*Alces alces*), traffic, visitation.

***31. Bath, A. J. , and J. W. Enck. 2003. Wildlife-human interactions in national parks in Canada and the USA. Social Science Research Review Vol 4(1). 20pp.***

(Notes: Wildlife focus with HD components)

***32. Bow Corridor Ecosystem Advisory Group (BCEAG). 1999 Guidelines for human use within wildlife corridors and habitat patches in the Bow Valley, Municipality of Bighorn, Twon of Canmore, Banff National Park, Government of Alberta. 5pp.***

(Notes: Wildlife focus with HD components)

***33. Boyle, S. A., and F. B. Samson. 1985. Effects of nonconsumptive recreation on wildlife: A review. Wildlife Society Bulletin 13:110-116.***

(Notes: Wildlife focus with HD components)

Conclusions: Burgeoning numbers of nonconsumptive outdoor recreationists are creating increasing impacts on wildlife and wildlife habitat, but proper management is hampered by the complexity of cause-and-effect relationships and the incompleteness of existing knowledge. Recreationists can affect wildlife through habitat alteration, disturbance, or direct mortality. Mechanized forms of recreation present the most serious potential impacts, but even the most casual intrusion by a person on foot may significantly affect vulnerable populations. Individuals, populations, and species vary in their sensitivity to disturbance; and researchers have begun to identify some mechanisms of human-wildlife interactions. Wildlife conservationists are challenged to identify recreational impacts on wildlife, establish priorities for management, and implement schemes to conserve wildlife resources while providing for increasing use demands of recreationists.

***34. Compton, G. 1994. Visitors and wildlife. Yellowstone Science 2(2):5-8.***
(Notes: Wildlife focus with HD components)

***35. Gander, H., and P. Ingold. 1997. Reactions of male alpine chamois (Rupicapra r. rupicapra) to hikers, joggers and mountainbikers. Biological Conservation 79: 107-109.***
Summary: In this short note, the authors found that hiking, jogging, and biking on trails through a foraging area caused chamois to alter their habitat use. They found a slight interaction between type of experiment and time of day that determined flight distance. The chamois showed some signs of habituation but this was hampered by hikers leaving the trail.

***36. Harris L. K., R. H. Gimblett, and W. W. Shaw. 1995. Multiple use management: Using a GIS model to understand conflicts between recreationists and sensitive wildlife. Society and Natural Resources 8(6): 559-572.***
(Notes: Wildlife focus with HD components)

***37. Harris L.K., W. W. Shaw, and J. Shelhas. 1997. Urban neighbors' wildlife-related attitudes and behaviors near federally-protected areas in Tucson, Arizona, USA. Natural Areas Journal 17(2):144-148.***
(Notes: Human focus with HD components-attitudes and behaviors)

Abstract. Urban development adjacent to protected natural areas may result in reduced scenic beauty, recreational opportunities, and tourism associated with the natural amenities of these areas. Conservation of the biological, recreational, and scenic resources in parks and preserves requires an understanding of the relationships between the protected areas and their suburban neighbors. This information can be useful to both resource managers concerned with protecting wildlife and natural resources and urban planners concerned with maintaining an attractive residential environment for people. As part of several studies on urban conservation issues being conducted at the University of Arizona, USA, a mail survey of households within 1.6 km (1 mile) of large federal landholdings adjacent to Tucson, Arizona (Pusch Ridge Wilderness, managed by the US Forest Service, and Saguaro National Park, managed by the US National Park Service) was conducted. The sample size was 690. >80% of the households completed the survey, providing information about their interests in wildlife resources and about their attitudes and behaviors relating to the public natural areas adjacent to their homes. Issues covered by the survey included interactions with wildlife (57% of the households fed wild birds and 26% fed other wildlife), importance of living near protected areas (69% reported "proximity to protected areas an important factor in choice of home location"), attitudes toward various kinds of

development in the neighborhood, and problems caused by wildlife at people's homes. These and other findings were analyzed in terms of their implications for the managers of protected areas and for metropolitan planning.

***38. Hecnar, S. J. and R. T. M'Closkey. 1998. Effects of human disturbance on five-lined skink, Eumeces fasciatus, abundance and distribution. Biological Conservation 85(3): 213-222.***

Abstract: We studied the effects of human disturbance on five-lined skinks at Point Pelee National Park, Canada. Surveys indicated low skink abundance and a lack of woody debris in areas heavily used by humans and a downward population trend concurrent with high disturbance levels. Skinks preferentially used large moderately decayed logs and boards for refuge sites. Human disturbance resulted in degradation and removal of debris. Degradation by fragmentation and accelerated decay resulted in decreased quality of available debris. To test the hypothesis that skink absence in human high-use areas was caused by a lack of suitable debris, we placed artificial microhabitats in areas which previously lacked woody debris and skinks. Experimental debris were colonized quickly and heavily used despite high disturbance rates. Skinks are resilient to minor disturbances such as displacements, but not to removal or degradation of debris. Essential microhabitat features must be actively preserved as well as suitable habitat to ensure the conservation of target species.

***39. Knight, R. L. and K. J. Gutzwiller. 1995. Wildlife and recreationists: Coexistence through management and research. Island Press, Washington, D.C. 372pp.***

(Notes: Human focus-recreationist behaviors)

***40. Kuss, F. R., A. R. Graefe, and J. J. Vaske. 1990. Visitor impact management: A review of research. National Parks and Conservation Association, Washington, D.C.***

(Notes: Human focus-visitor behavior)

***41. Leong, K. M., D. J. Daniel, J. Forester, P. D. Curtis, and M. A. Wild. 2007. Expanding Problem Frames to Understand Human-wildlife Conflicts in Urban-proximate Parks. Journal of Park and Recreation Administration 25(4): 62-78.***

(Notes: Human focus-integrating HD components into problem framing)

Executive summary: Landscape change that accompanies urbanization is leading to increased frequency and intensity of human-wildlife interactions. Many urban-proximate National Park Service (NPS) units are experiencing encroachment from development. This context presents increasingly complex wildlife management challenges for parks and recreation administrators and managers. White-tailed deer (*Odocoileus virginianus*) have been a major concern for over two decades in urban-proximate NPS units in the northeastern U.S., where biological studies have documented deer density, movement, and impact on park resources. Typically, NPS managers frame deer issues as population-management problems. The extent to which vegetation damage by deer affects the integrity of the unit's resource protection goals and objectives determines whether deer population levels in parks are acceptable or unacceptable, and to what extent. Deer that use urban-proximate parks also use habitats in surrounding communities and cause impacts to local community residents. Little research has assessed the scope of resident stakeholder understanding of the deer-management system for urban-proximate parks administered by the NPS. This study utilized semi-structured interviews with residents of

communities near two parks to describe the potential breadth of complex deer issues and contributing factors (i.e., the management system). At both study sites, interviewees revealed the management system as a multilevel system of factors that contributed to perceived deer problems: (I) causing (III) events or interactions between deer and people or resources, some of which lead to (IV) habituation of deer to anthropogenic activities, amplifying (V) perception of specific impacts experienced by stakeholders. A conceptual model was developed to visually depict the perceived relationship between the different system components. The NPS management frame and the dominant discourses at each park then were mapped onto the conceptual model to illustrate how differences in framing can contribute to suburban wildlife controversies. At both parks, the dominant discourse differed from the NPS management frame, illustrating that suburban deer issues are more than just complex; they are "messy." Messy problems, while fundamentally complex, do not have a single problem formulation. Conceptual models like the one described in this study may be used as a starting point for future discourse-based stakeholder engagement processes to facilitate mutual learning between stakeholders and managers that expands perspectives beyond conventional problem frames to create sustainable solutions.

***42. MacArthur, R. A., V. Geist, and R. H. Johnson. 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. Journal of Wildlife Management 46:351-358.***

Summary: This study examines the physiological effects of recreational disturbance on mountain sheep in Alberta. Researchers used telemetered heart-rate monitors to measure the effects of human disturbance. They found that sheep were habituated to human activity near a road, but became agitated when humans approached from a different angle or with a dog. The authors conclude that sheep can coexist with human recreation as long as human activity is concentrated on roads and trails and dogs are restricted.

***43. Muellner, A., K. E. Linsenmair, and M. Wikelski. 2004. Exposure to ecotourism reduces survival and affects stress response in hoatzin chicks (Opisthocomus hoazin). Biological Conservation 118:549-558.***

Summary: Some colonies of hoatzins are exposed to high levels of disturbance from eco-tourists. This study compared nesting success of hoatzins at undisturbed and eco-tourist-exposed nests. Adults at tourist-exposed nests were highly habituated to humans and had hatching rates similar to undisturbed nests. However, fledging success was significantly lower in disturbed areas due partly to hormonal response to disturbance stress. The authors discuss the variation in habituation capacity at different life stages.

***44. Nepsted, E. and P. Nilsen. 1993. Towards a better understanding of human/environment relationships in Canadian National Parks. National Parks Occassional Paper No 5. 77pp.***

(Notes: Human focus)

***45. Nevin, O. T., and B. K. Gilbert. 2005. Perceived risk, displacement and refuging in brown bears: positive impacts of ecotourism? Biological Conservation 121(4): 611-622.***

Abstract: Ecotourism is a rapidly growing industry with unknown impacts on viewed wildlife that may require novel management action. We examined the impact of viewing activities on the behavior of brown bears (Ursus arctos) in coastal British Columbia. Domination of the best

feeding sites and human avoidance by large male bears has consistently been reported. We, however, saw displacement in time rather than space – during the viewing day large males were less active than at other times, while females with cubs tended to be more active. In each year, females with cubs spent similarly high proportions of their time fishing when people were present. In years with large male activity, less time was spent fishing when people were absent. When freed from the potential threat of large male bears, females with cubs showed no measurable impact of controlled human activity. Human presence at a feeding site impacts the behavior of brown bears, but not as expected. Temporal avoidance of human activity by large males was observed; indications that they departed upon satiation, before the arrival of morning tours, however, suggests that there was little energetic impact. By displacing large males, viewing activities created a temporal refuge, enhancing feeding opportunities for subordinate age/sex classes. With the strong positive relationships between mean female mass and litter size, this may in turn increase population productivity.

***46. Papouchis, C. M., F. J. Singer, and W. B. Sloan. 2001. Responses of desert bighorn sheep to increased human recreation. Journal of Wildlife Management 65: 573-582.***

Summary: Disturbance from increasing human recreation in the southwestern United States may be a cause of declining bighorn sheep populations. The authors used radiomarked and visually spotted sheep in Canyonlands National Park to measure the responses of sheep to a variety of human activities in both low- and high-use recreation areas. Sheep reacted more strongly to hikers than to bikers or vehicles, and the reactions to hikers were stronger in the high-use area. The sensitivity of sheep to hikers may result from the unpredictability of hiker locations relative to trail- or road-bound vehicles. The authors suggest that hikers be restricted to trails, especially during lambing and rut, to minimize disturbance.

***47. Park, L. O., R. E. Manning, J. L. Marion, S. R. Lawson, and C. C. Jacobi. 2008. Managing Visitor Impacts in Parks: A Multi-Method Study of the Effectiveness of Alternative Management Practices. Journal of Park and Recreation Administration 26(1): 97-121.***

(Notes: Human focus-evaluation of interventions to influence visitor behavior)

Executive summary: How can recreation use be managed to control associated environmental impacts? What management practices are most effective and why? This study explored these and related questions through a series of experimental “treatments” and associated “controls” at the summit of Cadillac Mountain in Acadia National Park, a heavily used and environmentally fragile area. The treatments included five management practices designed to keep visitors on maintained trails, and these practices ranged from “indirect” (information/education) to “direct” (a fence bordering the trail). Research methods included unobtrusive observation of visitors to determine the percentage of visitors who walked off-trail and a follow-up visitor survey to explore why management practices did or didn’t work. All of the management practices reduced the percentage of visitors who walked off-trail. More aggressive applications of indirect practices were more effective than less aggressive applications, and the direct management practice of fencing was the most effective of all. None of the indirect management practices reduced walking off-trail to a degree that is likely to control damage to soil and vegetation at the study site. Study findings suggest that an integrated suite of direct and indirect management practices be implemented on Cadillac Mountain (and other, similar sites) that includes a) a regulation requiring visitors to stay on the maintained trail, b) enforcement of this regulation as needed, c)

unobtrusive fencing along the margins of the trail, d) redesign of the trail to extend it, widen it in key places, and provide short spur trails to key "photo points", and e) an aggressive information/education program to inform visitors of the regulation to stay on the trail and the reasons for it. These recommendations are a manifestation of what may be an emerging principle of park and outdoor recreation management: intensive use requires intensive management.

***48. Miller, S. G., R. L. Knight, and C. K. Miller. 2001. Wildlife responses to pedestrians and dogs. Wildlife Society Bulletin 29: 124-132.***

Summary: As recreational pressure on wildlife increases, managers need to understand how different species respond to different forms of disturbance. This study measured the responses of two grassland bird species, one forest bird, and mule deer to hikers and hikers with dogs and examined the area of influence for each treatment. Birds were more sensitive to pedestrians than to dogs, while the flush distance of mule deer greatly increased with the presence of dogs. The authors discuss habituation in the context of regular, predictable movements and show that flush distance is greater when pedestrians move off of designated trails. Management plans that limit movement off trails and/or restrict dogs are suggested.

***49. Swarthout, E. C. H., and R. J. Steidl. 2003. Experimental effects of hiking on breeding Mexican spotted owls. Conservation Biology 17: 307-315.***

Summary: In some parts of their range, Mexican spotted owls are subject to high levels of recreational disturbance, specifically from hikers. This study compared owl behavior during hiker disturbances and control periods. Activity budgets were not drastically altered, but prey handling decreased and vocalizations increased when hikers were near nests. The owls live in low-traffic areas and were likely not habituated to humans before the experiment. The authors hypothesize that they may have the capacity to habituate to greater levels of hiking.

***50. Wright, R. G. 1992. Wildlife research and management in the national parks. Univ. of Illinois Press: Urbana, IL.***

## Bears in Parks

***51. Albert, D. M. and R. T. Bowyer. 1991. Factors related to grizzly bear-human interactions in Denali National Park. Wildlife Society Bulletin 19(3): 339-349.***

(Notes: Bear focus with HD elements- shuttle bus use, road use, hiking, camping)

Abstract: Although improved management has reduced the number of more serious incidents between grizzly bears and people in Denali NPP, the rate of interactions has increased from 80 per million visitors in 1987 to 197 per million visitors in 1989. Most interactions in front-country areas occurred in early June and late August, and probably involved bears habituated to humans. Backcountry interactions were strongly correlated with the number of people riding shuttle buses and may have been caused by less-habituated bears moving from front-country to backcountry areas, or from seasonal changes in habitat selection by bears. Interactions occurred on river and gravel bars more frequently and on tundra less frequently than expected by occurrence of these habitats within the park. Although bears in Denali NPP are seldom conditioned to people by the reward of food, there is a high rate of bears approaching people or entering camps with people present. Further, bears showed a greater tendency to approach people in developed areas, along the park road, and in camps than when people were hiking in the backcountry. Efforts to

minimize interactions between bears and people will increase visitor safety and reduce opportunities for bears to obtain food from humans. We believe better education of NPS personnel, concession employees, and park visitors about bears, and reducing human activity in habitats used by both people and bears offer the greatest likelihood of achieving this goal.

***52. Bader, M. 1989. Habituation in yellowstone's grizzly bears: a special problem in wildlife management. Western Wildlands; 14(4): 25-29.***

Abstract. The 1973 Endangered Species Act, USA, requires federal officials responsible for grizzly bear management to preserve bear habitat and control human use of such areas to protect the species. Yet there has been an increase in bear/human conflicts in national parks in both the USA and Canada, and both bears and humans have died as a result. In the Yellowstone ecosystem, what is known as 'habituation' has been a factor in most of the bear mortalities. Grizzly bears, like other animals, become habituated to people as a result of frequent contact. This often leads to more and more close encounters, and the habituated bears may eventually become more aggressive around people. In order to enhance the chance of long-term grizzly preservation, emphasis needs to be placed on people management, whether that requires managers to time the seasonal distribution of people in the park or move some developments completely out of key habitat.

***53. Braithwaite, A. and S. McCool. 1989. Social influences and backcountry visitor behavior in occupied grizzly habitat. Society and Natural Resources 2(4): 273-283.***
(Notes: HD focus-behavior, social norms)

Increasing concerns about confrontations between backcountry recreational visitors and bears have led to bear management plans that rely heavily on information programs to persuade such visitors to adopt appropriate behaviors. The effectiveness of these programs is sometimes questioned because confrontations continue, and the cause is often inappropriate human behavior. Contemporary attitude theory suggests that social influences on behavior may affect the reception and adoption of information programs. This study investigated the importance of various social groups to backcountry visitors as sources of information and as influences on appropriate behavior in occupied grizzly bear habitat. Of nine referent groups, backcountry rangers and group members were identified as the most influential and reliable sources of information. Overall, the importance of specific types of social and informational influences varied in their influence on backcountry visitor behavioral norms.

***54. Creachbaum, M. S., C. Johnson, and R. H. Schmidt. 1998. Living on the edge: a process for redesigning campgrounds in grizzly bear habitat. Landscape and Urban Planning 42(2): 269-286.***
Abstract: The North Fork of the Shoshone Highway Corridor contains 52% of the developed recreation sites within the Shoshone National Forest. The highway is a popular access route for visitors traveling from Cody, WY to Yellowstone National Park. This river corridor is also an important habitat for a growing population of grizzly bears. The Shoshone National Forest is currently proposing a major reconstruction of recreation facilities along the highway corridor. This has presented the Forest with an excellent opportunity to recreate facilities that encourage more appropriate human behavior in grizzly habitat. This concept for campground design is a

composite of many design strategies currently used internationally in bear habitat designs and information derived from current research in bear/human conflict, grizzly bear behavior and bear habitat use and habitat assessment. The application of this concept to recreational facilities in the North Fork Corridor is the product of an interagency design team of landscape architects and biologists from the US Forest Service, Wyoming Game and Fish Department, US Fish and Wildlife Service, and the National Park Service in the Greater Yellowstone Area. The design process involves identifying local grizzly bear use patterns and zoning campground components to accommodate these patterns. The most vulnerable facilities (tent pads), are located furthest from bear travel corridors and food preparation areas. Buffer zones, leave strips, trails and barriers are used to help direct bear travel around the campground. Food storage facilities, garbage facilities, cooking sites, and other attractants are consolidated. Human access into bear travel zones is structurally controlled. A major focus of the design is to emphasize the presence of the bear through the actual layout of campground facilities and to capitalize on the unique experience of camping in the grizzly bear's domain.

***55. Chruszcz, B., A. P. Clevenger, K. E. Gunson, and M. L. Gibeau. 2003. Relationships among grizzly bears, highways, and habitat in the Banff-Bow Valley, Alberta, Canada. Canadian Journal of Zoology 81: 1378-1391.***

Abstract: Banff National Park and surrounding lands constitute one of the most developed landscapes in the world where grizzly bears (*Ursus arctos*) still survive. We examine the relationships among roads, grizzly bears, and their habitat in a protected area with low road density but dominated by a major transportation corridor and highway system. We examined grizzly bears' spatial response to roads, road-crossing behavior, crossing-location attributes, and habitat and temporal patterns of cross-road movements. Grizzly bears used areas close to roads more than expected, particularly roads with low traffic volume (low volume). Habituated bears were closer to roads than wary bears. Males were closer to low-volume roads than females but crossed roads less than females during the berry season. Bears were more likely to cross low-volume roads than high-volume roads and were more likely to cross at points with higher habitat rankings. In addition, bears were more likely to cross high-volume roads when moving from areas with low habitat values to areas with high habitat values. Efforts to prevent loss of habitat connectivity across highways should involve maintenance of high-quality grizzly bear habitat adjacent to roads and should address the effects of traffic volume on the road-crossing decisions of grizzly bears.

***56. Clark, J. E., F. T. van Manen, and M. R. Pelton. 2002. Correlates of success for on-site releases of nuisance black bears in great Smokey Mountains National Park. Wildlife Society Bulletin 30(1): 104-111.***

Abstract: Since 1990, wildlife biologists in Great Smoky Mountains National Park have used capture and on-site release as a management technique to reduce recurrence of nuisance activity by black bears (*Ursus americanus*). On-site release involves capture and immobilization of bears that frequent developed areas, collection of biological data, and subsequent release of the animals in the area of capture. Our objective was to identify factors related to success of this technique. We classified 85 on-site releases of black bears as successes or failures based on post-release observations and subsequent management actions at the release site. We examined 11 variables for their associations with release success. Important variables associated with success of on-site releases were sex, presence of young, type of developed area where capture occurred, time of day that the bear was active in developed areas, and bear population abundance. Given

various scenarios of nuisance bear activity, biologists can use our findings to determine when on-site release is appropriate.

***57. DeBruyn, T. D., T. S. Smith, K. Proffitt, S. Partridge, and T. D. Drummer. 2004. Brown bear response to elevated viewing structures at Brooks River, Alaska. Wildlife Society Bulletin 32(4): 1132-1140.***
(Notes: Bear focus with HD components-human traffic and behavior on viewing platforms)

Abstract: The increasing popularity of brown *bear* (Ursus arctos) viewing at Brooks River in Katmai *National Park*, Alaska has resulted in overcrowded facilities, increasing *bear*-human conflicts, displacement of *bears* from important habitats, and degradation of cultural resources. To partially address these issues, the *National Park* Service (NPS) constructed a 300-m-long elevated boardwalk with interconnected viewing platforms in August 2000. To determine what effects the new structures might have on individual *bears*, we observed *bear* movements and behaviors before and after construction. We used direct observations and motion-detection cameras to construct temporal-spatial profiles of *bear* activity. Although *bear* numbers were similar (59 *bears* in 2000 and 56 *bears* in 2001) and *bear* activity within the greater Brooks River area did not differ (P = 0.62, n = 29) between the 2 years of this study, trail crossings in the vicinity of the new structures decreased 78% (7,436 crossings in 2000 and 1,646 crossings in 2001; x2 = 762, df = 14, P< 0.001). *Bear* temporal use of the boardwalk area changed such that when human use was highest, *bear* use was proportionally lower in the post- versus pre-construction phase (x2 = 34, df = 3, P 0.005). Of 123 direct observations of *bears* approaching to pass beneath the structures, only 19.5% rerouted or avoided crossing under the structures. *Bears*' responses to the new structures were influenced by the behavior of visitors upon the structures. Potential management tools to minimize impacts of these structures on *bears* include enhanced public education regarding visitor conduct on the boardwalk, as well as visitor management and monitoring.

***58. Delozier, E. K., W. H. Stiver, and S. R. Darling. 1996. Great Smoky Mountains National Park status report. Proceedings Eastern Black Bear Workshop 13: 74-77.***
Abstract: The authors describe the management of the black bear in the Great Smoky Mountains National Park, Tennessee. Nuisance bear issues and conservation education are the important areas for the National Park at this time.

***59. Gibeau, M. L., A. P. Clevenger, S. Herrero, and J. Wierzchowski. 2002. Grizzly bear response to human development and activities in the Bow River Watershed, Alberta, Canada. Biological Conservation 103:227-236.***
Abstract: Few studies have reported the effects of multiple human activities on grizzly bears, Ursus arctos. We document the degree of grizzly bear response to various human developments as a function of multiple interacting variables based on observed median distances to roads, trails and development features in a landscape where human presence is widespread. Female grizzly bears remained further than males from paved roads regardless of habitat quality or time of day. Males were found closer to paved roads when within or adjacent to high quality habitat and during the period of least human activity. The combination of traffic volume and highway configuration, however, overrides a bear's attraction to high quality habitats for high-speed, high-volume, highways. Avoidance of busy transportation corridors was strongest in the adult segment of the population. Bears were found closer to trails during the human inactive period when within high quality habitat and further from trails when distant to high quality habitat. Our

data indicated an inverse relationship between the sexes in response to vehicles and traffic noise compared to the response to human settlement and encountering people. Female bears were found further away than males in relation to vehicles and traffic noise, yet found closer than males to human settlement and places where people may be encountered. Those males that were more willing to exploit high quality habitat near roads, did so at night and where hiding cover was present. Adult females were the most risk-averse cohort, choosing to avoid humans instead of seeking out high quality habitats. Adult female grizzly bears were influenced most by human activities and development. Management agencies must maintain access to high quality habitat, especially for adult females, and create new opportunities to support the reproductive potential of the population.

Summary: Development in the Bow River Watershed, Alberta, has brought grizzly bears into increasing contact with multiple human activities, and few studies have reported on how bears will respond to these activities. The authors examined bear response to human development by measuring a host of variables, including distance to roads and development across sex-age classes. Several aspects of habituation are discussed, including differences across sex-age classes, the need to manage habituation, advantages for resource exploitation, and increased risk of mortality. Adult females were the most affected by human activity and the authors make suggestions for managing habitat with adult females in mind.

***60. Greenleaf, S. S., S. M. Matthews, R. G. Wright, J. J. Beecham, and H. M. Leithead. 2009. Food habits of American black bears as a metric for direct management of human-bear conflict in Yosemite Valley, Yosemite National Park, California. Ursus 20(2): 94-101.***
(Notes: Bear focus with HD components-anthropogenic foods)

Abstract: The management of human- black bear (*Ursus americanus*) conflict has been of significant concern for Yosemite National Park (YNP) personnel since the 1920s. Park managers implemented the YNP Human Bear Management Plan in 1975 in an effort to reduce human bear conflicts, especially in the extensively developed Yosemite Valley (YV). We used scat analysis to estimate annual and seasonal food habits of black bears in YV during 2001 We assessed the success of efforts to reduce the availability of anthropogenic foods, including garbage, by examining changes in the diet compared to a study from 1974 78 (Graber 1981). also quantified consumption of non-native fruit to address its possible contribution to human bear conflicts. The annual percent volume of human-provided food and garbage in black bear scats in YV decreased from 21% to 6% between 1978 and 2002, indicating YNP efforts have been effective. We found high use of non-native apples by bears throughout YV. Non-native food sources could be contributing to *habituation* and food conditioning, given their proximity to developed areas of YV. We recommend that YNP managers continue to (I) adapt and improve their management tools to address changing circumstances, (2) quantify the success new management tools, and (3) reduce the availability of non-native food sources.

***61. Gunther, K. A. 1994. Bear Management in Yellowstone National Park, 1960-93. International Conference on Bear Research and Management 9(I): 549-560.***
Abstract: From 1931 through 1959, an average of 48 people per year was injured by bears within Yellowstone National Park (YNP). In 1960, YNP implemented a bear management program designed to reduce the number of bear-caused human injuries and property damages occurring

within YNP and to re-establish bears in a natural state. Although the 1960 program included some efforts to reduce the human food and garbage sources that were attracting bears into developed areas and roadside corridors, most management effort went into the removal of potentially hazardous bears and those bears that damaged property in search of human foods. After 10 years (1960-69) of the program, 332 nuisance black bears (Ursus americanus) and 39 nuisance grizzly bears (Ursus arctos horribilis) had been removed from the population. However, the number of bear-caused human injuries within YNP had decreased only slightly, to an average of 45 per year. In 1970, YNP initiated a new, more intensive bear management program with the objectives of restoring the grizzly bear and black bear populations to subsistence on natural forage and reducing the number of bear-caused injuries to humans. Management involved eliminating the sources of human food and garbage that attracted bears into developed areas and along roadsides, the source of most bear-human conflicts. During the first 3 years of the program, bear-caused human injuries decreased significantly to an average of 10 per year. During the same period, an average of 38 grizzly bears and 23 black bears per year were trapped and translocated from roadsides and developed areas to backcountry areas. In addition, an average of 12 grizzly bears and 6 black bears per year, were removed from the population. After 1972, the number of bear-human conflicts as well as the number of bear management control actions declined significantly. A modified bear management program similar to the 1970 program, but with greater emphasis on habitat protection in backcountry areas, was implemented in 1983. Since 1983, bear-caused human injuries have declined to an average of 1 per year and the number of nuisance bears translocated (grizzly bears = 4/yr, black bears = 2/yr) as well as the number of incorrigible bears removed from the population (grizzly bears = 1/yr, black bears = 0.4/yr) has also declined significantly from earlier periods. During the first years of these management programs, most bear-human conflicts involved food-conditioned bears that aggressively sought human foods. In more recent years, management problems have involved habituated (but not food-conditioned) bears seeking natural foods within developed areas and along roadsides.

***62. Gunther, K. A., and M. J. Biel. 1999. Reducing human-caused black and grizzly bear mortality along roadside corridors in Yellowstone National Park. Bear Management Office, Yellowstone National Park, WY.***

Abstract: For many years black bears (*Ursus americanus*) and grizzly bears (*Ursus arctos*) that frequented roadside corridors in Yellowstone National Park (YNP) were captured and translocated, removed, or hazed away from habitat adjacent to park roads due to concern for human safety. This practice reduced the overall amount of habitat available to bears in the park and increased human-caused bear mortality. In recent years, YNP has put less emphasis on management of roadside bears and more emphasis on managing people in roadside corridors frequented by bears. The park has successfully used managing of tourists at bear-jams (bear-sitting), no stopping zones, temporary area closures, fencing, vegetation screening, and baiting bears away from roadsides to reduce the need to haze, capture, move, or destroy bears that frequent roadside corridors. Use of these techniques has increased the overall amount of habitat in YNP available for use by bears and reduced the number of human-caused mortalities of black and grizzly bears occurring in the park.

***63. Gunther, K. A. and H. E. Hoekstra. 1998. Bear-inflicted human injuries in Yellowstone National Park, 1970-1994. Ursus 10: 377-384.***
(Notes: Bear focus with HD components-human behavior associated with bear attacks)

Abstract: The implementation of a new bear management program in Yellowstone National Park in 1970 began a new era in bear-human interactions within the park. The rate of bear-inflicted human injuries decreased from 2.7/million visitors from 1970 through 1979 to 0.5/million visitors from 1980 through 1994. This was primarily due to decreased roadside injuries from black bears (Ursus americanus) as public education increased and food conditioned bears were removed from roadsides and developed areas. After 1980, the majority of injuries occurred in the backcountry. Backcountry injuries tended to be more severe and were more often caused by grizzly bears (Ursus arctos) than those that occurred along roadsides. Of the 34 injuries that occurred in the backcountry from 1970 through 1994, 13 (38%) were considered severe and 3 (9%) resulted in human fatalities. Ninety-one percent of all injuries in the backcountry involved people as they were hiking, and 9% occurred in backcountry campsites. Ninety-seven percent of the hikers injured by bears reported surprise encounters as the cause of the attack, and 68% of these incidents involved female bears with young. Most hikers that were injured (61%) reacted to encounters with bears by running or attempting to climb trees. Most (80%) hikers that resisted during bear attacks were severely injured. Backcountry injuries occurred both in forested habitat (68%) and nonforested areas (32%). Visitor and employee education on precautions to take when hiking in bear habitat may be the most useful tool in further decreasing bear-inflicted human injuries within Yellowstone National Park.

***64. Herrero, S., T. Smith, T. D. DeBruyn, K. Gunther, and C. A. Matt. 2005. From the Field: Brown bear habituation to people--safety, risks, and benefits. Wildlife Society Bulletin 33(1): 362-373.***
(Notes: Bear focus with HD components-bear viewing)

Abstract: Recently, brown bear (Ursus arctos) viewing has increased in coastal Alaska and British Columbia, as well as in interior areas such as Yellowstone National Park. Viewing is most often being done under conditions that offer acceptable safety to both people and bears. We analyze and comment on the underlying processes that lead brown bears to tolerate people at close range. Although habituation is an important process influencing the distance at which bears tolerate people, other variables also modify levels of bear-to-human tolerance. Because bears may react internally with energetic costs before showing an overt reaction to humans, we propose a new term, the Overt Reaction Distance, to emphasize that what we observe is the external reaction of a bear. In this paper we conceptually analyze bear viewing in terms of benefits and risks to people and bears. We conclude that managers and policy-makers must develop site-specific plans that identify the extent to which bear-to-human habituation and tolerance will be permitted. The proposed management needs scientific underpinning. lt is our belief that bear viewing, where appropriate, may promote conservation of bear populations, habitats, and ecosystems as it instills respect and concern in those who participate.

***65. Jope, K. L. 1985. Implications of grizzly bear* habituation *to hikers. Wildlife Society Bulletin 13(1): 32-37.***
(Notes: Bear focus with HD components-hiker behavior. Insight: Studies like this one point out that some of the consequences of habituating bears to human presence are positive; mechanisms that encourage the right kind of habituation could be useful management interventions)

Summary: Behavior of grizzly bears towards hikers in Glacier National Park, Montana, indicated that only hikers who did not wear bear-bells were charged. Charges tended to occur at crepuscular times on cool days in early summer. Although bears were seen as often on heavily used trails as on trails with little human use, full-charges occurred primarily on trails with little human use. The findings of this research, together with records on human injuries in the park, suggest that habituation of grizzly bears to hikers reduces the rate of fear-induced charges and consequent injuries.

***66. Jope, K. L., K. L. McArthur, and E Meslow. 1983. Habituation of grizzly bears to people: A hypothesis. International Conference on Bear Research and Management 5: 322-327.***
Abstract: Reports of grizzly bear (Ursus arctos) observations between 1977 and 1979 in Glacier National Park were examined to test whether the behavior of grizzly bears was different in areas with high versus low levels of human activity. In both types of areas, females with young were more likely than adults and subadults to avoid human-use areas and showed little habituation to people. A midseason increase in habituated behavior by adult and subadult bears occurred in both areas, but adults and subadults showed a greater degree of habituation throughout the season in the high-use area.

***67. Keating, K. A. 1986. Historical grizzly bear trends in glacier national park, montana. Wildlife Society Bulletin 14(1): 83-87.***
Summary: Trends in sighting rates and population estimates indicated GNP's grizzly population in-creased significantly about 1930 and 1965. Habituation was an inadequate explanation for disproportionate increases in sighting rates, suggesting that population expansion also prompted a distributional change. Habituation was postulated to be necessary in allowing distributional expansion, but not a primary cause of it. Findings suggested that aversive conditioning of bears may occur at the expense of the park's responsibility to preservation.

***68. Lackey, B. K., and S. H. Ham. 2004. Assessment of communication focused on human-black bear conflict at Yosemite National Park. Journal of Interpretation Research 8(1): 25-40.***
(Notes: HD focus-Effects of communication program)

Abstract. This study assessed how Yosemite National Park (YNP) targets the continuing problem of human-black bear conflicts via interpretive communication. The research examines how YNP delivers information to visitors about human-black bear conflicts, and how visitors receive that information. Key variables include message recall by visitors, the effectiveness of message content and media in reaching visitors in various overnight lodging locations, the spatial relationship between message delivery and bear incidents, and the role of park employees in delivering bear information to visitors. Results indicate that park visitors receive messages about bears. Inconsistencies between messages delivered via personal interpretive services and YNP

bear management policy were revealed. Implications for future research and improving YNP's human-bear communication program are offered.

***69. Lackey, B. K. 2003. Contextual analysis of interpretation focused on human-black bear conflicts in Yosemite National Park. Journal of Applied Environmental Education and Communication 2(1): 11-21.***
(Notes: HD focus-Effects of communication program)

Abstract. This study examined how Yosemite National Park addresses the continuing problem of human-bear interactions with its interpretive communication services. A particular focus was on the food storage behavior of overnight users in Yosemite Valley. A theory-based questionnaire was used to elicit visitors salient beliefs pertinent to proper food storage behavior, and a message inventory was conducted to analyze message content that references human-bear conflicts. Following the theory of planned behavior, results reveal beliefs that may underpin future communication intervention strategies for human behavior modification related to proper food storage by Yosemite Valley overnight users. Implications are drawn for how the Yosemite interpretive services germane to human-bear conflicts might improve with guidance from contemporary communication theory.

***70. Martin, S. R., and K. McCurdy. 2009. Wilderness food storage in Yosemite: Using the theory of planned behavior to understand backpacker canister use. Human Dimensions of Wildlife 14(3): 206-219.***
Abstract: Bear-resistant food storage canisters have gained widespread acceptance by backpackers as the most convenient and effective means of avoiding conflict with black bears in Sierra Nevada wilderness areas. Bear incidents, however, continue in the Yosemite Wilderness. Beginning in 2004, Yosemite backpackers were required to store their food in approved bear-resistant food storage canisters when camped within seven air miles of a road and anywhere above 9,600 feet; this constitutes a large majority of the park's wilderness. In 2005 we evaluated backpackers' use of canisters for food storage. Trailhead and Internet-based surveys were used to identify wilderness visitors' beliefs, attitudes, subjective norms, perceived control, and intentions regarding use of food storage canisters. We used the Theory of Planned Behavior to explain intended use of food storage canisters in the Yosemite Wilderness and found that models containing measures of attitudes and subjective norm explained 38 to 43% of backpackers' intentions to use canisters

***71. Mattson, D. J., and B. M. Blanchard. 1992. Yellowstone grizzly bear mortality, human habituation, and whitebark pine seed crops. Journal of Wildlife Management 56(3): 432-442.***
(Notes: Bear focus with HD components-human facilities in occupied grizzly bear habitat)

Abstract: The Yellowstone grizzly bear (Ursus arctos horribilis) population may be extirpated during the next 100-200 years unless mortality rates stabilize and remain at acceptable low levels. Consequently, we analyzed relationships between Yellowstone grizzly bear mortality and frequency of human habituation among bears and size of the whitebark pine (Pinus albicaulis) seed crop. During years of large seed crops, bears used areas within 5 km of roads and 8 km of developments half as intensively as during years of small seed crops because whitebark pine's high elevation distribution is typically remote from human facilities. On average, management trappings of bears were 6.2 times higher, mortality of adult females 2.3 times higher, and

mortality of subadult males 3.3 times higher during years of small seed crops. We hypothesize that high mortality of adult females and subadult males during small seed crop years was a consequence of their tendency to range closest (of all sex-age cohorts) to human facilities; they also had a higher frequency of human habituation compared with adult males. We also hypothesize that low mortality among subadult females during small seed crop years was a result of fewer energetic stressors compared with adult females and greater familiarity with their range compared with subadult males; mortality was low even though they ranged close to humans and exhibited a high frequency of human habituation. Human-habituated and food-conditioned bears were 2.9 times as likely to range within 4 km of developments and 3.1 times as often killed by humans compared with nonhabituated bears. We argue that destruction of habituated bears that use native foods near humans results in a decline in the overall ability of bears to use available habitat; and that the number and extent of human facilities in occupied grizzly bear habitat needs to be minimized unless habituated bears are preserved and successful ways to manage the associated risks to humans are developed.

***72. Mattson, S. D., J. S. Herrero, R. G. Wright, and C. M. Pease. 1996. Science and Management of Rocky Mountain Grizzly Bears. Conservation Biology 10(4): 1013-1025.***
Authors present a conceptual model of the grizzly management system that includes human dimensions, focusing on human-caused bear mortality. They recommend changes in science and management that could improve learning and responsiveness by individuals and organizations (they recommend an application of adaptive management). This manuscript represents a "managers' model" exercise that provides excellent general guidance for internal discussion about bear management planning.

***73. Matthews S. M., J. J. Beecham, H. Quigley, S. S. Greenleaf, and H. M. Leithead. 2006. Activity patterns of American black bears in Yosemite National Park. Ursus 17(1): 30-40.***
(Notes: Bear focus with HD components-human behavior in park)

Abstract: The impacts of tourism, most notably food resource enrichment and harassment, have led to alterations in natural bear (Ursus sp.) behavior in many National Parks throughout the United States. Comprehensive efforts to reduce these impacts and restore natural activity patterns have been elements of US National Park management for decades. We described black bear (U. americanus) activity patterns during 2001 and 2002 to assess the influence of human activity centers on bear behavior in Yosemite National Park, California, USA. We found bear activity and movement patterns, habitat use, and the distance bears were located from developed areas continued to be influenced by human presence in the Yosemite Valley region of Yosemite National Park. We recommend continued use of educational campaigns, stronger law enforcement efforts, improvements to food storage containers, more effective waste management, and more aggressive aversive conditioning techniques to reduce the number of human-bear interactions and restore the natural behavioral elements of Yosemite's black bear population.

***74. McCullough, D. R. 1982. Behavior, bears and humans. Wildlife Society Bulletin 10: 27-33.***
(Notes: Bear focus with HD components-human behavior)

Abstract: Behavioral learning theory can be applied to bear-human encounters in parks. Conditioning of bears to foods of humans represents only part of the problem, and elimination of such food sources will not entirely solve it. Habituation, the loss of fear of humans through lack of negative reinforcement, can occur where bears and humans come into frequent, innocuous contact and is not necessarily dependent upon food conditioning. An active program of negative conditioning may be necessary in situations where habituated bears cause incidents. No program will eliminate bear problems, but "stalemate" through reinforcement of mutual fear and respect may be a more appropriate model for minimizing bear-human interactions in parks than "peaceful coexistence."

***75. Olson, T. L., and B. K. Gilbert. 1994. Variable impacts of people on brown bear use of an Alaskan river. International Conference on Bear Research and Management 9:97-106.***

Summary: Wildlife viewing, popular on many Alaskan rivers where brown bears fish, may differentially affect bear foraging behavior depending on level of habituation. The authors observed ten females with young, five that were habituated to people and five who weren't. The habituated females used a fishing area near a large campsite, while the nonhabituated females would not. The area avoided by nonhabituated bears had the highest concentration of fish in the area.

***76. Olson, T. L., B. K. Gilbert, and R. C. Squibb. 1997. The effects of increasing human activity on brown bear use of an Alaskan river. Biological Conservation 82:95-99.***

Summary: The Brooks River in Alaska is a popular wildlife viewing spot, but the effects of increased human disturbance on foraging brown bears is unknown. This study compared foraging use among habituated, non-habituated, and sub-adult brown bears in relation to increased human disturbance (i.e., viewing period extended by one week). Habituated bears were not affected by humans while non-habituated bears delayed their use of the river in response to human presence. The delayed use by non-habituated bears allowed sub-adults to increase their use of the river.

***77. Schirokauer, D. W., and H. M. Boyd. 1998. Bear-human conflict management in Denali National Park and Preserve, 1982-94. Ursus 10: 395-404.***

Abstract: In response to a dramatic increase in visitation and in problems with grizzly and black bears (Ursus arctos, U. americanus) during the 1970s, Denali National Park and Preserve implemented a comprehensive bear-human conflict management plan in 1982. The components of Denali's bear-human conflict management plan include visitor education, food-storage regulations, backcountry closures, and experimental aversive conditioning. Prior to the opening of a paved highway to the National Park in 1972, reports of bear-inflicted injuries, property damage, and bears obtaining anthropogenic food averaged <1/year. In 1982, 40 such incidents occurred. After implementation of the bear-human conflict management plan, incidents decreased steadily until 1988 when 9 occurred, a decrease of 77%. Incidents in which bears obtained anthropogenic food decreased from 23 in 1982 to 1 in 1989, a decrease of 96%. A recent slight increase in incidents (all types) may reflect the activities of either a few bears before they were removed or aversively conditioned, or bears which were never subjected to management actions. Since 1984, aversive conditioning was conducted on 2 black bears and 9 grizzly bears. In 8 of these cases, the bears avoided test camps and did not cause further problems during the season aversive conditioning occurred. Four of the bears aversively conditioned in the backcountry stayed away from camps for at least 2 years. Bears successfully

broke into bear-resistant food containers in 12 of 55 attempts since 1979, due to improperly latched or defective lids and overfilled containers. There have been no reports of bears breaking into the newest model of bear-resistant food container. This work updates previous analyses of bear-human conflict in Denali National Park and Preserve.

***78. Smith, T. S., S. Herrero, and T. D. DeBruun. 2005. Alaskan brown bears, humans, and habituation. Ursus 16(1): 1-9.***
(Notes: Bear focus with HD components-bear viewing)

Abstract: We present a new paradigm for understanding *habituation* and the role it plays in brown bear (Ursus arctos) populations and interactions with humans in Alaska. We assert that 3 forms of habituation occur in Alaska: bear-to-bear, bear-to-human, and human-to-bear. We present data that supports our theory that bear density is an important factor influencing a bear's overt reaction distance (ORD); that as bear density increases, overt reaction distance decreases, as does the likelihood of bear-human interactions. We maintain that the effects of bear-to-bear habituation are largely responsible for not only shaping bear aggregations but also for creating the relatively safe environment for bear viewing experienced at areas where there are high densities of brown bears. By promoting a better understanding of the forces that shape bear social interactions within populations and with humans that mingle with them, we can better manage human activities and minimize bear-human conflict.

***79. Smith, T. S. and A. Johnson. 2004. Modeling the Effects of Human Activity on Katmai Brown Bears (Ursus arctos) through the Use of Survival Analysis. Arctic 57(2): 160-165.***
(Notes: Bear focus with HD components-human use of river occupied by bears)

Abstract: Brown bear-human interactions were observed in 1993, 1995, and 1997 at Kulik River in Katmai National Park and Preserve, Alaska. We analyzed these interactions using survival analysis, creating survival curves for the time that bears remained on the river in the presence, and absence, of human activity. Bear-only survival curves did not vary significantly between years ($p=0.067$). Ninety-seven percent of bears left the river within 70 minutes of arrival in all years. Temporal patterns of bear activity were unaffected by the presence of humans as long as the bears did not share river zones with humans ($p=0.062$ to $p=0.360$). When people and bears did not share river zones, 38.6% (1993), 36.0% (1995), and 37.0% (1997) of bears remained on the river for at least 10 minutes after arrival. In contrast, when people and bears shared river zones, fewer bears remained on the river after the first 10 minutes, with 28.6% (1993), 25.0% (1995), and 32.6% (1997) observed in each year. We conclude that human activity displaced 26.0% (1993), 30.5% (1995), and 12.0% (1997) of the bears using the river, which otherwise would likely have remained longer. Over the three years of study, habituation to human activity may account for observed changes in bears' use of the river.

***80. St. Clair, C. C., S. Herrero, and T. E. Hurd. 2005. Finding the middle ground for managing habituated wildlife. Meeting Abstract. Advances in understanding and management applications, Annual Meeting of The Wildlife Society, September 27, 2005.***
(Notes: Bear focus with HD components-human behavior)

Abstract: The gradual expansion of human populations and infrastructure into wilderness areas inevitably creates opportunities for wildlife habituation. Habituation is most likely when humans

value close approaches to wildlife or when *habituation* is associated with resource acquisition. In such situation, habituation typically generates costs, usually measured as risk, and benefits for both humans and wildlife. Finding the right middle ground - where wildlife exhibit enough tolerance to persist without compromising human, wildlife, or ecosystem health - is a challenge for managers. Identifying a sustainable balance of the costs and benefits of *habituation* requires three things: (1) use of precise terminology, (2) identification of explicit objectives that set limits for both wildlife and human behavior, and (3) adaptive management to achieve the stated objectives. We demonstrate aspects of these steps with case studies of brown bears (Ursus arctos) in Yellowstone and Alaska, and elk (Cervus elaphus) in Banff. In those contexts, we find the term overt reaction distance helpful for quantifying animal tolerance and to assess the potential for habituation, without assuming that habituation is the mechanism of tolerant behavior. For elk, we use the behavioral measures captured by flight response distance to define a public safety goal that limits the proximity of humans to wildlife. Achieving such goals requires a species- and context-specific prescription of action that can be adjusted to changing information and circumstances. Principles of adaptive management and the dearth of information about the process of habituation in wild animals both encourage more experimental work. Finally, we suggest more generally how the three elements in our approach can be used with diverse taxa to achieve a healthy balance of costs and benefits concerning wildlife habituation.

***81. Yellowstone grizzly bear investigations: Annual Report of the Interagency Grizzly Bear Management Study Team, 2008. U.S. Geological Survey, Bozeman, Montana. (*Note these annual reports go back to 1989, authors and publishing agency vary by year; this is gray literature that should be reviewed as part of NPS document content analysis).***

## Bears outside of Parks

***82. Agee, J. D. and C. A. Miller. 2009. Factors Contributing Toward Acceptance of Lethal Control of Black Bears in Central Georgia, USA. Human Dimensions of Wildlife 14(3): 198-205.***

Abstract: More communities are experiencing problems associated with overabundant white-tailed deer (Odocoileus virginianus) populations. Public acceptance of approaches for managing deer may differ within communities. Although hunting with firearms is a common practice used to manage deer populations, many suburban communities only allow bowhunting. Our objectives were to assess suburban homeowners and bowhunters acceptance of lethal and nonlethal deer management strategies. Additionally, we wanted to determine homeowner willingness to pay for deer management and how long they would be willing to wait for relief to address conflicts caused by deer overabundance. Most homeowners supported using lethal strategies to reduce and manage deer populations. Most homeowners were unaware of the cost (94%) or effectiveness (92%) of birth control agents to manage free-ranging deer populations. Of lethal strategies, bowhunting was preferred. Establishment of a special crossbow season outside the existing archery season received the greatest support by bowhunters and was also acceptable to homeowners. As landscapes progressed from rural to more urban, hunting access, human-wildlife conflicts, and homeowner willingness to pay for deer management decreased. Regardless of management strategy, most homeowners were willing to wait 3-5 years to achieve a desired reduction in the deer population at no cost to them. As costs increased, homeowner willingness to wait decreased. Because exposure, tolerance of deer, and willingness to pay for

management varies by landscapes, towns with diverse landscapes should consider developing regional rather than town-wide plans to manage overabundant deer population.

***83. Breck, S. W., C. L. Williams, J. P. Beckmann, S. A. Matthews, C. W. Lackey, and J. J. Beecham. 2008. Using genetic relatedness to investigate the development of conflict behavior in black bears. Journal of Mammalogy 89(2): 428-434.***

Abstract: The acquisition of behavior in animals is a function of both inheritance and learning, where learning can occur asocially (independent of other animals), socially (by observing other animals), or both. For species that have a prolonged parent-offspring relationship and that live solitary adult lives, social learning between parents and offspring may be a dominant form of learning. If parent-offspring learning is a dominant avenue for acquiring behavior or if behavior is inherited, then behaviors that confer significant fitness advantages should lead to subpopulations of genetically related individuals with similar behavioral patterns. We investigated whether foodconditioning behavior in black bears (Ursus americanus) is inherited or learned via parent-offspring social learning. We combined genetic data with behavioral data for 116 black bears from Lake Tahoe Basin, Nevada, and Yosemite National Park, California. We categorized individual bears as food-conditioned or non-food-conditioned based on their behavior over a several-year period of intensive study at each site. We compared levels of relatedness, based on microsatellite DNA genotyping, within and between these groups and compared behavior between 9 mother-offspring pairs determined through genetic analysis of maternity. Based on 4 separate analyses of the data there was little evidence that food-conditioning behavior in black bears partitioned along related lineages, indicating that the acquisition of food conditioning behavior was not solely a function of social learning or inheritance.

***84. Eckhardt, G., J. M. Waterman, and J. Roth. 2004. Effects of vehicle approaches on polar bear behavior in Churchill, Manitoba. Florida Scientist 67:26.***

(Notes: Bear focus with HD component-use of buses for polar bear viewing)

Abstract: Polar bears near Churchill, Manitoba, aggregate along the coast of Hudson Bay in the fall waiting for the sea ice to form. These congregations of polar bears have led to a thriving tourism industry, with up to 10,000 people arriving in the fall to view bears on the tundra. Any potential disturbance of these bears, which have been fasting for up to four months, could be energetically costly to individual bears. Habituation to humans could pose a threat to bears and people in areas populated by both. We investigated the effect of tourist vehicles on polar bear behavior by recording responses of bears to approaching vehicles. Approach angle and increased exposure to vehicles affected the probability of response and the distance at which the response occurred. These data suggest that responses of individuals may be minimized by careful vehicle positioning for angle and distance to bears.

***85. Huber, D. 2010. Rehabilitation and reintroduction of captive-reared bears: feasibility and methodology for European brown bears Ursus arctos. International Zoo Yearbook 44(1): 4754.***

Abstract: Bears need to learn appropriate survival and behavioral skills in the first 1 or 2 years of life. They can acquire those skills fully only if raised by their mothers in the natural habitat. Releasing captive-born and/or hand-reared cubs threatens their life expectancy because individuals will have problems finding food and shelter, and experience intra- and inter-specific

predation. Additionally, bears reared in captivity may cause behavioral and genetic pollution of the indigenous free-living population. The release of bears cannot be called ‘reintroduction’. The surplus of bears currently in captivity should be resolved by control of reproduction and investment in efforts to prevent situations whereby wild-born bears become orphaned and captive. The existing captive population should be given the best possible care and be used as ambassadors to raise public awareness about situation of free-living conspecifics. The above statements are corroborated by experiences with European brown bears Ursus arctos.

***86. Kansas, J. 2002. Status of the grizzly bear (Ursus arctos) in Alberta. Alberta Wildlife Status Reports; 2002 Issue January, pi, 51p. Web Document***

***87. Mace, R. D. and J. S. Waller. 1996. Grizzly Bear Distribution and Human Conflicts in Jewel Basin Hiking Area, Swan Mountains, Montana. Wildlife Society Bulletin 24(3):461-467.***

Abstract: Telemetry data obtained from grizzly bears (Ursus arctos horribilis) were used to evaluate resource selection within the Jewel Basin Hiking Area (JBHA) of western Montana. Logistic regression models were constructed using Geographic Information System maps of elevation zones, dominant cover types, and distance to hiking trails and lakes. Fourteen radio collared grizzly bears used the JBHA between 1987-1994 primarily during summer. Using univariate statistics, we determined that grizzly bears were significantly farther than expected from trails and from lakes with campsites during spring, summer, and autumn. In multivariate models however, distance to trails and lakes were significant variables only during summer and autumn. During these 2 seasons the relative probability of grizzly bear use increased as distances to trails and lakes with campsites increased. For each season, grizzly bears selected relatively open habitats compared to the predominant forest habitat type in which most of the trail system occurred. We found no historical records of conflicts between grizzly bears and recreationists in the JBHA; bears did not appear to be conditioned to or habituated to food. No radio collared bears lived solely within the JBHA; each individual's home range included multiple-use lands with roads and where many human activities occurred. We concluded that several factors together precluded human-bear conflicts in the JBHA. These included low visitor-use levels, trail placement, an educated public, and the bears' negative conditioning towards a host of human activities occurring within and outside the area. Therefore, while in the JBHA, grizzly bears minimized their interaction with recreationists by avoiding high-use areas.

***88. Mazur R. L. 2010. Does Aversive Conditioning Reduce Human-Black Bear Conflict? Journal of Wildlife Management 74(1): 48-54.***

Abstract: Aversive conditioning (AC) has the potential to temporarily reduce conflicts between humans and black bears (Ursus americanus). From 2002 to 2005, I evaluated the effectiveness of projectiles with varying impact intensities, pepper spray, and chasing on approximately 150 bears in Sequoia National Park. Aversive conditioning was successful in keeping bears that were not food-conditioned from becoming food-conditioned. For the bears that were already food-conditioned, 17 of 29 bears subjected to AC abandoned unwanted behaviors, 6 required continual treatments, and 6 were killed or relocated. Success with food-conditioned bears was highest when AC was applied soon after bears obtained human food. Aversive conditioning was less successful on yearlings than adults. Rubber slugs were slightly more effective than lower impact projectiles.

***89. Mazur, R. and V. Seher. 2008. Socially learned foraging behavior in wild black bears, Ursus americanus Animal Behavior 75 (Part 4): 1503-1508.***

Abstract: 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 behavior (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 Behavior.

***90. McLellan, B. N., and D. M. Shackleton. 1989. Immediate Reactions of Grizzly Bears to Human Activities. Wildlife Society Bulletin 17(3): 269-274.***

We studied reactions of grizzly bears to human activities between 1979 and 1986 in the North Fork of the Flathead River drainage of southeastern British Columbia and northern Montana. Reactions of bears were measured primarily by radio telemetry rather than by direct observations to reduce recording biases caused by cover or bear behavior. Bears responded more strongly to ground-based human activities, such as people on foot or moving vehicles, when in the open than when in cover. Cover had less effect on their response to fixed-wing aircraft. Bears generally displayed stronger reactions to human activities, other than to people on foot, that occurred <76 m than farther away. The strongest response of bears was to people on foot, and these reactions were most extreme in areas of low human use.

Management Implications: Because grizzly bears in open habitats responded more strongly to ground-based human activities than did bears in cover, high human-use areas such as roads should be constructed away from open areas to reduce disturbance. Timber companies should always leave visual cover between haul roads and cutting units when practical and close spur roads to cutting units once post-logging treatments are complete. Conversely, where strong reactions of bears to humans are desired, such as at industrial camps or settlements, removing cover by clearing adjacent timber may be beneficial. Bears become habituated to human activities, particularly moving vehicles, and habituated bears are more vulnerable to both legal and illegal harvest. Therefore, we recommend that roads be closed whenever possible to reduce habituation and deaths of grizzly bears. Grizzly bears in this study responded more strongly to people on foot in remote areas than to any other stimulus. Areas with known seasonal concentrations of bears could be closed to hikers to protect both bears and people.

***91. Rauer, G., P. Kaczensky, and F. Knauer. 2003. Experiences with aversive conditioning of habituated brown bears in Austria and other European countries. Ursus 14: 215-224.***

Summary: Human-bear conflicts in Europe are contributing to long-term population declines. The authors attempted aversive conditioning of 16 brown bears using rubber bullets, cracker

shells, warning shots and fireworks. Results varied by individual. They discuss the need for a unified approach to bear management and problem bears in Europe.

***92. Telesco, D. J., and F. T. Van Manen. 2006. Do black bears respond to military weapons training? Journal of Wildlife Management 70(1): 222-230.***

Abstract:The primary function of military training areas is to support military missions, however, management of natural resources that is compatible with that function has become a focal issue on many military installations. We investigated the relationship between black bear (Ursus americanus) habitat use and weapons-firing exercises at 3 spatial scales on the western portion of U.S. Marine Corps Base Camp Lejeune (Camp Lejeune), North Carolina. in 2000 and 2001, we collected 1,494 telemetry locations for 14 bears (6 males, 8 females). We used spatial contours of human auditory disturbance levels based on the noise generated from firing activities to establish high-, medium-, and low-disturbance noise zones for each firing range. We used the multinomial logit form of discrete choice analysis to examine whether bears exhibited a spatial (i.e., general avoidance of areas associated with military activity) or temporal response (i.e., avoidance of military training areas but only when firing exercises occurred). Except for small areas near the firing positions, differences in bear use among the 3 noise zone areas was mostly a function of the prevalence of selected vegetation types and not a response to military activity. Our temporal analysis further suggested that bears did not respond to weapons exercises; the distance of bears to the nearest high-disturbance noise zone was not associated with the occurrence of weapons exercises.

***93. Ternent, M. A., and D. L. Garshelis. 1999. Taste-aversion conditioning to reduce nuisance activity by black bears in a Minnesota military reservation. Wildlife Society Bulletin 27: 720-728.***

Summary: Several nuisance black bears at a Minnesota military base became habituated to humans and were seeking out and consuming military MREs (meals ready to eat). Researchers attempted taste-aversion conditioning on five black bears using MREs containing thiabendazole. The experiment was successful and bears were conditioned to avoid MREs. The authors discuss the duration of effectiveness and other actions necessary to prevent or dissuade nuisance bears.

***94. Wielgus, R. B., P. R. Vernier, and T. Schivatcheva. 2002. Grizzly bear use of open, closed, and restricted forestry roads. Canadian Journal of Forest Resources 32: 1597–1606.***

Level and/or type of use by humans is likely a major component when evaluating the impact of roads on bear behavior. This study evaluates avoidance of open, closed, and restricted forestry roads by eleven bears. Males avoided open roads, females avoided closed roads, and no bears avoided restricted roads. The authors suggest that bears have become habituated to restricted roads because no harm is typically associated with these roads, while risk of mortality (e.g., from hunting) goes up along other roads.

## Cats in Parks

***95. Brooks J. J., R. J. Warren , M. G. Nelms and M. A. Tarrant. 1999. Visitor attitudes toward and knowledge of restored bobcats on Cumberland Island National Seashore, Georgia. Wildlife Society Bulletin 27(4): 1089-1097.***

Abstract: Effective management of our National Park Service lands requires information about the social aspects or human dimensions of wildlife. Understanding attitudes aids fish and wildlife professionals to predict public responses to management strategies like species restorations. We documented visitor attitudes toward and knowledge of restored bobcats (Lynx rufus) on Cumberland Island National Seashore (CINS). Bobcats were restored on ClNS in 1988 and 1989. During fall 1997, we compared four visitor user-groups (white-tailed deer [Odocoileus virginianus] hunters [DH], day-only [DO] visitors, developed-site [DS] campers, and back-country [BC] campers) concerning their attitudes and knowledge, using a self-administered, drop-off questionnaire distributed on return ferries and at island campsites. We contacted 1,138 individuals. Overall response rate was 82.6%. Across four visitor user-groups, the mean attitude-toward-restored-bobcat score was 0.8, with a range of -18 to 16. A positive score represented a positive attitude, and a negative score represented a negative attitude. Zero represented neutrality. Deer hunters had a statistically less positive mean attitude score (-0.1) than the three other visitor user-groups. Overall mean score for knowledge-of-bobcats was 3.8 out of a perfect score of 10.0. Deer hunters had a statistically greater mean knowledge score (5.1) than the three other visitor user-groups. Thus, our results indicated that visitor attitudes toward and knowledge of bobcats on CINS differed among the four visitor user-groups. Wildlife interpretive and education programs should be specifically targeted to address the differences in attitudes and knowledge among visitor user-group.

***96. Sweanor, L. L., K. A. Logan, J. W. Bauer, B. Millsap, and W. M. Boyce. 2008. Puma and human spatial and temporal use of a popular California State Park. Journal of Wildlife Management 72(5):1076-1084.***

(Notes: Puma focus with HD components-human activity)

Abstract: Because of increasing concerns about puma (Puma concolor) attacks on people and the desire to minimize dangerous puma-human encounters while conserving puma populations, we examined spatial and temporal relationships between pumas and people that used Cuyamaca Rancho State Park (CRSP), California, USA. From 2001 to 2003, we studied 10 adult pumas outfitted with Global' Positioning System collars. Although number of visitors to CRSP was increasing, no dangerous puma-human encounters were reported during our study. Male and female pumas typically moved short distances during the day (mean of means of individual hourly movements = 168 m and 131 m each hr, respectively) and moved the most at night (mean of means = 690 in and 390 in each hr, respectively). Of 10 pumas, 9 were least active during the day and most active during the evening or at night. In contrast, most visitor use of trails ([overhead single bar]x = 85%) occurred during the day. Based on puma and human activity patterns, risk of a puma-human encounter was greatest during the evening. Puma prey caches were randomly distributed in relation to trails and park facilities; however, 8 of 33 caches were still within 100 m of a trail and 2 were within 300 in of a facility. Individual puma behavior relative to human activity was variable. Some pumas appeared to temporally avoid human activity areas; others used the park randomly in relation to human activity areas; none appeared to be attracted to human activity areas. Pumas that did not show detectable responses to human

activity may have been exhibiting some level of habituation; if so, this level of habituation did not result in puma-human conflicts. When human activity peaked during the day, adult male and female pumas were within 100 m of a trail an average of 9% and 19% of the time they were located in the park, respectively. Thus, there were opportunities for puma-human encounters. Management personnel can take a proactive approach to deal with puma-human interactions through education and protocols that help to minimize probability of conflicts; this may provide the best chance for a continued puma presence in habitat used by pumas and people

## Cats outside of Parks

***97. Beier, P., J. E. Borrecco, and R. E., Marsh. 1992. Cougar attacks on humans: an update and some further reflections. Vertebrate Pest Conference Proceedings 15: 365-367.***

Abstract: The author examined historical records of unprovoked attacks by cougars on humans in the U.S. and Canada during 101 years (1890-1990). There were 9 attacks resulting in 10 human deaths and at least 44 nonfatal attacks. Although extremely rare, attacks on humans have increased markedly in the last two decades, during which cougar numbers and human use of cougar habitats have increased. There is no substantial evidence that habituation underlies this increase in attacks.

***98. Bolgiano, C. 1996. Why are cougars killing people? Theories and implications. Wild Earth 6(3): 46-49.***

Abstract: The author discusses the increasing number of cougar attacks on humans across western North America. One of the least disputed explanations of more frequent attacks is habitat invasion. For the last few decades, the Mountain West has been the fastest growing (in human population) area of the United States. More people are living in cougar country.

***99. Lambert, C. M. S.; R. B. Wielgus, H. S. Robinson, D. D. Katnik, H. S. Cruickshank, R. Clarke, and J. Almack. 2006. Cougar Population Dynamics and Viability in the Pacific Northwest. Journal of Wildlife Management 70(1): 246-255.***

Abstract: Increasing reports of human/cougar conflicts may suggest that cougars are increasing in the Pacific Northwest. We determined minimum relative densities and average fecundity, survival, and growth rate of an apparently increasing cougar population in northeastern Washington, USA; northern Idaho, USA; and southern British Columbia, Canada, from 1998 to 2003. Minimum relative densities declined from 1.47 cougars/100 km^sup 2^ to 0.85 cougars/100 km^sup 2^. We estimated average litter size at 2.53 kittens, interbirth interval at 18 months, proportion of reproductively successful females at 75%, and age at first parturition at 18 months fora maternity rate of 1.27 kittens/adult female/yr. Average survival rate for all radiocollared cougars was 59%: 77% for adult females, 33% for adult males, 34% for yearlings, and 57% for kittens. Hunting accounted for 92% of mortalities of radio collared cougars. The annual stochastic growth rate of this population was $\lambda = 0.80$ (95% CI = 0.11). Contrary to accepted belief, our findings suggest that cougars in the Pacific Northwest are currently declining. Increased conflicts between cougars and humans in this area could be the result of the 1) very young age structure of the population caused by heavy hunting, 2) increased human intrusion into cougar habitat, 3) low level of social acceptance of cougars in the area, or 4) habituation of cougars to humans. To help preserve this population, we recommend reduced levels of exploitation, particularly for adult females, continuous monitoring, and collaborative efforts of managers from adjacent states and provinces.

***100. Manfredo, M. J., A. C. Zinn, L. Sikorowski, and J. Jones. 1998. Public acceptance of mountain lion management: a case study of Denver, Colorado, and nearby foothills areas. Wildlife Society Bulletin 26(4): 964-970.***

Abstract: We propose that information about public attitudes toward mountain lion (Puma concolor) management practices is most useful when it accounts for the specific context of human-mountain lion encounter situations. A mail survey was used to assess public acceptance of four management actions involving mountain lions in four encounter situations occurring at two types of locations. Results showed strong support for the hypothesis that acceptance of management actions depends on the specific circumstances of the situations. We suggest that mountain lion management policies should account for a range of contingencies and that future studies of attitudes toward management actions should consider the importance of attitude specificity.

## Dingoes in Parks

***101. Burns, G. L., and P. Howard. 2003. When wildlife tourism goes wrong: a case study of stakeholder and management issues regarding Dingoes on Fraser Island, Australia. Tourism Management 24(6): 699-712.***

(Notes: human focus-wildlife-related tourism)

Abstract: Images on brochures, web pages and postcards lead to an expectation by tourists and visitors that interaction with Dingoes (Canis lupus Dingo) will be part of their Fraser Island experience. Yet, as the number of tourists to the island increase, so do the reports of Dingo attacks. The first recorded death from such an attack on Fraser Island occurred in April 2001, and was immediately followed by a government-ordered cull of Dingoes. This paper explores issues surrounding both this decision and the management strategies implemented afterwards. Based on interviews with a variety of stakeholders, many conflicting perspectives on human-wildlife interaction as a component of tourism are identified. The conclusion is drawn that while strategies for managing Dingoes are essential, if such attacks are a consequence of humans feeding wildlife and resultant wildlife habituation, then strategies for managing people are also necessary for this example of wildlife tourism to be both successful and sustainable.

## Ungulates in Parks

***102. Belant, J. L., J. A. Paynter, K. E. Stahlnecker, and V. van Ballenberghe. 2006. Moose distribution relative to human development in a national park. Alces 42:33-39.***

Abstract: The potential influence of human development on distribution of moose (Alces alces) within Denali National Park and Preserve, Alaska, was investigated during May-September 1995-1997. Univariate and multivariate analyses were conducted to evaluate seasonal habitat use and distances to the park road and developed areas. Moose exhibited avoidance of spruce habitat during summer and spruce, shrub, and deciduous habitats during autumn. Results from univariate analyses indicated moose were closer to the park road than expected during summer and autumn and further than expected from developed areas during autumn. However, multivariate logistic regression models including habitat types revealed that distances moose were located from roads were similar to expected during each season. Logistic regression models also indicated that moose were further from developed areas in autumn. Moose movement away from developed areas during autumn was likely because developed areas were located predominantly (69%) in forest and shrub habitats; moose appeared to select more open areas in autumn for rutting

activities. Distribution of moose did not appear strongly influenced by human development. That moose did not overall avoid the park road or developed areas appears a consequence of habituation (i.e., indifference) to human activity from no positive or negative reinforcement.

***103. Borkowski, J. J., P. J. White, R. A. Garrott, T. Davis, A. R. Hardy, and D. J. Reinhart. 2006. Behavioral responses of bison and elk in Yellowstone to snowmobiles and snow coaches. Ecological Applications 16(5): 1911-1925.***

Abstract: Managers of public lands are charged with protecting some of our most important natural resources and ecosystems, while providing for their use and enjoyment by visitors. Almost one million visitors entered Yellowstone National Park by motorized means on snowmobiles (87%) or snow coaches (13%) during 1992-2003. Most vehicles toured the central portion of the park where bison (Bison bison) and elk (Cervus elaphus) concentrate in geothermal areas. We sampled > 6500 interactions between groups of these species and groups of snowmobiles and snow coaches (collectively, OSV, over-snow vehicles) during five winters (1999-2000, 2002-2004). Multinomial logits models were used to identify conditions leading to behavioral responses. Elk responded three times as often (52%) as bison (19%). during interactions with groups of snowmobiles and snow coaches due to increased vigilance responses (elk, 44%; bison, 10%). However, the frequency of higher-intensity movement responses by bison and elk were similar (6-7% travel, 1-2% flight, < 1% defense) and relatively low compared to other studies of ungulates and snowmobile disturbance. The likelihood of active responses by bison and elk, increased significantly if animals were on or near roads, groups were smaller, or humans approached. The likelihood of an active response by bison decreased within winters having the largest visitation, suggesting some habituation to snowmobiles and snow coaches. There was no evidence that snowmobile use during the past 35 years affected the population dynamics or demography of bison or elk. Thus, we suggest that regulations restricting levels and travel routes of over-snow vehicles (OSVs) were effective at reducing disturbances to bison and elk below a level that would cause measurable fitness effects. We recommend park managers consider maintaining OSV traffic levels at or below those observed during our study. Regardless, differing interpretations of the behavioral and physiological response data will continue to exist because of the diverse values and beliefs of the many constituencies of Yellowstone

***104. Cassirer, E. F., D. J. Freddy, and E. D. Ables. 1992. Elk responses to disturbance by cross-country skiers in Yellowstone National Park. Wildlife Society Bulletin 20: 375-381.***

Management implications: Restricting cross-country skiers to locations > 650 m from elk wintering areas would probably minimize displacement of most nonhabituated elk by skiers on shrub steppe and upland steppe winter range similar to that in northern Yellowstone. Seventy-five percent of nonhabituated elk flight responses in northern Yellowstone occurred within 650 m. Skiers would likely have to remain at distances of >1,700 m to completely avoid disturbing elk. Although elk can habituate to human activity, this may be a localized phenomenon even in national parks. The amount of winter range used by skiers and the number of days involved seemed to be more important than skier numbers. Therefore, when skier activity is located on elk winter range we recommend concentrating use into as small an area as possible. Locating skiers in sites with abundant topographic relief and providing security areas in drainages adjacent to those where skiing occurs also might minimize added energy costs and displacement of elk.

***105. Fairbanks, W. S. and R. Tullous. 2002. Distribution of Pronghorn (Antilocapra americana Ord) on Antelope Island State Park, Utah, USA, Before and After Establishment of Recreational Trails. Natural Areas Journal 22(4): 277-282.***

Abstract: The distance of pronghorn (Antilocapra americana Ord) from recreational trails on Antelope Island State Park, Great Salt Lake, Utah, USA, recorded the year before the trails were opened for public use, was compared to distance from trails in three consecutive years after recreational use began. Groups of pronghorn were observed significantly farther from trails in years with recreational use than in the year before recreational use. There was no indication of habituation to recreational users over the three years. Analysis across years did not reveal particular sensitivity based on group composition, although distances of group types with the smallest mean group sizes (males only and females only) were significantly farther from trails in more years than groups with larger means (mixed sexes and groups with fawns). These results provide the first demonstration of a significant effect of nonconsumptive recreation on pronghorn. To minimize disturbance to wildlife, strategies to design and manage trails should be based on detailed studies of immediate behavioral responses to human recreational users.

***106. Porter, W. F. 1992. Burgeoning ungulate populations in national parks: is intervention warranted?; Pages 304-312 in Dale R. McCullough and Reginald H. Barrett, editors Wildlife 2001: Populations. WR 239. Document Type: Report.***

***107. Schultz, R. D., and J. A. Bailey. 1978. Responses of National Park elk to human activity. Journal of Wildlife Management 42: 91-100.***

Abstract: Responses of Rocky Mountain National Park elk (Cervus canadensis) to human activities were quantified in autumn 1974 and winter-spring 1975. During autumn, numbers of elk seen, rates of bugling, times of arrival and departure of elk to and from meadows, and harem bulls' activities were analyzed for relationships with traffic volume and tourist activities. Results suggested small effects of traffic volume upon elk, but no trends were statistically significant. People approaching animals off roads usually caused elk to leave open areas. Harassing elk in 2 meadows on alternate weeks during winter and spring did not affect their distribution or observability on winter ranges. Elk made greater use of areas near roads as the winter-spring study progressed, suggesting slight avoidance of roads when forage was more abundant earlier in winter. Wintering elk often used a residential area at night when human encounters were minimal. During winter and spring, elk were approached significantly closer during darkness with artificial lights than during daylight. These elk, which experienced little or no hunting, were very visible and were disturbed little, if any, by normal on-road visitor activities.

***108. Taylor, A. R., and R. L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13: 951–963.***
(Notes: HD focus-Visitor perceptions of how their use of trails affects wildlife)

Abstract. Outdoor recreation has the potential to disturb wildlife, resulting in energetic costs, impacts to animals' behavior and fitness, and avoidance of otherwise suitable habitat. Mountain biking is emerging as a popular form of outdoor recreation, yet virtually nothing is known about whether wildlife responds differently to mountain biking vs. more traditional forms of recreation, such as hiking. In addition, there is a lack of information on the ''area of influence'' (within which wildlife may be displaced from otherwise suitable habitat due to human activities) of

different forms of recreation. We examined the responses of bison (*Bison bison*), mule deer (*Odocoileus hemionus*), and pronghorn antelope (*Antilocapra americana*) to hikers and mountain bikers at Antelope Island State Park, Utah, by comparing alert distance, flight distance, and distance moved. Within a species, wildlife did not respond differently to mountain biking vs. hiking, but there was a negative relationship between wildlife body size and response. We determined the area of influence along trails and offtrail transects by examining each species' probability of flushing as perpendicular distance away from a trail increased. All three species exhibited a 70% probability of flushing from on-trail recreationists within 100 m from trails. Mule deer showed a 96% probability of flushing within 100 m of recreationists located off trails; their probability of flushing did not drop to 70% until perpendicular distance reached 390 m. We calculated the area around existing trails on Antelope Island that may be impacted by recreationists on those trails. Based on a 200-m ''area of influence,'' 8.0 km (7%) of the island was potentially unsuitable for wildlife due to disturbance from recreation.

Few studies have examined how recreationists perceive their effects on wildlife, although this has implications for their behavior on public lands. We surveyed 640 backcountry trail users on Antelope Island to investigate their perceptions of the effects of recreation on wildlife. Approximately 50% of recreationists felt that recreation was not having a negative effect on wildlife. In general, survey respondents perceived that it was acceptable to approach wildlife more closely than our empirical data indicated wildlife would allow. Recreationists also tended to blame other user groups for stress to wildlife rather than holding themselves responsible.

The results of both the biological and human-dimensions aspects of our research have implications for the management of public lands where the continued coexistence of wildlife and recreation is a primary goal. Understanding wildlife responses to recreation and the ''area of influence'' of human activities may help managers judge whether wildlife populations are experiencing stress due to interactions with humans, and may aid in tailoring recreation plans to minimize long-term effects to wildlife from disturbance. Knowledge of recreationists' perceptions and beliefs regarding their effects on wildlife may also assist public lands managers in encouraging positive visitor behaviors around wildlife.

## Ungulates outside of Parks

### *109. Kilpatrick, H. J., A. M. Labonte, and J. S. Barclay. 2007. Acceptance of Deer Management Strategies by Suburban Homeowners and Bowhunters. Journal of Wildlife Management 71(6): 2095-2102.*

Abstract: More communities are experiencing problems associated with overabundant white-tailed deer (Odocoileus virginianus) populations. Public acceptance of approaches for managing deer may differ within communities. Although hunting with firearms is a common practice used to manage deer populations, many suburban communities only allow bowhunting. Our objectives were to assess suburban homeowners and bowhunters acceptance of lethal and nonlethal deer management strategies. Additionally, we wanted to determine homeowner willingness to pay for deer management and how long they would be willing to wait for relief to address conflicts caused by deer overabundance. Most homeowners supported using lethal strategies to reduce and manage deer populations. Most homeowners were unaware of the cost (94%) or effectiveness (92%) of birth control agents to manage free-ranging deer populations. Of lethal strategies,

bowhunting was preferred. Establishment of a special crossbow season outside the existing archery season received the greatest support by bowhunters and was also acceptable to homeowners. As landscapes progressed from rural to more urban, hunting access, human-wildlife conflicts, and homeowner willingness to pay for deer management decreased. Regardless of management strategy, most homeowners were willing to wait 3-5 years to achieve a desired reduction in the deer population at no cost to them. As costs increased, homeowner willingness to wait decreased. Because exposure, tolerance of deer, and willingness to pay for management varies by landscapes, towns with diverse landscapes should consider developing regional rather than town-wide plans to manage overabundant deer population

***110. Morrison, J. R., W. J. de Vergie, A. W. Alldredge, A. E. Byrne, and W. W. Andree. 1995. The effects of ski area expansion on elk. Wildlife Society Bulletin 23: 481-489.***

Summary: Disturbance from development in wildlife habitat generally takes two forms: physical disturbance (i.e., construction activity) and increased human activity. Elk habitat use in response to each of these disturbances was compared at separate ski areas. In both cases, elk use of nearby habitat declined significantly with post-development but began to increase linearly by year as elk habituated. The authors discuss the differences in the habituation response between the two areas and warn that despite population increases, complete recovery should not be assumed.

***111. Thompson, M. J., and R. E. Henderson. 1998. Elk habituation as a credibility challenge for wildlife professionals. Wildlife Society Bulletin 26(3): 477-483.***

Abstract: We offer our perspectives on challenges facing the wildlife profession if habituation behavior becomes prevalent in North American elk (*Cervus elaphus*). We find it increasingly difficult to ignore habituation in our work with elk and the public in western Montana. The scientific literature documents elk avoidance responses to human activities, but does not provide information to managers that would reconcile apparent contradictions we observe of elk habituation responses in urban fringe areas. Conversations with elk managers and researchers across western North America suggest that elk habituation is a management issue of emerging importance as elk and human populations expand. We examine habituation as an adaptive behavioral strategy for maximizing reproductive fitness and predict that habituated elk populations will be common across the Rocky Mountain west in the 21St century. To reduce habituation risk, managers should consider options that may differ radically from traditional elk management strategies (i.e., to protect elk habitat). We challenge researchers to describe relationships between increasing levels of habituation in elk and environmental factors within management control.

***112. Weisenberger, M. E., P. R. Krausman, M. C. Wallace, D. W. De Young, and O. E. Maughan. 1996. Effects of simulated jet aircraft noise on heart rate and behavior of desert ungulates. Journal of Wildlife Management 60: 52-61.***

Wildlife near air bases may be subject to negative stress effects from noise disturbance created by loud aircraft. Using captive ungulates, the authors measured heart rate and behavior in animals exposed to repeated aircraft disturbances. They found that heart rate increased and behavior changed with simulated aircraft noise and in relation to the decibel level of the noise. However, heart rate and behavior returned to normal shortly after the noise ceased. The number of animals responding and the length of the response decreased.

***113. Yarmoloy, C., M. Bayer, and V. Geist. 1988. Behavior responses and reproduction of mule deer (Odocoileus hemionus) does, following experimental harassment with an all-terrain vehicle. Canadian Field-Naturalist 102: 425-429.***

Summary: Recreational disturbance has the ability to impact reproduction and alter behavior in ungulates. In this study, five mule deer were habituated to an ATV traveling on a road and three of them were subsequently followed for a few minutes with the vehicle for 15 consecutive days. The harassed deer changed behavior patterns and had poor reproduction the following year compared with the control deer. The authors discuss the ability of ungulates to habituate to vehicle traffic on roads as long as it remains in predictable areas.

## Ungulate Response to Stimuli

***114. Enggist-Dueblin, P., and P. Ingold. 2003. Modelling the impact of different forms of wildlife harassment, exemplified by a quantitative comparison of the effects of hikers and paragliders on feeding and space use of chamois Rupicapra rupicapra. Wildlife Biology 9(1): 37-45.***

Summary: To effectively manage recreational disturbance to wildlife, managers need to understand how different forms of disturbance affect different species. This paper describes a mathematical model to quantify and compare forms of wildlife harassment and uses it to compare the impact of hikers and paragliders on feeding time and area use by chamois. The model, which can be applied to other species and adjusted to simulate changing conditions such as habituation and tourist density, identified paragliders as a greater disturbance factor than hikers. The authors touch on predictability as a factor mitigating disturbance effects. The authors present a hierarchy of wildlife responses to recreational disturbance and call for additional research. They examine causes, immediate responses, and long-term effects of recreational disturbance. They discuss factors such as predictability and frequency that influence tolerance.

***115. Freddy, D. J., W. B. Bronaugh, and M.C. Fowler. 1986. Response of mule deer to disturbance by persons at foot and snowmobiles. Wildlife Society Bulletin 14:63-68.***

Responses of adult female mule deer to per-sons afoot and to snowmobiles were observed during 67 controlled disturbance trials in the winters of 1979 and 1980. Responses by deer to persons were longer in duration, involved running more frequently, and were greater in estimated energy expenditure. Minimizing all responses by deer would require persons afoot and snowmobiles to remain >334 m and >470 m from deer, respectively. Preventing loco-motor responses by deer would require per-sons afoot and snowmobiles to remain >191 m and >133 m from deer, respectively. These threshold distances could be used to establish corridors of human activity within sagebrush winter ranges occupied by deer.

***116. Kimball, B. A., J. Taylor, K. R. Perry, and C. Capelli. 2009. Deer Responses to Repellent Stimuli. Journal of Chemical Ecology 35(12): 1461-1470.***

Abstract: Four repellents representing different modes of action (neophobia, irritation, conditioned aversion, and flavor modification) were tested with captive white-tailed deer in a series of two-choice tests. Two diets differing significantly in energy content were employed in choice tests so that incentive to consume repellent-treated diets varied according to which diet was treated. When the high-energy diet was treated with repellents, only blood (flavor modification) and capsaicin (irritation) proved highly effective. Rapid habituation to the odor of meat and bone meal (neophobia) presented in a sachet limited its effectiveness as a repellent under conditions with a high feeding motivation. Thiram, a stimulus used to condition aversions,

was not strongly avoided in these trials, that included only limited exposures to the repellent. These data support previous studies indicating that habituation to odor limits he effectiveness of repellents that are not applied directly to food, while topically-applied irritants and animal-based products produce significant avoidance.

***117. King, M. M., and G. W. Workman. 1986. Response of desert bighorn sheep to human harassment: Management implications. Transactions North American Wildlife and Natural Resources Conference 51:74-85.***

***118. Kloppers, E. L., C. Cassady St. Clair, and T. E. Hurd. 2005. Predator-Resembling Aversive Conditioning for Managing Habituated Wildlife. Ecology & Society 10(1): 1-18.***

Abstract: Wildlife habituation near urban centers can disrupt natural ecological processes, destroy habitat, and threaten public safety. Consequently, management of habituated animals is typically invasive and often includes translocation of these animals to remote areas and sometimes even their destruction. Techniques to prevent or reverse habituation and other forms of in situ management are necessary to balance ecological and social requirements, but they have received very little experimental attention to date. This study compared the efficacy of two aversive conditioning treatments that used either humans or dogs to create sequences resembling chases by predators, which, along with a control category, were repeatedly and individually applied to 24 moderately habituated, radio-collared elk in Banff National Park during the winter of 2001–2002. Three response variables were measured before and after treatment. Relative to untreated animals, the distance at which elk fled from approaching humans, i.e., the flight response distance, increased following both human and dog treatments, but there was no difference between the two treatments. The proportion of time spent in vigilance postures decreased for all treatment groups, without differences among groups, suggesting that this behavior responded mainly to seasonal effects. The average distance between elk locations and the town boundary, measured once daily by telemetry, significantly increased for human-conditioned elk. One of the co-variates we measured, wolf activity, exerted counteracting effects on conditioning effects; flight response distances and proximity to the town site were both lower when wolf activity was high. This research demonstrates that it is possible to temporarily modify aspects of the behavior of moderately habituated elk using aversive conditioning, suggests a method for reducing habituation in the first place, and provides a solution for Banff and other jurisdictions to manage hyperabundant and habituated urban wildlife.

***119. Stankowich, T. 2008. Ungulate flight responses to human disturbance: A review and meta-analysis Biological Conservation 141(9): 2159-2173.***

Abstract: As human recreation in natural areas increases, so does the potential for disturbance to wildlife, and many factors (environmental, disturbance type, experience with humans) influence the impact of disturbance. However, there exists no comprehensive examination of the effects of human disturbance on ungulate escape responses. I conducted a comprehensive review of studies measuring Artiodactyl escape responses (e.g., flight initiation distance, distance moved) to experimental harassment by humans and vehicles, and meta-analyses aimed at predictive questions about the impact of human disturbance on ungulate behavior under an optimization framework. I found evidence across studies that ungulates pay attention to approacher behavior, have greater perceptions of risk when disturbed in open habitats, and females or groups with young offspring show greater flight responses than adult groups. Increased group size and the presence of hunting showed weak but positive heterogeneous effects on flight behavior both

between and within species. Humans on foot were more evocative than other stimuli (vehicles, noises). Populations in areas with higher levels of human traffic showed reduced wariness but a lack of alternative sites to move to may explain some of this effect. Hunted populations showed significantly greater flight responses than non-hunted populations. Finally, I suggest five factors to consider when forming predictive models of ungulate flight behavior: (1) how seasonal variation in reproductive status and body condition effects wariness, (2) the relative impacts of lethal and non-lethal human contact, and (3) unique natural history traits that may cause differences in flight behavior between populations, (4) the availability of alternative sites, and (5) shorter distances between feeding sites and refugia can reduce the impact of other factors on flight responses.

***120. Ujvari, M., H. J. Baagoe, and A. B. Madsen. 1998. Effectiveness of wildlife warning reflectors in reducing deer-vehicle collisions: a behavioral study. Journal of Wildlife Management 62(3): 1094-1099.***

Abstract: Researchers investigated habituation of fallow deer to repeatedly occurring light reflections from WEGU reflectors. Fallow deer exhibited increasing indifference to reflections. The results suggest reflectors are not a reliable method for reducing deer-vehicle accidents on a long-term basis.

***121. Ujvari, Marianne, B., H. Jorgen, and A. B. Madsen. 2004. Effectiveness of acoustic road markings in reducing deer-vehicle collisions: a behavioral study. Wildlife Biology 10(2): 155-159.***

Abstract: The behavioral responses and habituation of fallow deer Dama dama to play-back sounds from repeatedly occurring acoustic road markings were studied during 13 nights. Our experimental design eliminated factors normally associated with passing vehicles (e.g. vehicle noise and light), and fallow deer were exposed to play-back sounds from road markings at predetermined time intervals. Though the distribution of the predefined behavioral responses 'flight', 'alarm', 'movement of head' and 'no reaction' varied among nights, the fallow deer exhibited increasing indifference to sounds from road markings with time, and this we explained as being habituation to the acoustic stimulus. As we expect our results to be valid for other species of deer as well, we find that acoustic road markings are not a reliable method to reduce the number of deer-vehicle collisions on a long-term basis.

## African Herbivores

***122. Nyahongo, J. W. 2008. Flight initiation distances of five herbivores to approaches by vehicles in the Serengeti National Park, Tanzania. African Journal of Ecology 46(2): 227-229.***

Abstract: The article reports on a study which was conducted at the Serengeti National Park (SNP), Tanzania from May 2001 to April 2002 in order to assess flight initiation distances (FID) in herbivores. As reported, in this study, the approach of a vehicle to herbivores in the SNP was used to simulate a standardized level of threat. The study found that FIDs were significantly greater, regardless of species, in the western corridor than the central area. The study also found that illegal bushmeat hunting may undermine the process of habituation of herbivores to the presence of vehicles. It was also found that the quality of nonconsumptive tourism is influenced by wildlife viewing distances.

## Avian Habituation, Disturbance, and Food Conditioning

***123. Anderson, D. W. 1988. Dose-response relationship between human disturbance and brown pelican breeding success. Wildlife Society Bulletin 16: 339-345.***

Abstract: The California brown pelican nesting colony at Isla Coronado Norte has been disturbed to such an extent that nesting success has been reduced and nesting populations on that island are threatened. Nest abandonments increased with nearness of human activity, and human disturbances versus nesting success followed a typical dose-response pattern, thus providing also an estimate of a "safe" distance without apparent negative effects. Pelicans began to suffer detriment at distances less than about 600 m, illustrating the extreme sensitivity of brown pelicans to human disturbance.

***124. Anderson, M., T. D. Bergman, and T. Knight. 1999. Black-billed magpie (Pica pica) foraging response to human presence in urban and rural areas. Journal of the Colorado Field Ornithologists 32(4): 248-252.***

Abstract: The purpose of this experiment was to determine the impact of human presence on the foraging behavior of black-billed magpies (Pica pica) at food sources in urban versus rural settings. We predicted that magpies at urban sites (n=29) were more likely to approach a food source in close proximity to humans than magpies at rural sites (n=18). Sites were selected according to previous sightings of magpies and their habitat preferences. At each site, raw meat was placed 10 meters from a seated observer. In a 20-minute trial, the observer recorded how many times magpies approached within one meter (3.3 feet) of the food during 20 1-minute intervals. We also estimated the total number of magpies using the site overall. While we found no statistical difference in the total number of magpies at urban versus rural sites, repeated measures ANOVA analysis revealed a significant site type (rural vs. urban) by time interaction term. The mean number of magpie approaches to food over the 20 1-minute intervals increased at urban sites but not at rural sites. We attribute this to the ***habituation*** of magpies to human activities in urban areas. Climatic variation and occasional interruptions may have contributed to some bias in the data, however, and future studies should attempt to control for these natural errors. This experiment demonstrates that magpies often adapt to human activity and will continue to forage in the presence of a human. The ability of magpies to adjust to different levels of human disturbance will likely ensure their continued existence well into the future.

***125. Baird, P. H., and S. Hink. 2002. Disturbance causes and effects and habituation at colony of California Least Terns. Pacific Seabirds 29(1): 29-30.***

***126. Baxter, A. T., and J. R. Allan. 2008. Use of Lethal Control to Reduce Habituation to Blank Rounds by Scavenging Birds. Journal of Wildlife Management 72(7): 1653-1657.***

Abstract: Scavenging bird deterrence frequently fails due to habituation. We demonstrated such habituation by gulls and corvids to blank rounds used in a dawn-to-dusk regime at a landfill site in southern England. We then combined blank rounds with live rounds and shot birds whenever they attempted to land. Gull numbers declined significantly despite only 1.9% of the population being shot. Corvid numbers returned to precontrol levels despite 52.7% of the population being shot. We suggest that shooting reduces gull habituation to blank rounds but is ineffective at reducing habituation by corvids.

***127. Camp, R. J., and R. L. Knight. 1998. Rock climbing and cliff bird communities at Joshua Tree National Park, California. Wildlife Society Bulletin 26(4): 892-898.***

Abstract: We studied rock climbing and bird communities associated with cliffs, with and without rock climbing, at Joshua Tree National Park, California. Bird communities differed between sites with different levels of rock climbing. Four bird species were detected only at cliffs where no climbing occurred; 5 species were detected only at cliffs with moderate levels of climbing activity; and 3 species were seen only at cliffs with many popular climbing routes. European starlings (Sturnus vulgaris) and brown-headed cowbirds (Molothrus ater) were seen only at climbed cliffs. Birds at unclimbed cliffs were more likely to be perched at the faces of cliffs, whereas birds at popular climbing cliffs were more likely to be flying. At popular cliffs, birds were usually seen away from cliff faces, whereas at unclimbed cliffs birds were more likely to be detected near cliff faces.

***128. Carney, K. M., and W. J. Sydeman. 1999. A review of human disturbance effects on nesting colonial water-birds. Waterbirds 22: 68-79.***

Abstract. We reviewed 64 published investigations concerning effects of human disturbance on nesting colonial waterbirds. We summarized and reviewed articles, based on taxonomy, examining investigator, ecotourist, recreator, watercraft, and aircraft activity effects on physiology, reproductive behavior, reproductive success, and population trends of waterbirds. Though most studies found significant negative effects, taking careful measures minimized impact on some species. Guidelines for minimizing investigator and visitor disturbance are outlined. Little practical information for visitor management is available. Increasing pressure from the ecotourism industry to visit waterbird colonies makes research that develops scientifically-defensible tourism policies imperative.

***129. Carney, K. M., and W. J. Sydeman. 2000. Response: Disturbance, habituation and management of waterbirds. Waterbirds 23(2): 333-334.***

Excerpt: (This article is a response to critique of the article, "Carney, K. M. and W. J. Sydeman. 1999. A review of human disturbance effects on nesting colonial water-birds. Waterbirds 22: 68-79). … we find ourselves agreeing with Nisbet (2000) more than disagreeing. We agree that (i) making a clear connection between human disturbance is problematical given the many factors that can affect breeding success and the difficulty of measuring reproductive success accurately, if doing so precludes entering colonies, (ii) the effects of visitors can be difficult to study due to their unpredictable and variable nature and the inability in most cases to control for confounding effects, (iii) convincing evidence of adverse effects of human disturbance has been presented for several groups of waterbirds, including penguins, cormorants, pelicans, and alcids, (iv) some waterbird species are capable of habituating to human disturbance, (v) what need to be minimized are the adverse effects of human disturbance. In fact, though we mention them in different contexts, all of these points are made in both his and our papers. Finally, we agree that future studies should more rigorously address how visitor activities affect waterbird colonies; such studies should include examining the effectiveness of different management strategies, which may include actively habituating waterbirds to human intrusion to ameliorate adverse disturbance effects as suggested by Nisbet (2000).

***130. Conover, M. 1999. Can waterfowl be taught to avoid food handouts through conditioned food versions? Wildlife Society Bulletin 27(1): 160-166.***

Abstract: Preventing park visitors from feeding animals is a major management problem. One potential solution is to teach wildlife not to accept food from humans. I hypothesized that if handouts were treated with a chemical that would make this food distasteful, irritating, or sickening, free-ranging Canada geese (Branta canadensis) and mute swans (Cygnus olor) would develop an aversion to handouts and stop accepting them from humans. I offered 39 Canada geese bread treated with dimethyl anthranilate or methiocarb for 5 consecutive days. The percentage of geese that ate treated bread daily during the treatment period was lower (P = 0.008) than the percentage that ate untreated bread in the pretreatment period. However, once geese were again fed untreated bread (post-treatment period), most resumed eating bread within 1-2 days. Most swans (85% on a given day) accepted bread from either of 2 different people (referred to as the "hand-feeder" and the "manager") during the pretreatment period. During the IO-day treatment period, the manager (but not the hand-feeder) offered swans methiocarb-treated bread. During this period, significantly fewer swans accepted bread than during the pretreatment period, and those that did took significantly longer to begin feeding. When swans were again fed untreated bread, most continued to avoid bread and feeding delays remained lengthy. Swans were equally reluctant to accept bread from either the hand-feeder or the manager. These results support the hypothesis that it is possible to teach free-ranging birds not to accept handouts through conditioned food aversions, but the aversions I established in geese were weak.

***131. Dunlop, J. N. 1996. Habituation to human disturbance by breeding bridled terns Sterna anaethetus. Corella 20(1): 13-16.***

Abstract: Bridled terns breeding on Penguin Island, Western Australia, allow humans to come closer to their nesting area than do bridled terns on Bridled Island off the Pilbara coast. The terns on Penguin Island have become accustomed to the presence of people near the colony. The author discusses the management of human visits to seabird colonies.

***132. Fitzpatrick, S., and B. Bouchez. 1998. Effects of recreational disturbance on the foraging behavior of waders on a rocky beach. Bird Study 45(2): 157-171.***

Abstract: Researchers studied the types and extent of human recreational disturbances on a beach and the effects of these disturbances on the foraging behavior of oystercatchers, curlews, and redshanks. For all species, arrival was delayed and departure was earlier when disturbed. Characteristic avoidance behavior differed among the species, and habituation may be a response to regular disturbance.

Summary from 2007 bibliography: A common side effect of recreational disturbance to wildlife is a loss of feeding time. This study examined the effects of human disturbance on oystercatchers, curlews, and redshanks during summer foraging. While disturbance generally disrupted foraging, the response varied among species. Moderate disturbance did not affect foraging time though capture rates increased with disturbance, indicating that undisturbed birds were not foraging at peak efficiency. Habituation to humans likely allows these birds to keep disturbance-induced disruptions in foraging to a level which may be compensated for.

***133. Fowler, G. S. 1999. Behavioral and hormonal responses of Magellanic penguins (Spheniscus magellanicus) to tourism and nest site visitation. Biological Conservation 90: 143-149.***

Abstract: One of the results of human disturbance at seabird colonies may be the provocation of the typical vertebrate adrenocortical response to stressors, but there have been few studies that demonstrate this. The present study demonstrates that simple human presence at the nest site, without effects of capture or handling, is physiologically stressful for breeding Magellanic penguins (Spheniscus magellanicus) that are not accustomed to seeing humans. It also demonstrates that birds that have been exposed to very high levels of human visitation via tourism do not respond to human presence as a stressor, whereas those exposed to moderate levels of disturbance do not show evidence of habituation over a period of a few years. These results suggest that tourist visits should be concentrated in a small part of breeding colonies, allowing birds nesting in the visitation area to habituate, leaving the remainder of the colony free of disturbance.

Summary: A possible side effect of human disturbance at seabird colonies may be an increase in the andrenocortical stress response. To examine this effect, the authors measured corticosterone levels of Magellanic penguins in areas with varying levels of disturbance by tourists. They found that human presence near nest sites was stressful to birds unless the birds were habituated — though only birds exposed to very high levels of tourists became habituated. Large differences in corticosterone variability among nesting areas may also indicate that not all individuals are capable of habituation. The results suggest that tourist activities should be restricted to concentrated areas of breeding colonies.

***134. Fox, A.D. 1997. Behavioral and distributional effects of hunting disturbance on waterbirds in Europe: implications for refuge design. Journal of Applied Ecology 34(1): 1-13.***

Abstract: The paper is based on studies of the effects of hunting disturbance on local waterbird distribution and abundance, freedom from such disturbance is concluded to be an important part of waterbird management on nature conservation areas. Measures to mitigate the effects of disturbance from hunting are reviewed. These include complete removal of hunting in refuges, as well as spatial and temporal regulation of hunting activity in reserve areas without hunting-free refuges. 2. Disturbance-free refuge design should take account of the ecological requirements of all species using a site and the functional units required to meet all daily activities, especially primary feeding and roosting areas used by waterbirds. Refuge size and shape must ensure birds are free from the effects of external disturbance. The most effective refuges are of regular shape, maximum practicable size, and should have a minimum diameter of three times the escape flight distance of the most sensitive species present. 3. Zoning in non-refuge areas can increase local bird numbers by restricting disturbance to regular predictable stimuli to which habituation is more likely. Mobile hunting activity close to roosting and/or feeding areas is more disturbing than hunting from fixed points or where birds are shot moving between such areas. Intermittent hunting is not an effective means of minimizing disturbance, but where implemented, rest periods between hunting events should be considered in weeks rather than days. 4. Most studies of mitigation techniques to minimize hunting disturbance have been descriptive and retrospective. Manipulative studies testing specific hypotheses are essential to create a sound scientific base for management. 5. Management of hunting activity should take place within a broader management planning framework that identifies ideal and operational objectives in the

management of the site, including feedback monitoring to determine the effectiveness of management prescriptions. 6. We recommend that local site management planning should be integrated internationally, especially in the planning of refuge networks along migration corridors. Management actions in one part of a flyway may affect the ability of areas elsewhere to meet obligations to biodiversity conservation and maintenance of range under international law. In populations that are limited by winter resources, creation of a refuge network may offer a mechanism to enhance population size, but more large scale density dependence studies are required to confirm this.

***135. Grubb, T. G., W. L. Robinson, and W. W. Bowerman. 2002. Effects of watercraft on bald eagles nesting in Voyageurs National Park, Minnesota. Wildlife Society Bulletin 30(1): 156-161.***

Abstract: Some activities of humans near bald eagle (*Haliaeetus leucocephalus*) nests during the breeding season have been related to reduced nesting success. We evaluated effects of watercraft on nesting bald eagles in Voyageurs National Park, Minnesota, by observing eagles attending 9 active nests in 1995 and 1996. In 515.8 hours of observation, 2,431 watercraft passed within 800 m of these nests. Eagles responded by showing alert pos-ture or flying 115 times (78 or 3.2% alert; 37 or 1.5% flight) for a 4.7% response fre-quency. Frequency of response varied between 2.4 and 16.7% among nesting pairs of eagles and showed a curvilinear (quadratic) relationship with mean number of watercraft per hour (r2 =0.666, P=0.037). We used a classification and regression tree model (CART) to explore and quantify conditions leading to bald eagle response, despite the species' low overall response rate. Our model indicated that distance was the most crit-ical component of any potential watercraft disturbance, with responses decreasing at dis-tances of <85 m (82%), 86-172 m (61%), 173-335 m (44%), and 336-800 m (31%). Duration (>90 sec), number of watercraft/event (>1), and time of day (before 1800 h) also affected eagle response rates beyond 85 m. Overall accuracy for our CART model was 0.65, indicating that response to watercraft will be predicted correctly 2 times out of 3.

***136. Holm, T. E. and K. Laursen. 2009. Experimental disturbance by walkers affects behavior and territory density of nesting Black-tailed Godwit Limosa limosa. Ibis 151(1): 77-87.***

***137. Holmes, N. D, M. Giese, H. Achurch, S. Robinson, and L. K. Kriwoken. 2006. Behavior and breeding success of gentoo penguins Pygoscelis papua in areas of low and high human activity. Biology 29(5): p399-412.***

Abstract A key factor influencing wildlife responses to human activity is the degree to which animals have been previously exposed to human stimuli. On subantarctic Macquarie Island, gentoo penguins Pygoscelis papua breed in areas of high and low human activity (on and off-station, respectively). We investigated the behavior and breeding success of gentoo penguins on and off station, by a) comparing the behavioral responses of guarding gentoos before, during and after exposure to standardized pedestrian approaches, and b) employing an observational study to determine how human activity may have contributed to within-season breeding success in light of other environmental and site variables. Behavioral responses to pedestrian visitation by gentoos off-station were significantly stronger than those of birds breeding on-station. However, no relationship was found between pedestrian activity and breeding success off-station. Breeding success was, however, positively related to colony size, and negatively related to the activity of other penguins, the number of nearby southern elephant seal Mirounga leonina harems and the

location of colonies within short grassland. On-station, breeding success was amongst the highest recorded for that season. Habituation, predator exclusion and the relevance of these findings for management are discussed.

***138. Lord, A., J. R. Wass, J. Innes, and M. J. Whittingham. 2001. Effects of human approaches to nests of northern New Zealand dotterels. Biological Conservation 98: 233-240.***

Summary: New Zealand dotterels are an endangered shorebird that may be further threatened by human disturbance to nest sites. To examine the effects of disturbance, the authors measured the flush responses of dotterels when approached by humans walking, running, or leading a dog. Flush distances were significantly greater when approached by a dog. Comparing reactions at high- and low-use beaches showed a significant habituation effect at high-use beaches. The authors discuss the positives (i.e., ability to nest in high-use areas) and negatives (i.e., elevated corticosterone levels) of this habituation.

***139. Nisbet ICT. 2000. Disturbance, habituation, and management of waterbird colonies – Commentary. Waterbirds 23(2): 312-332.***

Abstract. This Commentary presents a critique of studies of effects of human disturbance on breeding colonial waterbirds, including a recent review by Carney and Sydeman (1999). It challenges the mind-set that the effects of disturbance are always adverse, and the resulting management principle that disturbance should be minimized. I argue that many studies do not withstand critical scientific scrutiny, and that published papers and reviews systematically overstate the adverse effects of human disturbance. I propose definitions of the terms "disturbance", "habituation" and "tolerance", as well as classifications of types of disturbance and types of effect. Contrary to prevailing opinions, there is little scientifically acceptable evidence that human disturbance causes substantial harm to terns (Sterna spp.), gulls (Larus spp.) or herons (Ardeidae), although it is likely that sporadic incidents of harassment and vandalism are under-reported. Convincing evidence of adverse effects has been presented for several other species and groups of species; most well-documented cases have been early in the nesting cycle and/or mediated by diurnal avian predators. Although there are no formal studies of habituation, many or most colonial waterbirds can become extremely tolerant of repeated human disturbance. I recommend that, where appropriate, waterbird colonies should be managed for multiple uses (including research, education, and recreation) by deliberately promoting habituation. Although many field biologists are careful to investigate the effects of their activities and are successful in minimizing them, others appear insufficiently aware of the potential for harm, so that there is a need for more complete guidelines and better training.

***140. Keller, V. 1989. Variations in the response of great crested grebes Podiceps cristatus to human disturbance: a sign of adaptation? Biological Conservation 49:31-45.***

Summary: Some species may be able to overcome the negative effects of recreational disturbance by habituating to the disturbance. This study examined the flush distance and breeding success of great crested grebes at three lakes in Switzerland with varying levels of recreation. Birds on high-use lakes showed signs of habituation (i.e., lower flush distances) but were still flushed more frequently and had lower reproduction than on low-use lakes. Within high-use lakes, birds with the smallest flush distances displayed greater reproduction, suggesting that habituation may act as an adaptive behavior.

***141. Klein, M. J., S. R. Humphrey, and H. F. Percival. 1995. Effects of ecotourism on distribution of waterbirds in a wildlife refuge. Conservation Biology 9: 1454-1465.***
Summary: Ecotourism and recreational disturbance may prevent use of protected habitat by wildlife. This paper describes the distribution of 38 waterbird species in relation to areas of human activity at a sanctuary in Florida. Resident birds were less affected by humans than migrants, and migrants were more affected upon arrival. Certain species were likely to be found near human activity. Several species were divided into two groups: one habituated to humans and one easily disturbed. The authors discuss the implications for refuge design and management.

***142. Metcalf, B. M., S. J. Davies, and P. G. Ladd. 2002. Adaptation behavior by two bird species as a result of habituation to humans. Australian Birdwatcher 18: 306-312.***
Summary: Until recently, Carnaby's cockatoo and the grey currawong were absent from heavily populated areas within their range. This paper examines their return to developed areas by measuring flight initiation distance of the two bird species. Flight initiation distances were much smaller in urban areas, and the authors conclude that habituation to humans has allowed the repopulation of these species into urban areas. They discuss possible causes of the habituation, such as learned behavior by young or natural selection.

***143. Pearson, E. W., P. R. Skon, and G. W. Corner. 1967. Dispersal of urban roosts with records of starling distress calls. Journal of Wildlife Management 31(3): 502-506.***
Abstract: A starling (Sturnus vulgaris) roost in Denver, Colorado, that contained 5,000 birds in October, 1964, and 1,500 in July, 1965, was dispersed both years in four evenings by starling distress calls on records played by 8 to 13 residents as birds arrived at the roost. A second roost that formed a few blocks away contained more than 10,000 starlings and a few common grackles (Quiscalus quiscula) when it was dispersed in three evenings in October, 1965, with starling distress calls played by 34 residents. If the starlings found later in outlying roosts were from this urban roost, more than 85 percent were moved to areas where they were not a nuisance. Participation by about half the residents in an urban roost area appears to be sufficient for starling dispersal. Contrary to observations by previous workers, habituation to calls did not materialize, despite almost continuous playing by several residents in each roost area.

***144. Rees, E. C., J. H. Bruce, and G. T. White. 2005. Factors affecting the behavioral responses of whooper swans (Cygnus c. cygnus) to various human activities. Biological Conservation 121(3): 369-382.***
Abstract: The effects of human activity on bird behavior and distribution have been studied extensively in recent years, but variation in their response to disturbance is still poorly understood. Here, we analyze variation in the behavior of wintering whooper swans Cygnus c. cygnus, to determine whether their susceptibility to human activity changes with time, location and the type of disturbance involved. Overall, the swans" feeding activity varied within and between years, and in relation to feeding site, but there was less variation in the amount of time spent alert. Disturbance frequency resulting from human activity was lower with increasing flock size and with increased distance to the nearest road or track. Distances that humans could approach before alerting the birds similarly varied with field characteristics (e.g. size and proximity to roads or tracks), and also with the type of disturbance involved. The distance at which 5% of the flock became alert because of human activity decreased with the number of previous disturbance incidents in the day, indicating that swans become less sensitive to disturbance events if daily disturbance frequency is high, but there was no evidence that

habituation to disturbance persisted over longer periods. The time taken for the birds to resume undisturbed behavior varied with the duration of the disturbance event, which in turn depended on the type of disturbance involved, with pedestrians alerting the birds for longer periods than vehicles and aircraft. Recovery rates following disturbance were also associated with field size, flock size and the proportion of the flock alerted. Feeding activity was influenced by a range of variables, including year, season, field location, crop type and the number of days that the flock had used the field (32.9% of variance in the data explained by these variables), with disturbance factors explaining an additional 4.9% of variance in the proportion feeding per hour. Conversely, alert activity was influenced mainly by disturbance events. The range of factors influencing the swans" feeding behavior, and variability in their response to human activity, has implications for management programs and for attempts to predict the effects of human activity on the birds at a local and larger scale.

***145. Rodriguez-Prieto, I., E. Fernández-Juricic, J. Martín, and Y. Regis. 2009. Antipredator behavior in blackbirds: habituation complements risk allocation. Behavioral Ecology 20(2): 371-377.***

Abstract: Several studies showed that animals allow closer approaches (measured through flight initiation distances, FIDs) by potential predators (e.g., humans) in high–predator density areas, which has been explained by habituation effects. We assessed whether this pattern could be produced by not only habituation but also risk allocation by simulating attacks on blackbirds Turdus merula by both usual (pedestrians) and novel (radio-controlled vehicle) potential predators in parks with different levels of human visitation. Individual blackbirds from parks with higher pedestrian rates showed lower FID than individuals from parks with lower pedestrian rates, in response to both usual and novel approaches. Blackbirds adjusted their antipredator behavior to the specific level of pedestrian rate encountered every morning and evening in each park, with higher FID in the period with lower pedestrian rate. Similar responses to usual and novel potential predators among parks and daily variation in antipredator behavior support the risk allocation hypothesis and could not be explained by habituation. However, the rate at which FID was reduced in individuals from low-visited parks to high-visited parks was greater for pedestrian attacks than for novel potential predator attacks, suggesting that habituation is also present in our system and complements the effects of risk allocation. Our results have applied implications: the reduction in FID with increasing human visitation in natural areas is usually attributed to habituation; however, we propose that risk allocation can also reduce antipredator behavior effort to survive in habitats with high levels of recreational activities at the expense of potential physiological costs.

***146. Scott, G. W., A. R. Niggebrugge, and B. Sweeney. 1996. Avian habituation to recreational disturbance on the North Yorkshire coast. Naturalist 121: 11-15.***

Summary: The effects of recreational disturbance on shorebirds are generally related to the number of human visitors. This study measured responses of oystercatchers, turnstones, and redshanks to human disturbance at three beaches. Responses varied among species and among beaches. Birds at the beach with the highest level of recreational disturbance displayed the smallest flight distances, suggesting the ability to habituate and mitigate the effects of disturbance.

***147. Spanier, E. 1980. The use of distress calls to repel night herons (nycticorax nycticorax) from fish ponds. Journal of Applied Ecology 17(2): 287-294.***

Abstract: Night herons (Nyctieorax nyctieorax) (Linnaeus) inflict heavy losses on pisciculture by taking commercial fishes from cultivation ponds. Several previous attempts to repel them by various methods failed to reduce losses. Distress calls of both young and adult night herons were recorded and then played back in the vicinity of trout ponds. More than 80% of the night herons were repelled from the ponds when natural distress calls of their own species were broadcast. Although they did not leave the general area after playback, their repulsion from the immediate surroundings reduced losses considerably. No habituation to playback of natural distress calls was observed, even after many weeks of successive nightly broadcasts. This finding is in contrast to the reduction in heron response to an artificial sound (gas-gun) noted after the first night of experimentation. The ecological significance of the use of bio-acoustics to repel pests in agriculture and industry is discussed.

***148. Stalmaster, M. V., and J. R. Newman. 1978. Behavioral responses of wintering bald eagles to human activity. Journal of Wildlife Management 42: 506-513.***

Summary: Declines in bald eagle populations have been attributed to human development and disturbance. This paper examined eagle tolerance to disturbance by analyzing distribution with relation to development and flight responses from human activity. Human activity significantly altered distribution, and flight distances from disturbance were high — especially over water. Moderate habituation to regular human activities was observed. The authors recommend buffers and restricted activity zones around eagle wintering grounds.

***149. Steidl, R. J., and R. G. Anthony. 1996. Responses of bald eagles to human activity during the summer in interior Alaska. Ecological Applications 6: 482-491.***

Summary: On narrow rivers, spatial restrictions on humans based on wildlife reactions can eliminate certain waterways from use, suggesting the need for alternative management strategies. The authors measured the responses of bald eagles to boating activity on a narrow waterway in Alaska. Similar to other studies, they found that eagles in lower use areas displayed a more severe reaction to human disturbance. They discuss whether the mechanism is habituation or habitat choice (i.e., eagles prone to being disrupted select low-disturbance areas to roost). Based on the results, temporal, rather than spatial, restrictions are recommended.

***150. Steidl, R. J., and R. G. Anthony. 2000. Experimental effects of human activity on breeding bald eagles. Ecological Applications 10(1): 258-268.***

To assess the consequences of increased recreational activity in wilderness areas, we studied the effects of human activity on breeding behavior of Bald Eagles (*Haliaeetus leucocephalus*) in interior Alaska. Activity budgets of breeding eagles changed considerably when humans were camped for 24 h at a distance of 100 m from nests (treatment) compared to when they were camped 500 m from nests (control) ($P = 0.0036$). With humans near nests, adult eagles decreased the time they preened (percentage change from control to treatment = −53%), slept (−56%), maintained nests (−50%), and fed themselves and their nestlings (−30%) and increased the time they brooded nestlings (+14%). Further, overall activity (total number of behaviors performed by adults at nests per day) decreased by 27% with humans near nests, as did the amount of prey adults consumed (−26%) and fed to nestlings (−29%). In contrast, nest attendance did not change with humans near nests (percentage change = 0.3%, $P = 0.9$); however, the time adults were absent from the nest area (≥200 m from nests) increased by 24% with humans near nests ($P = 0.013$). Throughout 24-h treatments, eagle responses to nearby humans diminished, suggesting

that eagles habituated to the disturbance. During the last 4 h of treatment, however, adults still vocalized twice as frequently as controls, indicating continued agitation. Human activity near nests caused clear and consistent changes in behaviors of breeding eagles, suggesting that frequent human activities near nests could adversely affect nestling survival, and therefore reproductive success.

***151. Stolen, E. D. 2003. The effects of vehicle passage on foraging behavior of wading birds. Waterbirds 26: 429-436.***

Summary: Protected refuges in Florida provide critical habitat for wading birds, but these areas may also be exposed to high levels of human disturbance. Foraging rates of Snowy Egrets, Great Egrets, and Tricolored Herons were measured in relation to disturbance from passing vehicles. Birds were more likely to be disturbed by vehicles that slowed or stopped near foraging areas. Some habituation to vehicles was observed in high-use areas, though the response varied by individual. The authors discuss their results in the context of refuge design and tourist education.

***152. Titus, J. R., and L. W. Vandruff. 1981. Response of the common loon (Gavia immer) to recreation pressure in the Boundary Waters canoe area, northeastern Minnesota, USA. The Wildlife Society, Wildlife Monographs no. 79.***

Summary: The effects of recreational disturbance on loon reproduction in wilderness areas are relatively unknown. This study measured a number of nest-site characteristics and disturbance indexes for loons in the Boundary Waters Canoe area of Minnesota. High disturbance areas led to reduced nesting success. Habituation of some individuals, which allows them to remain in high disturbance areas despite lower nesting success, may be one reason that the population has declined in the face of disturbance.

***153. Urfi, A. J., J. D. Goss-Custard, and S. E. A. le V. dit Durell. 1996. The ability of oystercatchers Haematopus ostralegus to compensate for lost feeding time: field studies on individually marked birds. Journal of Applied Ecology 33: 873-883.***

Summary: The lost-feeding compensation hypothesis, derived from captive birds, suggests that birds are able to increase their foraging rate after a disturbance to compensate for lost time. Researchers tested this hypothesis on free-ranging birds exposed to natural, experimental, and fisherman induced disturbance. They did not find evidence of compensation via feeding rate for foraging lost to disturbance, but they found that birds with the highest exposure to humans were able to habituate and reduce the effects of disturbance.

***154. Vennesland, R. G. 2010. Risk perception of nesting Great Blue Herons: experimental evidence of habituation. Canadian Journal of Zoology 88(1): 81-88.***

Abstract (English): The nesting behavior of the Great Blue Heron (Ardea herodias L., 1758) was studied in western Canada in 1998 and 1999 to (i) investigate how individual parents assess risk when repeatedly exposed to a disturbance stimulus (an investigator) and (ii) experimentally test in the field whether any variation in their nest defense behavior was due to experience with the disturbance stimuli or the stage of the nesting period. Heron response declined through the nesting period and the level of response varied among colonies, suggesting different perceptions of risk among groups of herons in the study. It was experimentally shown that variation in the response of herons through one nesting period was due to both behavioral habituation and the stage of the nesting period. Response was stronger in 1999 than in 1998, indicating that habituation did not hold between nesting periods. In general, habituation in herons may bode well for their potential to persist in areas with light human use. But irrespective of habituation,

stimuli early in the nesting period and large or novel events may still cause herons to abandon their nests owing to the effects of the stage of the nesting period.

***155. Walker, B. G., D. Boersman, and J. C. Wingfield. 2006. Habituation of Adult Magellanic Penguins to Human Visitation as Expressed through Behavior and Corticosterone Secretion. Conservation Biology 20(1): 146-154.***

Abstract: Ecotourism is increasing worldwide; hence, it is important to know how wildlife are affected behaviorally and physiologically by human visitation. We studied the effects of human visitation on the Magellanic Penguins (Spheniscus magellanicus) at Punta Tombo, Argentina, by monitoring changes in defensive head turns and plasma corticosterone (a hormone secreted in response to stress) for penguins with and without a history of tourist visitation. Habituation to human visitation was rapid. In penguins with no previous exposure to tourists, the number of defensive head turns and level of plasma corticosterone decreased significantly within 5 days of one 15-minute visit/day. Penguins living in tourist-visited and undisturbed areas secreted more corticosterone when captured and restrained than penguins visited by a person. Penguins in tourist areas, however, did not show as strong a corticosterone response to capture and restraint as did penguins in areas without tourists. This difference was due to a decreased capability of the adrenocortical tissue to secrete corticosterone in tourist-visited birds. Although our data show no direct negative effects of tourism on Magellanic Penguins at Punta Tombo, consequences of a modification of physiological capabilities (e.g., adrenocortical function) may not become apparent until much later in life. The physiological differences between tourist-visited and undisturbed groups of Magellanic Penguins emphasize the importance of monitoring the effects of anthropogenic disturbances on wildlife at multiple levels.

***156. Walker, B. G., J. C. Wingfield, and P. D. Boersma. 1999. Magellanic penguins at Punta Tombo, Argentina: do tourists push them over the edge? (abstract). Pacific Seabirds 26:47.***

Summary: Annually, over 40,000 tourists visit the Magellanic penguin colony at Punta Tombo, Argentina, with most walking directly among the colony. Researchers examined agitation and habituation of penguins exposed to high levels of eco-tourism by observing agonistic head movements and blood corticosterone levels. Birds exposed to tourists were habituated and were significantly calmer than naïve birds. However, naïve birds were able to habituate to heavy tourist activity within ten days, and the authors conclude that well controlled tourist activity may not harm the colony.

***157. Walker, B. G. 2005. Physiological and behavioral differences in Magellanic Penguin chicks in undisturbed and tourist-visited locations of a colony. Conservation Biology 19:1571-1577.***

Summary: This study examined how Magellanic Penguin (Spheniscus magellanicus) chicks living in either tourist-visited or undisturbed areas of a breeding colony were physiologically affected by human visitation by comparing the baseline and stress-induced levels of corticosterone during three periods of the breeding season. Although it is unknown whether Magellanic Penguin chicks raised in visited areas suffer negative consequences from the elevation of the corticosterone stress response at hatching, they do exhibit behavioral habituation to human contact by the time they are ready to fledge. Unlike adults living in tourist areas, however, fledging chicks in visited areas do not have a decreased stress response to capture and restraint. This suggests that the coupling of behavioral and physiological habituation in

Magellanic Penguins is complex and life-history context may greatly affect the ability of wildlife to adapt to anthropogenic disturbances.

***158. Werner, S. J., and L. Clark. 2006. Effectiveness of a Motion-Activated Laser Hazing System for Repelling Captive Canada Geese. Wildlife Society Bulletin 34(1): 2-7.***

Abstract (summary): Effective management techniques are needed to disperse Canada geese (Branta canadensis) and reduce the human-wildlife conflicts associated with high population densities. We evaluated the effectiveness of a motion-activated laser hazing system for repelling captive Canada geese. The system decreased occupancy of 8 pairs of geese on the treated subplot by 83% during habituation trials. When an additional pair of geese were added to the experiment, occupancy of the treated subplot decreased >92% during each of the 20 nights of the extended habituation test. Avoidance (conditioned during the test) remained <80% of pretreatment levels during the 2 days immediately following the habituation test but extinguished 3 days subsequent to the permanent inactivation of the laser hazing system. The motion-activated laser hazing system effectively repelled Canada geese in captivity. Additional field research is needed to determine the spatial extent of the laser hazing system and the effectiveness of the Doppler radar motion detector for repelling wild geese.

## Coyotes

***159. Bounds, D. L. and W. W. Shaw. 1994. Managing coyotes in U.S. national parks: Human-coyote interactions. Natural Areas Journal 14(4): 280-284.***

Abstract. This paper examines the management of coyotes throughout the National Park Service (NPS) Units of the USA. The objectives of the paper are to: (1) determine which of the 359 NPS units in 1992 had coyotes within or adjacent to park boundaries, (2) document problems and management activities related to coyotes in NPS units during 1992, and (3) develop guidelines and recommendations to address coyote related issues in national parks. Coyotes were reported in 46% of all parks. Parks with coyotes were found in 41 of the 50 states. In some parks, hunting or trapping of coyotes was permitted within park boundaries. The most commonly reported human-coyote interaction within park boundaries was people viewing coyotes; the least commonly reported interaction was coyotes displaying aggressive behavior towards humans. In those parks that reported having aggressive coyotes, feeding of coyotes by visitors was more commonplace than in those parks that did not report coyotes having aggressive behavior. The study supports the existing management practices of the NPS, but it also points to the need to more strictly enforce these policies to minimize the potential for conflicts between coyotes and humans. The findings point to the importance of educating the public about wildlife habituation to feeding.

***160. Carbyn, L. N. 1989. Coyote Attacks on Children in Western North America. Wildlife Society Bulletin 17(4): 444-446.***

Discussion. Examination of the 4 most serious attacks on humans indicated that they were predatory in nature. Coyotes appeared to have lost fear of humans and regarded the children as prey. Loss of fear of humans by coyotes has been widespread in national parks and urban areas where this predator associates humans with food at campgrounds (W. Bradford, Can. Parks Serv., Jasper Natl. Park, Alta., pers. comm.). The process is analogous to habituation by bears to food sources associated with humans (Herrero 1985, Gilbert 1989).

Three attacks occurred at times of year when coyotes were either about to have pups, were feeding pups, or had recently been feeding pups. It is significant also that serious attacks were made only on infants, the most vulnerable humans. It is possible that boldness in coyotes toward humans is related to food stress. Coyotes that normally prey on ungulate young may find it more difficult to obtain food as the season progresses and young ungulates grow larger. Predatory instincts may, therefore, be redirected to other potential sources of food. Having lost the "normal" fear of humans, coyotes may perceive humans as just another potential food item. Till and Knowlton (1983) demonstrated experimentally that predation on domestic sheep can be reduced by destroying pups of depredating adults. It follows that adults with young would be more persistent in their efforts to kill and may therefore be more likely to switch to novel prey if food shortages should occur. Furthermore, individual coyotes have been known to show unusual behavioral responses to humans. In Riding Mountain National Park, Manitoba, 1 coyote repeatedly chased cars and snapped at tires (A. Sturko, Can. Parks Serv., Waterton Natl. Park, Alta., pers. comm.). In the same park a coyote repeatedly slashed tents in a campground. Similarly, in July 1988, there were several coyote attacks in Banff National Park on campers that were sleeping or resting in sleeping bags (R. J. Haney, Can. Parks Serv., Banff Natl. Park, Alta., pers. comm.). These events in Banff occurred in the same general area, but it was not possible to determine the number of coyotes involved. It is difficult to determine motivations for tent slashing, tire biting, or sleeping bag "nipping" behavior, and there may not be a common basis for these occurrences. There was no evidence to suggest that any of the attacks summarized in this paper were acts of diseased coyotes, such as recorded by Young and Jackson (1951). Availability of garbage in campgrounds and along highway stopovers likely contributes to the habituation process of coyotes to humans.

***161. Darrow, P. A. and J. A. Shivik. 2009. Bold, shy, and persistent: Variable coyote response to light and sound stimuli. Applied Animal Behavior Science 116(1): 82-87.***

Abstract: To improve frightening device technology for managing predation, we examined variation in coyote (Canis latrans) response to visual, auditory, and combined stimuli using a behavior-contingent programmable frightening device. We hoped to gather information on the relative effectiveness of light, sound, and combined stimuli for deterring coyotes from a food resource. We exposed five pairs of captive coyotes each to one of three stimuli during a 10-day treatment period. Coyotes habituated to the three stimuli differentially ($\chi$ <sup>2</sup> =7.8, d.f.=2, P =0.02). Four of five coyote pairs habituated to sound treatment, one of five pairs habituated to light stimulus, and none of five pairs habituated to combined stimuli. We further examined variability in coyote response to the device and determined that social status predicted boldness; 67% (S.E.=12%) and 33% (S.E.=12%) of subordinate and dominant coyotes attempted to eat the protected food respectively. Similarly, 60% (S.E.=15%) and 20% (S.E.=18%) of subordinate and dominant coyotes habituated and ate respectively. Our findings suggest that light may be the most important component of a frightening device for coyotes, but because coyotes can be bold or persistent, significant numbers of coyotes are expected to overcome a frightening device's long-term effectiveness.

***162. Gibeau, M. 1993. Use of urban habitats by coyotes in the vicinity of Banff, Alberta. MS thesis. University of Montana. 66pp.***

***163. Martínez-Espiñeira, R. 2006. Public Attitudes Toward Lethal Coyote Control. Human Dimensions of Wildlife 11(2): 89-101.***

Abstract: Predator control policies for coyotes are expensive and often controversial. A key aspect of this controversy is the public acceptability of different methods of coyote control, because some of the most controversial control methods are also the most cost-effective. This article casts further light on public preferences regarding lethal coyote control by analyzing data from Prince Edward Island, Canada. A distinction is made between the effects of sociodemographic characteristics on acceptability of control versus the acceptability of different lethal measures, based on damage caused by coyotes and rationale for control policies. The analysis confirms that lethal coyote control is more acceptable when coyotes are causing damage and that wildlife managers can minimize public opposition to control policies by carefully choosing among alternative methods of lethal control.

***164. White, L. A. and S. D. Gehrt. 2009. Coyote Attacks on Humans in the United States and Canada. Human Dimensions of Wildlife 14(6): 419-432.***

Abstract: Coyotes (Canis latrans) have expanded their range across much of North America and are now established in many metropolitan areas. Their presence in urban areas has often elicited concern from the public, although the actual risk that they pose to human populations is unclear. We conducted an analysis of coyote attacks on humans in the United States and Canada, including 142 reported incidents of coyote attacks resulting in 159 victims. Most attacks were classified as predatory (37%) or investigative (22%) in nature. The number of reported attacks was nearly equal between adults and children, although child victims were more ($p < .001$) prevalent in predatory attacks. Future coyote attacks could be reduced or prevented through modification of human behavior and public education designed to prevent the habituation of coyotes. A standardized reporting system for coyote attack incidents would be beneficial for further investigating characteristics of coyote attack incidents.

## Marine Wildlife Watching, Ecotourism

***165. Bejder, L., and H. Whitehead. 2005. Linking short and long-term effects of nature-based tourism on cetaceans. Dissertation Abstracts International. Section B: Physical Sciences and Engineering; 2005, Vol. 66 Issue 03, p1364, 157p.***

(Notes: Whale focus with HD components-nature-based tourism behaviors)

Abstract: A complex and unresolved problem in wildlife management is detecting whether human activities, which superficially appear to be benign, have cumulative effects that are harmful to wildlife populations. For instance, current understanding of impacts of nature-based tourism on free-ranging cetaceans is far from satisfactory. To ensure the sustainability of the economically-important and rapidly-growing global cetacean-watching industry, there is a pressing need for sound scientific evidence on which to base management. In a review of the literature pertaining to the evaluation of impacts of nature-based tourism on cetaceans, I identified factors that have limited the utility of this research, and pinpointed factors that allow for effective impact assessment. With this in mind, the Indo-pacific bottlenose dolphin (*tursiops* sp.) population in Shark Bay, Australia, was identified as a system where all key factors could be incorporated into one impact assessment study. I designed a multi-faceted study that incorporated experimental vessel approaches to dolphins that had differing histories of exposure to tourism. The long-term nature of the Shark Bay research project (>20 years) allowed for

interpretation of short-term responses within a longitudinal perspective by providing information on two fundamental measures of population health, dolphin habitat use and female reproductive success, in response to increased vessel activity over a 14-year period. Canonical-variate analyses showed that experimental vessel approaches elicited significant changes in patterns of sociality and movement of targeted dolphins at both control and tourism sites. Responses at the control site were stronger, more prevalent, and longer lasting than those at the tourism site. The moderation in the short-term responses at the tourism site was likely not the result of habituation to vessel activity, but could be better explained by a displacement of sensitive individuals during the development of the tourism operations. Habitat use by individual dolphins was compared between three successive 4.5-year periods in which dolphins were followed by research vessels and no dolphin-watch tour vessels (T0), one tour vessel (T1), and two tour vessels (T2), respectively. In the tourism site from T1 to T2, there was a 1.78 fold increase in the time vessels spent with dolphins, of which 74.9% could be attributed to tour vessels. As the number of tour vessels increased from one to two, there was a statistically significant average decline of 14.9% in numbers of individuals per square kilometer in the tourism site and a non-significant average increase of 8.5% in the control site.

***166. Bryant. L. 1994. Report 10 congress on results of feeding wild dolphins: 1989-1999. United States National Marine Fisheries Service. July 1994.***

In the United States in 1992, 20 commercial and 50 charter boat operators were running cruises which allowed tourists to feed wild dolphins (Wilson 1994). As a result of concerns over the impacts of these operations the United States National Marine Fisheries Service commissioned this report, which analyzed the effects of such cruises. The report concluded that regular feeding of wild dolphins alters natural behavior patterns and places the dolphins at risk. More specifically, in all cases where dolphins were regularly fed. The dolphins became habituated to accepting food from humans. This habituation substantially altered normal behavior by creating dependency, "negatively modifying foraging strategies and social behavior and encouraging animals to approach vessels and humans where they beg for food" (Wilson. 1994: 4). As a result of this report, and a confirmation by the United States Circuit Court of the finding that feeding does place dolphins at risk, the United States' Marine Mammal Protection Act was amended to specifically prohibit human feeding of wild dolphins in United States waters.

***167. Foss, K. M., and J. R. Reed. 2001. Bottlenose dolphin utilization of the Elizabeth River, Virginia (abstract). Virginia Journal of Science 52(2): 86.***

***168. Orams, M. B. 1997. The effectiveness of environmental education: Can we turn tourists into 'greenies'? Progress in Tourism and Hospitality Research 3: 295–306.***
(Notes: HD focus-Effects of communication program)

Abstract. A study which tested the effectiveness of an education program for managing tourists was conducted at Tangalooma, Australia. At this holiday resort tourists are able to hand feed a group of wild dolphins which visit the shallow waters adjacent to the resort's beach. The education program, which uses techniques derived from cognitive psychology and learning theory, attempted to prompt increased enjoyment, knowledge and improved environmental attitudes, intentions and behavior in participants. The study, which compared a control group who were not exposed to the education with an experiment group who were, found that desirable

changes did occur as a result of the program. This research provides much needed evidence that education can be an effective means of managing tourists' interaction with wildlife and the natural environment.

***169. Richter, C., S. Dawson, and E. Slooten. 2006. Impacts of commercial whale watching on male sperm whales at Kaikoura, New Zealand. Marine Mammal Science 22(1): 46-63.***
(Notes: Whale focus with HD components-nature-based tourism behaviors)

Abstract: Male sperm whales are the basis for a commercially important whale-watching industry at Kaikoura, New Zealand. We examined the influence of whale-watching boats and aircraft over three years using observations from an independent research boat and from shore. We employed all information- theoretic approach to determine which factors were necessary to explain variation in blow interval, time at surface, and time to first click. In almost all analyses, models required the inclusion of the presence of the research boat or whale-watching boats or airplanes. The only exception was the model explaining variation ill blow intervals observed from shore, which required only season. We also analyzed spatial behavior at the surface. Resident whales changed direction significantly more in the presence of whale-watching boats compared to encounters with only the research boat present. No Such difference was observed for encounters with aircraft. Our results thus indicate that sperm whales off Kaikoura respond to whale-watching activities, although these changes are small and most likely not of biological importance. However, resident whales responded less to these activities compared to transient whales, possibly indicating habituation and, more importantly, the need to monitor continued activities closely.

***170. Laroche R.K., A. A. Kock, L. M. Dill, and W. H. Oosthuizen. 2007. Effects of provisioning ecotourism activity on the behavior of white sharks Carcharodon carcharias. Marine Ecology-Progress Series 338: 199-209.***
(Notes: Shark focus with HD components-nature-based tourism behaviors)

Abstract: Ecotourism operations which provide food to large predators have the potential to negatively affect their target species, by conditioning them to associate humans with food, or by generally altering their behavioral patterns, This latter effect could have potentially detrimental consequences for the ecosystem inhabited by the predator, because any behavioral changes could affect the species with which they interact. We present the results of an experimental study conducted from June to October 2004, which examined the effects of provisioning ecotourism on the behavior of white sharks around a seal colony on a small island in South Africa. Although ecotourism activity had an effect on the behavior of some sharks, this was relatively minor, and the majority of sharks showed little interest in the food rewards on offer. It is unlikely that conditioning would occur from the amount of ecotourism activity tested, because even those sharks identified supplying most of the data presented here (which may be more strongly predisposed towards conditioning, as their persistence around the boat is what allowed them to be identified) showed. A nearly ubiquitous trend of decreasing response with time. Furthermore, even the sharks frequently acquiring food rewards typically stopped responding after several interactions. Consequently, moderate levels of ecotourism probably have only a minor impact on the behavior of white sharks, and are therefore unlikely to create behavioral effects at the ecosystem level.

## Primates

***171. Chapman, K. L, M. J. Lawes, and M. M. Macleod. 1998. Evaluation of non-lethal control methods on problematic Samango monkeys in the Cape Vidal Recreation Reserve, Greater St. Lucia Wetland Park. South African Journal of Wildlife Research 28(3): 89-99.***

***172. Matheson, M. D., L. K. Sheeran, L. Jin-Hua, and R. S. Wagner. 2006. Tourist impact on Tibetan macaques. Anthrozoos 19(2): 158-168.***

Abstract: Ecotourism is a growing sector of the tourism industry, but few studies to date have quantified its impacts on local people, tourists and wildlife. We present a preliminary study on threat and affiliative behaviors of two groups of free-ranging Tibetan macaques (Macaca thibetana) as a function of habituation and tourist presence. Data indicate that the less habituated group spent less time within sight of tourists compared with the more habituated group. The more habituated group engaged in frequent affiliative behaviors while within sight of humans, whereas affiliative behavior was not observed in the less habituated group. The general pattern of threats consisted of adults primarily threatening juveniles and juveniles primarily threatening humans, possibly due to redirection. No clear pattern of threats as a function of tourist density emerged. Tourist feeding, although discouraged, potentially provided a catalyst for some aggression. Future research will focus on clarifying which human behaviors evoke specific threat responses from monkeys. These data will be used to refine the existing management plan for this monkey population.

## Small Mammals

***173. Griffin, S. C. and L. S. Mills. 2005. Impacts of tourism on behavior and demography of Olympic marmots. Intermountain Journal of Sciences 11(3-4): 106.***

Abstract: Relatively little is known about the impacts of hiking and other recreation on small mammals, whose size and life-history may constrain their responses to disturbance. We tested for effects of recreation pressure on survival and reproduction on Olympic marmots (Marmota olympus), a large ground-squirrel that has disappeared from several areas of high human activity levels. We assessed the degree to which anti-predator and foraging behavior and demographic rates differed between heavily visited and unvisited sites. Marmots at heavily visited sites displayed behavioral signs of habituation; they allowed hikers to approach significantly closer before retreating to their burrows, and remained in their burrows for less time after disappearance of hikers. During two-minute focal observation periods, heavily visited marmots looked up more often while foraging although length of each look was the same as that seen in unvisited marmots. By foraging longer, visited marmots did not appear to compensate for this difference. In support of the assumption that energy intake is not limited by human disturbance, marmots at both types of sites had comparable reproductive rates and were in similar body condition as measured by seasonally adjusted body mass. Survival rate estimates for radio-tagged marmots appeared only slightly higher at the low-visitation sites. All these results are consistent with the hypothesis that marmots adjust their behavior to accommodate current levels of tourism without incurring a demographic penalty; however, the possibility that high visitation may decrease marmot survival rates should be investigated further.

***174. Griffin, S. C., T. Valois, M. L. Taper, and M. L. Scott. 2007. Effects of Tourists on Behavior and Demography of Olympic Marmots. Conservation Biology 21(4): 1070-1081.***

Abstract: If changes in animal behavior resulting from direct human disturbance negatively affect the persistence of a given species or population, then these behavioral changes must necessarily lead to reduced demographic performance. We tested for the effects of human disturbance on Olympic marmots (*Marmota olympus*), a large ground-dwelling squirrel that has disappeared from several areas where recreation levels are high. We assessed the degree to which antipredator and foraging behavior and demographic rates (survival and reproduction) differed between sites with high recreation levels (high use) and those with little or no recreation (low use). Compared with the marmots at low-use sites, marmots at high-use sites displayed significantly reduced responses to human approach, which could be construed as successful accommodation of disturbance or as a decrease in predator awareness. The marmots at high-use sites also looked up more often while foraging, which suggests an increased wariness. Marmots at both types of sites had comparable reproductive and survival rates and were in similar body condition. Until now, the supposition that marmots can adjust their behavior to avoid negative demographic consequences when confronted with heavy tourism has been based on potentially ambiguous behavioral data. Our results support this hypothesis in the case of Olympic marmots and demonstrate the importance of considering demographic data when evaluating the impacts of recreation on animal populations.

***175. Magle, S., J. Zhu, and K. R. Crooks. 2005. Behavioral responses to repeated human intrusion by black-tailed prairie dogs (Cynomys ludovicianus). Journal of Mammalogy 86(3): 524-530.***

Abstract: This study addressed behavioral responses by black-tailed prairie dogs (Cynomys ludovicianus) to human intrusion in urban and rural environments in Boulder, Colorado. We expected that if prairie dogs habituate to repeated disturbances, they should allow a recurring human intruder to approach closer over time before sounding an alarm bark or initiating concealment. We also predicted that urban colonies could be approached more closely than rural colonies before displaying an avoidance response. Four colonies (2 rural and 2 urban) were approached > 100 times over a 7-month period. Rather than exhibiting habituation, prairie dogs demonstrated increased responsiveness in concealment behavior, retreating to their burrows earlier, with recurring disturbances. Barking distances did not change consistently with repeated intrusion, but, over time, prairie dogs barked less frequently when performing their avoidance response, a result with implications for prairie dog management. Rural colonies had higher initial concealment distances, and these distances increased more rapidly with repeated intrusion than did concealment distances in urban colonies. Thus, rural prairie dogs may be more sensitive to human intrusion than urban prairie dogs.

## Wolves

***176. Enck, J. W. and T. L. Brown. 2002. New Yorker's attitude toward restoring wolves to the Adirondack Park. Wildlife Society Bulletin 30(1): 16-29***

Abstract: Presents a study that assessed public attitudes toward wolf restoration at the Adirondack Park in New York. Factors affecting public attitudes toward wolf restoration; Importance of the restoration issue; Implications of the study for wildlife management.

***177. Frame, P. F, H. Dean Cluff, and D. S. Hik. 2007. Response of wolves to experimental disturbance at homesites. Journal of Wildlife Management 71(2): 316-320.***

Abstract: Events during the denning period (parturition to first autumn) often determine the reproductive success of wolves (Canis lupus). Consequently, there is concern about the potential adverse effects of human-caused disturbance at wolf den and rendezvous sites (homesites), but relatively little information on this subject is available. We conducted standardized experimental disturbance treatments at 12 unique wolf homesites in the Northwest Territories, Canada, during summers 2002 and 2003. The treatment consisted of an intruder approaching a homesite once per day for 3 consecutive days and recording behavioral responses, response distance, and response intensity of wolves. We counted pups and estimated their ages prior to the initial treatment at each site. Adult wolves moved pups at 3 of 6 treated homesites in each year. The amount and type of known human activity within a pack's home range did not influence whether adults moved pups in response to the treatment. The response intensity of wolves to the treatment was inversely related to the amount of human activity near a homesite. There was no relationship between the distance at which wolves responded to the intruder and the amount or type of human activity. There was a positive relationship between increasing age of pups and their relocation in response to the treatment. Reproductive success was not influenced by the treatment or by the amount and type of human activity. Treated sites were used by wolves the following year in the same proportion as untreated sites. It appears that pups are most vulnerable early in the year when less mobile; therefore, managers should consider age of pups before human activity at or near wolf home sites occurs.

***178. Heilhecker, E., R. P. Thiel, and R. Hall Jr. 2007. Wolf, Canis lupus, Behavior in Areas of Frequent Human Activity. Canadian Field-Naturalist 121(3): 256-260.***

Abstract: We report incidental observations of Wolves (*Canis lupus*) tolerating human activity in central Wisconsin. Three monitored packs raised pups in close proximity to varying levels of human activity. Wolf pups were raised <350m from rearing pens of the endangered Whooping Crane (*Grus americana*), which saw daily human activity. One pack used cornfields as rendezvous sites within 175 m of a maintenance shed visited regularly by workers. Another pack centered their activities along a well-traveled state highway using both the verge and the road center for activity. Aerial locations of 10 yearling and adult dispersing Wolves were plotted to evaluate human densities in natal territories relative to dispersal and post-dispersal territories. Township densities ($\chi^{-}$ = 9.02 humans/km2, SE = 4.015) and residential densities ($\chi^{-}$ = 5.59 housing units/km2, SE = 2.12 ) in natal pack territories were significantly greater ($P$ <.01) for dispersal and post-dispersal township densities ($\chi^{-}$ = 43.98 humans/km2, SE =7.37) and residence densities ($\chi^{-}$ = 23.12 housing units/km2, SE =3.49). Furthermore, a pup negotiated the densely populated region of northern Illinois and dispersed from central Wisconsin to east-central Indiana, a distance of at least 690 km. As Wolves live in closer proximity to humans, living in areas of higher township and residential densities, they can be expected to be more habituated to people, increasing the probability of human/Wolf conflicts.

***179. McNay, M. E. 2002. Wolf-human interactions in Alaska and Canada: a review of the case history. Wildlife Society Bulletin 30(3): 831-843.***

(Notes: Wolf focus with HD component-human behavior)

Abstract: After gray wolves (Canis lupus) were extirpated over a large portion of their North American range during the early 1900s, researchers reviewed the history of wolf-human

encounters and concluded that wild, free-ranging wolves posed little or no threat to human safety. However, documented cases of wolf aggression toward people have recently increased, indicating a need for further examination of wolf-human interactions. I reviewed 80 cases of wolf-human encounters and compared behaviors of wild wolves that interacted with people in different contexts in Alaska and Canada. Only 1 case of unprovoked wolf aggression was documented between 1900 and 1969, but 18 cases of unprovoked wolf aggression toward people occurred between 1969 and 2000, including 3 cases of serious injury to children since 1996. Increases in wolf protection, human activities in wolf habitat, and wolf numbers occurred concurrently with increases in unprovoked aggressive encounters. Aggressive behavior was documented in all regions and among all wolf subspecies of Alaska and Canada. Wolves rarely vocalized during unprovoked aggressive encounters, but wolves that were defending dens consistently displayed loud vocalizations. Behavior of rabid wolves was variable and ranged from stubborn, persistent approaches to prolonged attacks. Habituation contributed to unprovoked wolf aggression toward people in 11 cases; nonhabituated wolves in remote areas displayed unprovoked aggression in 7 cases. Where wolves are protected and frequently encounter people, some level of negative conditioning should be applied to prevent habituated and food-conditioned behaviors in wolves.

***180. McNay, M. E. and P. W. Mooney. 2005. Attempted predation of a child by a gray wolf, Canis lupus, near Icy Bay, Alaska. Canadian Field-Naturalist 119(2): 197-201.***

Abstract: On 26 April 2000 a six-year-old boy was attacked and repeatedly bitten by a Gray Wolf (Canis lupus) in a logging camp near Icy Bay, Alaska. The animal's behavior during the attack clearly contained elements of predation. The wolf was killed shortly after the attack and found to be in normal physical condition; tests for rabies and canine distemper were negative. Low densities of ungulate prey and increased energetic demands associated with denning may have influenced the wolf's behavior, but we believe the wolf's habituation to people was a more significant factor contributing to the attack. Food-conditioning may have facilitated the habituation process, but there was no evidence the attack resulted from a food-conditioned approach response.

***181. Thiel, R. P., S. Merrill, and L. D. Mech. 1998. Tolerance by denning wolves, Canis lupus, to human disturbance. Canadian Field-Naturalist 112(2): 340-342.***

Abstract: The authors discuss observations of tolerance displayed by wolves towards humans in proximity to dens and pups. Wolves living in wilderness areas have less tolerance for humans than those living in human occupied areas. The observations of wolf/human interactions include the Black River State Forest, Wisconsin, where moss harvesting work is done; Camp Ripley Military Reservation, where military maneuvers take place; and the Superior National Forest in Minnesota during road construction work.

***182. Van Manen, F. T, and B. A. Crawford. 2000. Predicting red wolf release success in the southeastern United States Journal of Wildlife Management 64(4): 895-902.***

Abstract: Although the red wolf (Canis rufus) was once found throughout the southeastern United States, indiscriminate killing and habitat destruction reduced its range to a small section of coastal Texas and Louisiana. Wolves trapped from 1973 to 1980 were taken to establish a captive breeding program that was used to repatriate 2 mainland and 3 island red wolf populations. We collected data from 320 red wolf releases in these areas and classified each as a success or failure based on survival and reproductive criteria, and whether recaptures were

necessary to resolve conflicts with humans. We evaluated the relations between release success and conditions at the release sites, characteristics of released wolves, and release procedures. Although <44% of the variation in release success was explained, model performance based on jackknife tests indicated a 72- 80% correct prediction rate for the 4 operational models we developed. The models indicated that success was associated with human influences on the landscape and the level of wolf habituation to humans prior to release. We applied the models to 31 prospective areas for wolf repatriation and calculated an index of release success for each area. Decision-makers can use these models to objectively rank prospective release areas and compare strengths and weaknesses of each.

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NPS 909/119761, February 2013

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