

Annotated Habituation Bibliography **TWS Symposium 2005**

- Albert, D. M., and R. T. Bowyer. 1991. Factors related to grizzly bear-human interactions in Denali National Park. *Wildlife Society Bulletin* **19**:339-349.
Despite improved management, serious bear-human interactions in Denali National Park increased greatly from 1987 to 1989. Researchers collected reports of bear-human interactions to evaluate level, location, and type of interactions. Causes and prevention of habituation are discussed. The authors differentiate between front- and back-country encounters and suggest methods to reduce interaction. They also talk about habituated bears gaining a competitive advantage over timid conspecifics.
- Andersen, D. E., O. J. Rongstad, and W. R. Mytton. 1989. Response of nesting red-tailed hawks to helicopter overflights. *Condor* **91**:296-299.
The literature is somewhat divided on the impact of low-level aircraft flights on raptors, and, prior to this study, no one had examined whether a habituation component existed. The authors measured the effects of helicopter flights on red-tailed hawks that had been exposed to helicopters previously and those that had not. They found a stronger reaction in naïve birds compared to experienced birds, and they conclude that red-tailed hawks are capable of habituating to air traffic. They discuss the implications of aircraft disturbance on nesting success.
- 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**:248-252.
This article describes an experiment comparing the effect of humans on black-billed magpie foraging at urban and rural sites. The authors placed food near an observer and measured the number of times birds approached within one meter of the food. The experiment suffered from an inability to control external factors, but the birds exhibited a significant time*area relationship with urban magpies approaching the food more frequently over the course of an observation period. The authors speculate that urban magpies habituated quickly to the observer and conclude that the ability to habituate will enable them to persist in heavily populated areas.
- Arnould, C., and J. P. Signoret. 1993. Sheep food repellents: efficacy of various products, habituation, and social facilitation. *Journal of Chemical Ecology* **19**:225-236.
Food repulsion is an important tool for controlling browse damage to forests or crops by ungulates. This experiment tested the repulsive value of three natural and two synthetic repellents on domestic sheep. Dog feces were the most effective repellent, while pig feces and sheep fetal fluid were less effective and synthetic lion feces and commercial deer repellent were relatively ineffective. Sheep did not habituate to dog feces while showing significant habituation to sheep fetal fluid and commercial deer repellent.

- Aumiller, L. D., and C. A. Matt. 1994. Management of McNeil River State Game Sanctuary for viewing of brown bears. *International Conference on Bear Research and Management* **9**:51-61.
This paper describes the management of bears and humans at a wildlife viewing area that has not had any serious bear-human interactions. The authors spend a section defining and discussing the habituation of bears at the site. They discuss food conditioning as a separate behavior and suggest that bears that are simply habituated to humans pose minimal threat.
- Bader, M. 1989. Habituation in Yellowstone's grizzly bears: a special problem in wildlife management. *Western Wildlands* **14**:25-29.
Habituation of grizzlies to humans may result in injury or death for both humans and bears. This review describes research and management of bear-human interactions at Yellowstone and Glacier national parks. The author identifies predictable, non-threatening human activity as a root cause of habituation. Some methods to prevent habituation — specifically, aversive conditioning — are discussed.
- Baird, P. H., and S. Hink. 2002. Disturbance causes and effects and habituation at a colony of California least terns. 29th Annual Meeting Pacific Seabird Group. Santa Barbara, CA, February 20-23, 2002 : 28.
Abstracts from this meeting are not currently available online. Contact the Pacific Seabird Group at info@pacificseabirdgroup.org for more information.
- Barry, T. W., and R. Spencer. 1976. Wildlife response to oil well drilling. *Canadian Wildlife Service, Progress Notes* 67.
- Becker, J. M. 2002. Response of wintering bald eagles to industrial construction in southeastern Washington. *Wildlife Society Bulletin* **30**:875-878.
A local bald eagle management plan requires an evaluation of human disturbance occurring within an 800 m sightline from eagle roost sites. This study monitored the response of eagles to a large industrial construction project. Results indicated no measurable negative effect on roosting eagles. The authors suggest that a management plan requiring evaluation of activities within 800 m of nests may be overly protective if eagles are already habituated to human disturbance.
- Beier, P., J. E. Borrecco, and R. E. Marsh. 1992. Cougar attacks on humans: an update and some further reflections. *Proceedings of the 15th Vertebrate Pest Conference*. Newport Beach, CA, March 2-5, 1992 : 365-367.
This conference paper reviews 101 years of cougar attack records. The author, who has written extensively on the subject, concludes that recent increases in attacks result from increased human use of cougar habitat. There is no evidence that habituation has played a part in the recent increase in cougar attacks.

Belant, J. L. 1997. Gulls in urban environments: landscape-level management to reduce conflict. *Landscape and Urban Planning* **38**:245-258.

Gull populations have been increasing in many coastal areas of North America and Europe due to reduced persecution and environmental contamination and their easy habituation to human-altered environments. These increased populations are responsible for a number of human-wildlife conflicts, including disease, building and aircraft damage, and general nuisance. Since site-specific solutions do not ease the broad-scale problems, this paper addresses the need for coordinated efforts among city and county planning commissions, affected businesses, private citizens, and wildlife agencies when managing gull populations. Working groups should define the extent of the problem, develop appropriate management strategies, and conduct periodic assessments of program efficacy.

Beringer, J., K. C. VerCauteren, and J. J. Millspaugh. 2003. Evaluation of an animal-activated scarecrow and a monofilament fence for reducing deer use of soybean fields. *Wildlife Society Bulletin* **31**:492-498.

Deer repellents are typically deployed to reduce damage from white-tailed deer to crops, but habituation to the repellents often reduces their efficacy. Using three plots for each treatment and three control plots, the authors found that an animal-activated scarecrow was moderately effective at repelling deer. Scarecrow activations increased significantly over time, however, indicating habituation to the device. The authors suggest that animal-activated scarecrows may be useful only for short periods.

Blackwell, B. F., G. E. Bernhardt, and R. A. Dolbeer. 2002. Lasers as nonlethal avian repellents. *Journal of Wildlife Management* **66**:250-258.

Every year birds near runways cause millions of dollars of damage to aircraft, and lasers have been proposed as a possible repellent. In this experiment using captive birds, lasers did not repel or disperse cowbirds, starlings, or rock doves, but were effective for repelling mallards and Canada geese. Mallards habituated to the beams after 20 min, however. The authors suggest species-specific studies to evaluate variation in the laser.

Bleich, V. C., R. T. Bowyeer, A. M. Pauli, M. C. Nicholson, and R. W. Anthes. 1994. Mountain sheep *Ovis canadensis* and helicopter surveys: ramifications for the conservation of large mammals. *Biological Conservation* **70**:1-7.

Mountain sheep may respond severely to helicopter overflights. Observers recorded sheep movements and foraging behavior on survey and non-survey days. On sampling days, sheep abandoned sampling blocks in significantly larger numbers and, in spring, altered the vegetation they were observed in. Contrary to many aircraft disturbance studies, sheep showed no signs of habituating to helicopter disturbance. The authors discuss implications for helicopter surveys, including the risk of altering habitat use, increasing predation, and causing nutritional stress.

- Boegel, R., and G. Haerer. 2002. Reactions of chamois to human disturbance in Berchtesgaden National Park. *Pirineos* **157**:65-80.
Chamois in Berchtesgaden National Park are exposed to varying levels of recreational disturbance. The response of chamois to disturbance in relation to the source and frequency of the disturbance was studied. Researchers found that animals exposed to higher levels of disturbance exhibited reduced responses compared to animals in more remote areas, indicating habituation. They also noted that tolerance to disturbance varied across habitat, season, age-sex class, and group size.
- Bolgiano, C. 1996. Why are cougars killing people? Theories and implications. *Wild Earth* **63**:46-49.
This article is a synthesis of information from recent conferences. While discussing cougar attacks in the western U.S., it touches briefly on habituation as a possible explanation. The theory put forth is that attacks are rare in places where cougars are harassed by people.
- Boyd, D. K., S. H. Fritts, L. Boitani, L. D. Mech, and M. E. Patterson. 2000.
Habituation of wild wolves toward humans, and implications for conservation. 14th Annual Meeting of the Society for Conservation Biology. Missoula, MT, June 9-12, 2000. (<http://www.umt.edu/scb2000/>)
Based on the conference abstract (available at <http://www.umt.edu/scb2000/>) the authors discuss several issues of wolf-human interaction and focus on habituation. They conducted an international survey of wolf biologists and managers to examine perceptions on the causes and consequences of wolf habituation to humans.
- Boyle, S. A., and F. B. Samson. 1983. Nonconsumptive outdoor recreation: an annotated bibliography of human-wildlife interactions. US Fish and Wildlife Service, Washington, DC, Special scientific report - wildlife no. 252.
- Boyle, S. A., and F. B. Samson. 1985. Effects of nonconsumptive recreation on wildlife: a review. *Wildlife Society Bulletin* **13**:110-116.
This is a literature review of the effects of nonconsumptive recreation on North American terrestrial wildlife. The review includes effects of hiking and camping, boating, wildlife observation and photography, off-road vehicles, snowmobiles, spelunking, swimming, and rock climbing. The authors summarize a variety of effects and touch on habituation, stating that habituation may reduce disturbance impact and increase chances of poaching. This is a good source for older and more obscure references.
- Brandenburg, D. M. 1996. Effects of roads on behavior and survival of black bears in coastal North Carolina. Thesis. University of Tennessee, Knoxville, TN.
Based on citations, this thesis represents one of the first attempts to study black bear behavior in relation to roads with high traffic volumes. It is available from the University of Tennessee Agriculture and Veterinary Medicine Library.

Bratton, S. P. 1990. Boat disturbance of Ciconiiformes in Georgia, USA, estuaries. *Colonial Waterbirds* **13**:124-128.

Ciconiiformes in Georgia estuaries are often subject to large quantities of boat disturbance. Researchers in boats approached birds on the shore of Cumberland Sound and in tidal creeks. Birds in tidal creeks reacted more strongly, flushing earlier and flying further when disturbed. The boat was necessarily closer to the bank in the creeks, but the birds were also more sensitive. The authors discuss how habitat may influence the ability of Ciconiiformes to habituate to boat traffic.

Bright, A., G. R. Reynolds, J. Innes, and J. R. Waas. 2003. Effects of motorised boat passes on the time budgets of New Zealand dabchick, *Poliiocephalus rufopectus*. *Wildlife Research* **30**:237-244.

New Zealand dabchicks, a type of grebe, are geographically isolated and exist in very small numbers. This paper examines the effects of boat disturbance on their time budgets. Boat passes caused considerable changes in behavior, and the effect was positively correlated with frequency of passes. The authors found some evidence of habituation, but only in high-use areas.

Buehler, D. A., T. J. Mersmann, J. D. Fraser, and J. K. D. Seegar. 1991. Effects of human activity on bald eagle distribution on the northern Chesapeake Bay. *Journal of Wildlife Management* **55**:282-290.

In lieu of recent increases in development, this paper examines the distribution of bald eagles on northern Chesapeake Bay. Bald eagle distribution was measured in relation to human activity and development. Researchers found that eagles generally avoided highly developed areas. They discuss seasonal differences in eagles' habituation to humans due to changes in human activity.

Burger, J. 1981. The effect of human activity on birds at a coastal bay. *Biological Conservation* **21**:231-241.

Human disturbance at coastal refuges may have both direct and indirect impacts on migrating shorebirds. This study measured the response of several shorebird species to a variety of human disturbances on the Atlantic coast. Results varied across species but indicated that birds flushed more frequently when exposed to fast movement or when humans were in close proximity, while birds were able to habituate to birdwatchers or clambers. The author discusses the need to provide roosting areas for migrating shorebirds that are protected from certain human activities.

- Burger, J., and M. Gochfeld. 1999. Role of human disturbance in response behavior of Laysan albatrosses (*Diomedea immutabilis*). *Bird Behavior* **13**:23-30.
Albatrosses nesting on the Midway Atoll have historically been free of threats from mammalian predators and therefore do not exhibit anti-predator behavior. Researchers measured the importance of prior experience with humans and the response of albatrosses to human disturbance. They found that experience with prior human disturbance predicted the severity of the response, indicating the ability to habituate to humans. They discuss their results in the context of eco-tourism, concluding that visitors should be restricted to certain areas of the colony.
- 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**:699-712.
Advertising images have led tourists to expect interactions with dingoes on Fraser Island, Australia, but this has been followed by several dingo attacks, a tourist's death, and a resultant government ordered cull of dingoes. The authors conducted stakeholder interviews to explore various management issues and tourism policies. Many conflicting perspectives emerged on the role of human-wildlife interaction in eco-tourism. Among the conclusions is that if tourist behavior results in habituation of dingoes (and increased attacks) then management of humans must be considered when managing dingoes.
- Busnel, R. G. 1978. Introduction. *In* Fletcher, J. L., and R. G. Busnel. *Effects of noise on wildlife*. Academic Press, New York.
This chapter leads a series of papers presented at the 9th International Congress on Acoustics, in Madrid, Spain. Human produced noise may interfere with acoustic signals used by animals for navigation and communication and can cause physiological stress or physical injury. However, many species (e.g., those occupying habitat near airfields) are able to habituate readily to noise disturbance. Other species may mimic human noise or even be attracted to it. Though noise may appear minor in contrast to other forms of pollution, the author proposes that its effects on wildlife be studied in greater detail, specifically in Asia and Africa.
- Canfield, J. E., L. J. Lyon, J. M. Hillis, and M. J. Thompson. 1999. Ungulates. Pages 1-25 *in* Joslin, G., and H. Youmans. *Effects of recreation on Rocky Mountain wildlife: a review for Montana*. Montana Chapter of the Wildlife Society.
Ungulates provide a large percentage of the recreational opportunities, and resultant economic gain, in Montana through hunting, viewing, and photography. However this recreational pressure may push ungulates onto private land and negatively effect population growth. This chapter describes the effects of various recreational disturbances on ungulate populations in Montana. The authors touch on the ability of some ungulates to habituate but suggest that habituation is usually not a desired response in ungulates. They discuss management of recreation with regard to ungulates, including a focus on ethical considerations.

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.

Elk are easily disturbed by hikers and skiers, so an increase in skiers at Yellowstone National Park may negatively effect elk survival or reproduction. This study measured the responses of disturbed elk from three subpopulations, one of which had habituated to humans. The non-habituated populations had high flight distances and abandoned habitat for the duration of human disturbance. The habituated elk had a much smaller flight distance, but were still easily disturbed when approached outside of the area where human activity is usually present. The authors recommend creating a buffer around elk wintering areas and discuss how habituation relates to predictability, habitat, and movement.

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.

When grizzly bears enter developed areas they present a safety risk to themselves and humans. This paper examines habitat use and movements by grizzly bears in a highly developed area. Grizzly bears were closer to roads than expected, with habituated bears being closer on average than wary bears. The authors discuss habitat management adjacent to high-volume roads.

Clevenger, A. P., B. Chruszcz, K. Gunson, and J. Wierzchowski. 2002. Roads and wildlife in the Canadian Rocky Mountain parks -- movements, mortality and mitigation. Parks Canada, Final report to Parks Canada, Banff, Alta.

Colman, J. E., B. E. Jacobsen, and E. Reimers. 2001. Summer response distances of Svalbard reindeer *Rangifer tarandus platyrhynchus* to provocation by humans on foot. *Wildlife Biology* **7**:275-283.

Svalbard reindeer live in the absence of natural predators or insects and are disturbed only by human activity – conditions that the authors hypothesize may allow them to habituate despite hunting pressure. Flight responses of reindeer were measured in five areas with varying levels of human disturbance and hunting. Flight response was highly correlated with the level of human activity in the area. Further, reindeer habituated to humans independent of hunting activity, which conflicts with the long-standing hypothesis that hunted populations are less likely to habituate.

Conomy, J. T. 1993. Habitat use by, and effects of aircraft noise on the behavior and energetics of wintering dabbling ducks in Piney and Cedar islands, North Carolina. Thesis. North Carolina State University, Raleigh, NC.

This thesis is available through NC State University's D. H. Hill Library. See related article: Conomy, J. T., J. A. Dubovsky, J. A. Collazo, and W. J. Fleming. 1998. Do black ducks and wood ducks habituate to aircraft disturbance? *Journal of Wildlife Management* **62**(3): 1135-1142.

Conomy, J. T., J. A. Dubovsky, J. A. Collazo, and W. J. Fleming. 1998. Do black ducks and wood ducks habituate to aircraft disturbance? *Journal of Wildlife Management* **62**:1135-1142.

Some species of dabbling ducks may habituate quickly to aircraft disturbance. The authors used real and simulated military aircraft activity to compare the habituation response of black ducks and wood ducks. They found that black ducks habituated readily and returned within 24 hr to pre-disturbance activity patterns. Conversely, wood ducks did not show a significant reduction in disturbance response over the course of several days. The authors hypothesize that the habituation capabilities of waterfowl vary by species, and they discuss the importance of frequency and intensity of disturbance in the habituation response.

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**:269-286.

The North Fork of the Shoshone Highway Corridor in Wyoming contains both a high density of developed campgrounds and important habitat for a growing grizzly bear population. Following a proposal for a major reconstruction of the recreational facilities, this paper describes planning and design for campgrounds in an area frequented by both campers and grizzly bears. The process involves planning locations around known bear home ranges and using the landscape to maintain some level of separation. The authors discuss the role that habituation plays in human-bear interactions, bear attacks, and risk of mortality.

Dalle-Molle, J. L., J. C. VanHorn, and M. Bromley. 1989. Bear-people conflict management in Denali National Park, Alaska. *Bear-people conflicts: proceedings of a symposium on management strategies*. Northwest Territories Department of Renewable Resources, Yellowknife, Canada, April 6-10, 1987: 121-128.

Dalle-Molle, J., and J. VanHorn. 1991. Observations of vehicle traffic interfering with migration of Dall's sheep. *Canadian Field-Naturalist* **105**:409-410.

Roads intersecting migration routes may pose barriers to ungulates. Researchers observed the crossing behavior of migrating Dall's sheep in Denali National Park. Sheep with roads near their home range appeared habituated to traffic and had no trouble crossing roads during migration. However, sheep migrating from more remote areas were not habituated and had difficulty with traffic.

Davies, R. B., and C. E. Braun. 1991. Lion damage to pets in urban Colorado Springs, Colorado. Mountain Lion-Human Interaction, Symposium and Workshop. Denver, CO, April 24-26, 1991: 79-80.

For many years, mountain lion attacks on dogs in Colorado Springs did not elicit public outcry over lion populations. However, public opinion shifted after seeing a video depicting a mountain lion killing a tied dog, which came shortly after a young man was killed by a mountain lion in another area of the state. This conference paper describes several of these attacks and focuses on public education and lion management plans. Among the actions supported by the public was the removal of any lion that becomes habituated to housing areas.

de Boer, H. Y., L. van Breukelen, M. J. M. Hootsmans, and S. E. van Wieren. 2004. Flight distance in roe deer *Capreolus capreolus* and fallow deer *Dama dama* as related to hunting and other factors. *Wildlife Biology* **10**:35-41.

Hunting pressure has been proposed as a major factor determining deer response to approaching humans. This study measured flight distance in roe and fallow deer with respect to a human observer on foot in four nature reserves in the Netherlands representing a gradient of hunting pressures. Hunting regime and habitat structure were the most important factors predicting flight response, with flight distance being correlated positively to hunting pressure and negatively to vegetation density. The authors discuss how hunting and habitat variables can influence habituation and disturbance effects.

DeForge, J. A. 1981. Stress: changing environments and the effects on desert bighorn sheep. *Desert Bighorn Council Transactions* **25**:15-16.

Transactions may be ordered directly from the Desert Bighorn Council at <http://www.desertbighornCouncil.org/about.html>.

Delaney, D. K., T. G. Grubb, P. Beier, L. L. Pater, and M. H. Reiser. 1999. Effects of helicopter noise on Mexican spotted owls. *Journal of Wildlife Management* **63**:60-76.

Military aircraft have been limited over Lincoln National Forest in New Mexico in order to protect Mexican spotted owls. In this controlled experiment, the authors measured several variables during nesting and nonnesting periods for Mexican spotted owls exposed to helicopter and chainsaw noise. They added a manipulation to test habituation and found that naïve owls were more likely to flush than those previously exposed to noise disturbance — though the habituation aspect of the experiment utilized only a small sample of owls. The results indicate that a 105-m buffer zone on helicopter flights should minimize negative effects to nesting owls.

Derr, M. 1999. If you're a bear, these dogs will give you paws. *Smithsonian* **30**:92-98.

This magazine article discusses the use of trained dogs as a method of aversive conditioning for habituated or food-conditioned bears.

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

Bridled terns breeding on Penguin Island, Western Australia, allow closer approaches by humans than they do on Bridled Island. This difference in behavior is attributed to the gradual habituation of Penguin Island terns to the regular presence, and relatively predictable activity, of people at that colony. The author discusses the management of human visits to seabird colonies.

Dwyer, N., and G. W. Tanner. 1992. Nesting success in Florida sandhill cranes. *Wilson Bulletin* **104**:22-31.

The authors examined 111 crane nests and found high hatching success but low recruitment. Nest failures resulted from flooding, abandonment, infertility, and addling, though almost half the failures had an unknown cause. Investigator disturbance and development disturbance accounted for a quarter of the failures despite the apparent ability of the nesting cranes to habituate to certain forms of human disturbance.

Dykstra, C. R., J. L. Hays, F. B. Daniel, and M. M. Simon. 2000. Nest site selection and productivity of suburban red-shouldered hawks in southern Ohio. *Condor* **102**:401-408.

Though hawks commonly nest near developed areas, few studies have examined how the proximity of humans impacts nesting. This paper compares nest-site selection of red-shouldered hawks to random plots in both rural and suburban areas. In both areas, hawks chose nest trees that were taller, surrounded by greater tree density, and closer to water than random sites. Nest-site selection and reproductive success were very similar between urban and suburban hawks and the authors discuss this result in the context of habituation to suburban surroundings.

Edge, W. D., and C. L. Marcum. 1985. Movements of elk (*Cervus elaphus*) in relation to logging disturbances. *Journal of Wildlife Management* **49**:926-930.

Large-scale disturbance, like that from logging, may disrupt the movement patterns, foraging, and habitat use of ungulates. This study examined elk movements in relation to logging activities in Chamberlain Creek, Montana. Net movements of elk were away from logging. While elk moved back into logging areas on weekends, the authors do not think this was the result of habituation. Habituation may gradually reduce the buffer zone around the logging activity, but not enough to compensate for the displacement and loss of habitat. The discussion contains a review of several studies looking at habituation of ungulates to resource removal.

Enggist-Dublin, D., 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**:37-45.

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.

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**:277-282.

Newly opened recreation trails provide an excellent opportunity to observe the effects of recreational disturbance on wildlife. This well-planned study measured the distance from trails of pronghorn for one year before trails were open to the public and for three years after the trails were open. Pronghorn were significantly further from trails after trails were open to the public. Contrary to many ungulate studies, the pronghorn did not exhibit a habituation response during the three years that the trails were open.

Fernandez, J. E. 2001. Avian spatial segregation at edges and interiors of urban parks in Madrid, Spain. *Biodiversity and Conservation* **10**:1303-1316.

Few studies have investigated the effects of urban landscape composition on avian habitat selection at urban-park edges. This paper compared habitat structure, avian species richness, and species density at the interior and edge of six wooded parks. Species that foraged and nested in trees were found in the interior while species that were highly habituated to humans were more common at the edge. The authors discuss the impact of urban sprawl on both species types.

- Fitzpatrick, S., and B. Bouchez. 1998. Effects of recreational disturbance on the foraging behaviour of waders on a rocky beach. *Bird Study* **45**:157-171.
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.
- Follmann, E. H., R. A. Deiterich, and J. L. Hechtel. 1980. Recommended carnivore control program for the northwest Alaskan pipeline project including a review of human-carnivore encounter problems and animal deterrent methodology. Institute of Arctic Biology, University of Alaska, Fairbanks, AK, Final Report.
- Fowler, G. S. 1999. Behavioral and hormonal responses of Magellanic penguins (*Spheniscus magellanicus*) to tourism and nest site visitation. *Biological Conservation* **90**:143-149.
A possible side effect of human disturbance at seabird colonies may be an increase in the adrenocortical 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.
- Fox, A. D., and J. Madsen. 1997. Behavioural and distributional effects of hunting disturbance on waterbirds in Europe: implications for refuge design. *Journal of Applied Ecology* **34**:1-13.
Freedom from hunting disturbance is an important aspect of waterfowl management on wildlife refuges. This paper examines several aspects of refuge design with respect to disturbance and hunting. Refuges should be free of hunting disturbance, regular in shape, and at least three times in diameter the flight distance of sensitive species. Disturbance needs to be both temporally and spatially managed. The authors recommend zoning in non-refuge areas so that disturbance is regular and predictable, which allows birds to habituate more easily.
- Fox, M. W. 1971. Behaviour of wolves, dogs and related canids. Harper and Row, New York.

Franklin, W. L., W. E. Johnson, R. J. Sarno, and J. A. Iriarte. 1999. Ecology of the Patagonia puma *Felis concolor patagonica* in southern Chile. *Biological Conservation* **90**:33-40.

Puma populations in protected areas of Chile have increased recently and data on their behavior is important for management. Using 13 radiomarked pumas, researchers examined the movements, home ranges, and diet of Patagonia pumas in a national park. Several pumas had home ranges outside park boundaries and had preyed on sheep. The authors suggest that recent increases in puma numbers have resulted from habituation to humans after a reduction in hunting and harassment.

Freddy, D. J., W. M. Bronaugh, and M. C. Fowler. 1986. Responses of mule deer to disturbance by persons afoot and snowmobiles. *Wildlife Society Bulletin* **14**:63-68. Several studies have indicated that hikers present a greater disturbance to ungulates than do most vehicles. Observers measured the responses of mule deer approached by persons afoot and on snowmobiles. Persons afoot elicited a more severe response at greater distances from mule deer than did snowmobiles, though both caused a significant response. The authors discuss the need to restrict hikers and snowmobiles to marked trails, and they comment on the inability of mule deer in their study to habituate to hikers.

Gander, H., and P. Ingold. 1997. Reactions of male alpine chamois (*Rupicapra r. rupicapra*) to hikers, joggers and mountainbikers. *Biological Conservation* **79**:107-109.

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.

Geist, V. 1975. On the management of mountain sheep: theoretical considerations (and discussion). Pages 77-105 in Trefethen, J. B. *The wild sheep in modern North America*. Winchester Press, New York.

This chapter discusses the role of sheep biology in management and describes strategies for a number of management objectives. Being a K-selected, highly social species, mountain sheep may be more susceptible than other ungulates to certain types of disturbance. However, like other Ice Age mammals, they are good learners that will readily inhabit or abandon disturbed habitat depending on the circumstance. When sheep are managed for non-consumptive recreation or when remnant populations are forced to live in proximity to humans, the author suggests that the sheep be intentionally habituated to the presence of humans. These ideas, along with the importance of informing human observers, are explored further in a Q&A discussion following the chapter.

- Geist, V. 1978. Behavior. Pages 283-296 in Schmidt, J. L., and D. L. Gilbert. Big game of North America: ecology and management. Stackpole Books, Harrisburg, PA.
This chapter instructs game managers on the aspects of animal behavior essential to formulating management strategies. Behavior is discussed in the contexts of ecology and habitat use, harassment, and learning. The author describes the negative consequences of animal harassment and explains how different stimuli may interact with the conditioned responses of different species. Habituating wildlife to humans or human activities is proposed as a means of reducing the negative effects of harassment, provided the animals are taught to ignore humans rather than approach them. In summary, the author states that managers should not shy away from teaching wildlife in an effort to preclude the learning of detrimental behaviors.
- 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.
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.
- Grandin, T. 2000. Habituating antelope and bison to cooperate with veterinary procedures. *Journal of Applied Animal Welfare Science* **3**:253-261.
Wild animals are often injured when they are handled for veterinary procedures, blood samples, etc. The authors of this paper attempted to reduce the excitability of wild antelope and bison through habituation. Animals were taught to enter a box voluntarily for a food reward and researchers were able to perform simple blood tests on the unsedated animals. Cortisol levels of the habituated animals were much lower than those reported in the literature for nonhabituated restrained ruminants.
- Grossman, E. 2001. Meet your new neighbor. *The Amicus Journal* **23**:18-19.
Cougar-human interactions are increasing in the western United States. This short description of cougar natural history and interaction with humans touches on their ability to habituate to humans and the consequences of habituation.

Grubb, T. G., and R. M. King. 1991. Assessing human disturbance of breeding bald eagles with classification tree models. *Journal of Wildlife Management* **55**:501-512. Classification trees provide a means to evaluate effects from a variety of disturbance factors. This paper uses the method for bald eagles in Arizona. The models indicated that pedestrians caused the largest amount of disturbance, followed by anglers, vehicles, noise, and aircraft. The authors suggest that the high volume of air traffic and the low disturbance rate indicates habituation to aircraft. The discussion focuses mainly on buffer zones and flush distances.

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

Recreational disturbance to nesting bald eagles may reduce nesting success by promoting a repeated flight response. The authors of this paper used a classification and regression tree model to predict eagle responses to passing watercraft in Voyageurs National Park. The model revealed a very low response rate compared to other values reported for bald eagles in the literature. This population is subject to a large amount of boat traffic and has been for decades, and the authors discuss habituation in comparison to other populations.

Gunther, K. A. 2003. Information Paper No. BMO-5.

(<http://www.nps.gov/yell/nature/animals/bear/infopaper/info5.html>).

This brief informational paper discusses the initiatives of the Bear Management Area program in Yellowstone National Park. The first initiative is to prevent habituation of bears to recreationists, which may lead to attacks. The paper has a useful and relevant, though abbreviated, literature cited section.

Gutzwiller, K. J., and R. E. McCabe. 1991. Assessing recreational impact on wildlife: the value and design of experiments. *Transactions of the 56th North American Wildlife and Natural Resources Conference*. Wildlife Management Institute, Edmonton, Alberta, March 17-22, 1991: 248-255.

While observational studies have definite value – especially when logistics prevent experimentation – they often fail to account for any number of confounding factors. This commentary makes a case for using well-designed experiments to assess the impact of recreation on wildlife. He describes various statistical and biological considerations that should be considered when researching recreational disturbance. Habituation is listed among the major biological considerations and the author explains the need to test habituation response across levels of recreational disturbance.

Halfpenny, J. C., M. R. Sanders, K. A. McGrath, and C. E. Braun. 1991. Human-lion interactions in Boulder County, Colorado: past, present, and future. Mountain Lion-Human Interaction, Symposium and Workshop. Denver, CO, April 24-26, 1991 : 10-16.

During the 1980s, human-mountain lion interactions increased dramatically in Boulder County Colorado. To assess the potential for future problems, the authors solicited reports of human-lion interactions from residents. They discovered that reports of interactions during daylight, in summer, and closer to population centers increased over time, suggesting increases of lion habituation. They discuss habituation being passed from adults to young, the implications of increased interactions, and the possibilities for lion attacks.

Hamaan, B., H. Johnston, J. Gobielle, M. Hillis, S. Johnson, L. Kelly, and P. McClelland. 1999. Birds. Pages 1-34 *in* Joslin, G., and H. Youmans. Effects of recreation on Rocky Mountain wildlife: a review for Montana. Montana Chapter of the Wildlife Society.

Understanding declines in biodiversity of avian species includes knowledge of the effects of recreational disturbance. In this chapter, the authors review literature concerning human disturbance of various bird species. Reaction to humans varies within species based on breeding status and other factors. Response to disturbance ranges from altering behavior or habitat use to nest abandonment to habituation to humans. Management recommendations are given by species group.

Hamilton, K., S. Holl, and C. L. Douglas. 1982. An evaluation of the effects of recreational activities on bighorn sheep in the San Gabriel Mountains, California. Desert Bighorn Council Transactions **26**:50-55.

Transactions may be ordered directly from the Desert Bighorn Council at <http://www.desertbighornCouncil.org/about.html>.

Harrington, F. H., and A. M. Veitch. 1991. Short-term impacts of low-level jet fighter training on caribou in Labrador. Arctic **44**:318-327.

Heimberger, M., D. Euler, and J. Barr. 1983. The impact of cottage development on common loon (*Gavia immer*) reproductive success in central Ontario, Canada. Wilson Bulletin **95**:431-439.

The impact of recent human activity, specifically cottage development, on loon nesting success is unknown. This study compared nesting success of loons in developed and undeveloped areas of Ontario, Canada. Contrary to reports from other waterbirds, hatching success was negatively related to proximity to cottages but fledging success was independent. The loons in the more developed areas may have become habituated to humans.

- Herrero, S. 1985. Bear attacks: their causes and avoidance. Nick Lyons Books, New York.
This book relates several years worth of hands-on research of bear attacks in North America. The author examines causes, characteristics of bears, avoidance strategies, and management ideas. The chapter on garbage and habituation explains the difference between habituation and food conditioning and how the two are related. Using specific examples, these behaviors are explored as factors contributing to bear attacks.
- Herrero, S., and M. Bromley. 1989. The role of learning in some fatal grizzly bear attacks on people. Bear-people conflicts: proceedings of a symposium on management strategies. Northwest Territories Department of Renewable Resources, Yellowknife, Canada, April 6-10, 1987: 9-14.
- Herrero, S., and S. Fleck. 1990. Injury to people inflicted by black, grizzly or polar bears: recent trends and new insights. International Conference on Bear Research and Management **8**:25-32.
The authors extend the data presented in Herrero's (1985) book on bear attacks. They review cases and discuss the role of habituation and food conditioning. They suggest that habituated bears may not be dangerous as long as humans stay on predictable paths. However habituated bears may cause problems because humans believe they can be approached.
- Horesji, B., and T. Thorne. 1976. Some thoughts and observations on harassment and bighorn sheep. Proceedings of the Biennial Symposium of North American Bighorn Sheep Council. Jackson, WY, February 10-12, 1976 : 149-155.
- Hunt, C. 1984. Behavioral responses of bears to tests of repellents, deterrents and aversive conditioning. Thesis. University of Montana, Missoula, MT.
This thesis includes a second volume titled "Deterrents, aversive conditioning, and other practices: an annotated bibliography to aid in bear management." It is available from the U.Mt. Mansfield Library.
- Joep, K. L. 1983. Habituation of grizzly bears to people: a hypothesis. Proceedings of the international conference on bear research and management **5**:322-327.
Habituation of grizzlies to humans poses a threat to both bears and people and presents a challenge to wildlife managers. This paper examines habituation of bears to people across seasons and sex-age class. Habituation was smallest in females with young. Midseason increases in habituation may be related to natural inter-specific habituation that bears exhibit around concentrated food sources.

Jope, K. L. 1985. Implications of grizzly bear habituation to hikers. *Wildlife Society Bulletin* **13**:32-37.

Some authors have suggested that bear attacks in national parks are the result of bears becoming less wary of humans. This paper examines human-bear conflict in Glacier National Park by reviewing bear-attack statistics and monitoring and interviewing park users. Instances of bears charging were far more common on low-use trails. The author concludes that habituated bears are less likely to charge humans out of fear and suggests methods for improving habituation.

Jope, K. L. M. 1982. Interactions between grizzly bears and hikers in Glacier National Park, Montana. University of Oregon, National Park Service Cooperative Park Studies Unit Report 82-1.

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.

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.

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. 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.

Knight, J. E., Jr. 1980. Effect of hydrocarbon development on elk movements and distribution in northern Michigan. Dissertation. University of Michigan, Ann Arbor, MI.

This dissertation examined the effects of oil exploration and drilling on elk herds in northern Michigan. Using pellet surveys, track counts, and radiotelemetry the researchers monitored responses of elk to seismic exploration and well-drilling activities. Elk were consistently alarmed by the ever-moving seismic activity but were relatively undisturbed by drilling. The author concludes that elk are more likely to habituate to stationary human activity (e.g., developed area) than to dispersed activity. The dissertation is available through the Burr Shelving Facility at the University of Michigan.

- Knight, R. L., and K. J. Gutzwiller. 1995. *Wildlife and recreationists: coexistence through management and research*. Island Press, Washington, DC.
This book covers several aspects of recreation and wildlife, including human dimensions, physiological and behavioral responses of wildlife, philosophical issues, noise pollution, and several case studies. Habituation is covered in general terms of wildlife response, in case studies of specific species, in response to noise, and in terms of ethics.
- Knight, R. L., and S. K. Knight. 1984. Responses of wintering bald eagles to boating activity. *Journal of Wildlife Management* **48**:999-1004.
In this short communication, the authors recorded responses of wintering bald eagles to canoes on adjacent rivers with differing levels of human activity. Eagles on the high-traffic river flushed less often from boats, likely due to greater habituation. Eagles on both rivers habituated to canoes over the winter. The authors describe the necessities of studying habituation in eagles.
- Knight, R. L., D. N. Cole, and R. E. McCabe. 1991. Effects of recreational activity on wildlife in wildlands. *Transactions of the 56th North American Wildlife and Natural Resources Conference*. Wildlife Management Institute, Edmonton, Alberta, March 17-22, 1991 : 238-247.
Preservation of wildlife and recreational opportunities are competing principles guiding our management of designated wildlands. This paper summarizes current knowledge about the impact of recreational disturbance on wildlife. The authors propose a hierarchy of responses that includes the immediate response as well as long-term effects on individuals, populations, and communities. They describe the factors that influence wildlife reactions, including habituation. They conclude that as research fills in gaps in our knowledge, a conceptual model can be created to understand the relationship between recreation and wildlife.
- Kovach, S. D., M. C. Wallace, C. L. Hayes, and D. W. DeYoung. 1998. Effects of jet aircraft on mountain sheep. *Journal of Wildlife Management* **62**:1246-1254.
The effects of aerial disturbance from air bases on desert ungulates are relatively unknown. In this study, a massive enclosure was constructed and mountain sheep were subjected to F-16 flyovers while researchers measured behavior, heart rate, and actual sound levels. Sheep gave very little response to the flyovers. The authors concluded that the sheep were habituated to aircraft noise.
- Krausman, P. R., M. E. Weisenberger, M. C. Wallace, B. Czech, D. W. De Young, and O. E. Maughan. 1996. Behavioral responses of mule deer and mountain sheep to simulated aircraft noise. *Desert Bighorn Council Transactions* **40**:1-7.
Using simulated low-altitude aircraft noise, researchers evaluated the effects of this disturbance on captive mule deer and mountain sheep. Similar to other studies, the authors found that these desert ungulates habituated rapidly to aircraft noise disturbance.

Lee, J. A. 1981. Habituation to human disturbance in nesting accipiters. *Raptor Research* **15**:48-52.

Though many accipiters traditionally avoid developed areas, they occasionally nest near humans. In this short, descriptive paper the author examined three nests in Utah subject to large amounts of disturbance. Two explanations (the birds were inexperienced or the birds were using traditional nests) are put forth to explain why these birds tolerate human disturbance.

Leslie, D. M., Jr. and C. L. Douglas. 1980. Human disturbance at water sources of desert bighorn sheep (*Ovis Canadensis nelsoni*). *Wildlife Society Bulletin* **8**:284-290.

A large construction project was undertaken near the primary watering site of a local desert bighorn sheep herd. Researchers observed sheep use of artificial water sources in response to construction activities. Reproduction was not affected by the disturbance. The study population was highly habituated to humans, and the authors cite this as a mitigating factor.

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.

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.

Lyon, L. J., and A. L. Ward. 1982. Elk and land management. Pages 443-478 in Thomas, J. W., and D. E. Towell. *Elk of North America: ecology and management*. Stackpole Books, Harrisburg, PA.

Elk herds typically inhabit large ranges which cover both private and public lands and include a wide variety of land-use objectives, and their presence in certain landscapes often results in conflict. This chapter discusses how these conflicts may be resolved by coordinating land management goals to allow for and benefit elk. The authors focus on management issues related to silviculture, range management, agriculture, and recreation. In many cases, elk have habituated easily to human disturbance, though their reactions are widely variable and likely depend on season, habitat, the type and predictability of disturbance, previous exposure, and hunting pressure. The authors conclude that effective land management for elk is achieved only with cooperation from all stakeholders.

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.

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.

Mace, R. D., and J. S. Waller. 1998. Demography and population trend of grizzly bears in the Swan Mountains, Montana. *Conservation Biology* **12**:1005-1016.

Though managing wildlife at the ecosystem level is critical to conservation, few studies are broad enough to inform managers at this large scale. Using capture and telemetry, researchers studied the demography, movements, and population trends of grizzly bears in wilderness and non-wilderness areas of the Swan Mountains. Grizzly bears in rural and wilderness areas had much higher mortality rates than those in nonwilderness multiple-use areas, and the authors suggest a sourced-sink relationship. A major mortality source for bears in rural areas was removal by managers of habituated and food-conditioned bears. Managers may promote population growth by improving female survival, minimizing conflict on private land, eliminating anthropogenic food sources, and teaching identification skills to prevent black bear hunters from mistakenly harvesting grizzlies.

Mahaulpatha, D., T. Mahaulpatha, K. Nakane, and T. Fujii. 2000. Factors affecting the distribution of waterfowl wintering in the inland water of the Saijo Basin in western Japan. *Japanese Journal of Ornithology* **49**:167-173.

The impact of disturbance on waterfowl habitat use is likely dependent on the type and level of disturbance. This study examined the effects of human disturbance on the distribution of wintering waterfowl at 64 irrigation ponds in the Saijo Basin. Non-hunting disturbance, such as fishing, hiking, and bird watching, did not influence waterfowl use of residential ponds, suggesting habituation. However, hunting and construction activities strongly predicted use of forest ponds. The authors discuss the ability of waterfowl to adapt to heavy disturbance in the absence of hunting.

- Marsh, R. E., W. A. Erickson, T. P. Salmon, J. E. Borrecco, and R. E. Marsh. 1992. Scarecrows and predator models for frightening birds from specific areas. Proceedings of the 15th Vertebrate Pest Conference. Newport Beach, CA, March 2-5, 1992 : 112-114.
Scarecrows and predator models are traditional methods of repelling nuisance birds, though their effectiveness depends on external conditions and the bird species involved. This conference paper describes design factors influencing the effectiveness of these repellents on nuisance birds. Repellents that utilize loud noises or distress calls are generally most effective. The authors discuss the inevitability of habituation by some species and the need for reasonable expectations
- Mastrota, F. N., and J. A. Mench. 1995. Avoidance of dyed food by the northern bobwhite. *Applied Animal Behaviour Science* **42**:109-119.
Colored dyes may possibly be used to prevent birds from consuming agricultural grains or pesticide granules. This experiment tested the efficacy of food dyes as a repellent to northern bobwhite. Hens exhibited far more initial avoidance to dyed foods than cocks, though hens quickly habituated to all dye colors except red and orange. The authors hypothesize that the more persistent avoidance of red and orange dyes may be evidence of unlearned aversions by bobwhites to the warning colors found in toxic prey — although the absence of this aversion in cocks limits the potential effectiveness of the dyes.
- Mattson, D. J. 1990. Human impacts on bear habitat use. *International Conference on Bear Research and Management* **8**:33-56.
This paper discusses the distribution and population dynamics of bears in relation to human development. Habituation is included as a major factor determining the success of bear populations near humans. The author suggests that removing habituated bears reduces carrying capacity, and he concludes that humans must either accept habituated bears or provide large tracts of undisturbed habitat.
- Mattson, D. J., B. M. Blanchard, and R. R. Knight. 1992. Yellowstone grizzly bear mortality, human habituation, and whitebark pine seed crops. *Journal of Wildlife Management* **56**:432-442.
The Yellowstone grizzly bear population may be extirpated in the next 100-200 years according to this study, unless mortality rates stabilize and remain at low levels. They authors attribute differing mortality rates across sex/age cohorts to levels of human habituation and proximity to human settlement, and to the annual whitebark pine seed crop which draws bears to higher elevations. They found that bears, especially adult females and subadult males, were more likely to be in close proximity to humans and more likely to be killed in management actions during small seed crop years. The authors determined that food-conditioned or habituated bears were at least three times more likely to be killed by humans. They conclude that human settlement in grizzly habitat needs to be minimized and non-lethal means for dealing with habituated bears that eat native foods needs to be explored.

- McCrary, W. P., S. Herrero, G. Jones, and M. Bromley. 1989. A program to minimize conflicts between grizzly bears and people in British Columbia Provincial Parks. Bear-people conflicts: proceedings of a symposium on management strategies. Northwest Territories Department of Renewable Resources, Yellowknife, Canada, April 6-10, 1987: 93-98.
- McCullough, D. R. 1982. Behavior, bears, and humans. *Wildlife Society Bulletin* **10**:27-33.
In this opinion article, the author calls on the need to incorporate animal behavior concepts into bear management. He provides a lucid definition of wildlife habituation and argues that habituation needs to be addressed in bears with the same rigor as food conditioning. He thinks negative conditioning should be used for problem bears to move toward a “peaceful coexistence”.
- McGarigal, K., R. G. Anthony, and F. B. Isaacs. 1991. Interactions of humans and bald eagles on the Columbia River estuary. The Wildlife Society, *Wildlife Monographs* no. 115.
Though human activities may have substantial effects on nesting bald eagles, few studies have quantified these effects. This paper examined the impact of various human disturbances on bald eagle behavior. The authors discuss the impact of different encounter types in detail and touch on habituation when speaking on flush distance. They don’t address habituation directly but suggest that eagles may have buffer zones for tolerance of human intruders that vary among populations depending on level and type of disturbance.
- McNay, M. E. 2002. A case history of wolf-human encounters in Alaska and Canada. Alaska Department of Fish and Game, *Wildlife Technical Bulletin* 13.
See related article: McNay, M.E. 2002. Wolf-human interactions in Alaska and Canada: a review of the case history. *Wildlife Society Bulletin*, 30(3): 831-843.
- McNay, M. E. 2002. Wolf-human interactions in Alaska and Canada: a review of the case history. *Wildlife Society Bulletin* **30**:831-843.
This case history examines 80 wolf-human encounters, including 18 since 1969 that involved unprovoked aggression. Eleven of the 18 cases involved habituated wolves, and the author suggests aversive conditioning to prevent habituation in areas with high levels of interaction.
- Mech, L. D. 1998. Who’s afraid of the big bad wolf? : revisited. *International Wolf* **8**:8-11.

- Metcalf, B. M., S. J. Davies, and P. G. Ladd. 2002. Adaptation behaviour by two bird species as a result of habituation to humans. *Australian Birdwatcher* **18**:306-312. 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.
- Miller, F. L., and A. Gunn. 1979. Responses of Peary caribou and muskoxen to helicopter harassment. Canadian Wildlife Service, Ottawa, Ontario. Helicopter overflights may negatively affect ungulate herds by causing stress, herd fragmentation, or habitat abandonment. This study examined a number of factors contributing to the response of caribou and muskoxen to helicopters. Habituation was observed within single flights but not across flights; however, the article does not give much space to the habituation finding. Relevant response factors included group size and type, number of calves, sun position and wind direction relative to the helicopter, terrain, and previous activity of the animals.
- Miller, F. L., and A. Gunn. 1980. Behavioral response of musk ox (*Ovibos Moschatus*) herds to simulation of cargo slinging by helicopter, Northwest Territories, Canada. *Canadian Field-Naturalist* **94**:52-60. Repeated exposure of musk oxen to aerial disturbance has the potential to cause injuries, herd splintering, or range abandonment. To assess the risk from cargo slinging, the authors flew repeated helicopter flights over three muskoxen herds. The animals exhibited short-term habituation responses within a series of passes and a long-term habituation response within the most excitable herd. Understanding habituation will instruct industry on how to follow procedures that allow animals to adapt to disturbance.
- Miller, S. G., R. L. Knight, and C. K. Miller. 2001. Wildlife responses to pedestrians and dogs. *Wildlife Society Bulletin* **29**:124-132. 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.

- Moen, A. N., S. Whittemore, and B. Buxton. 1982. Effects of disturbance by snowmobiles on heart rate of captive white-tailed deer (*Odocoileus virginianus*). *New York Fish and Game Journal* **29**:176-183.
This paper reports on the physiological effects of recreational disturbance on deer. Researchers found that snowmobiles caused heart-rate increases of 2.5-3 times pre-stimulus rates in captive deer exposed to disturbance from snowmobiles. The magnitude of the increase depended on the direction of the vehicle. Deer exhibited no evidence of habituation.
- Morgantini, L. E., and R. J. Hudson. 1979. Human disturbance and habitat selection in elk. Pages 132-139 in Boyce, M. S., and L. D. Hayden-Wing. *North American elk: ecology, behavior and management*. University of Wyoming, Laramie, WY.
The proceedings of this symposium are available through the University of Wyoming libraries.
- 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.
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.
- Mueller, C., S. Herrero, and M. L. Gibeau. 2004. Distribution of subadult grizzly bears in relation to human development in the Bow River Watershed, Alberta. *Ursus* **15**:35-47.
Survival of subadult grizzlies is often impacted most by increasing human activity. This paper compares habitat use of adult and subadult grizzly bears with respect to development. Subadults were found at lower elevations and closer to high-use roads than adults. The authors discuss the increased chances of habituation and human-caused mortality for subadult bears due to their greater proximity to humans.
- 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.
Some colonies of hoatzins are exposed to high levels of disturbance from ecotourists. This study compared nesting success of hoatzins at undisturbed and ecotourist-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.

- Nisbet, I. C. T. 1978. Direct human influences: hunting and the use by birds of man's waste deposits. *Ibis: the International Journal of Avian Science* **120**:134.
- Nisbet, I. C. T. 2000. Disturbance, habituation, and management of waterbird colonies. *Waterbirds* **23**:312-332.
In this commentary, the author critiques a number of studies found in a literature review by Carney and Sydemann (who provide a response). Nisbet argues that many disturbance studies are too narrow in focus and terminology. He defines habituation and discusses it as a management and research tool for terns and other colonial shorebirds.
- 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.
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.
- 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.
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.
- Olson, T. L., B. K. Gilbert, and S. H. Fitkin. 1990. Brown bear and human activity at salmon streams in Katmai National Park, Alaska. Utah State University, Logan, UT, Interagency Agreement IA9700-7-8028.
This report is available from the Quinney Natural Resources Library at Utah State University.

- 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. 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.
- Patterson, I. J. 1988. Responses of Apennine chamois to human disturbance. *Zeitschrift fuer Saeugetierkunde* **53**:245-252. Determining the impact of recreational disturbance on wildlife requires managers to understand how disturbance interacts with sex/age class. This study measured flight distances across sex/age classes of Apennine chamois in 3 areas of Abruzzo National Park, Italy, with varying numbers of human visitors. The results showed no consistent difference between sexes, but yearling and sub-adult chamois had significantly shorter flight distances than young adults. The authors found that flight initiation distances were shortest in the most visited area and longest in the most remote area, suggesting some level of habituation.
- Peeke, H. V. S., and L. F. Petrinovich. 1984. *Habituation, sensitization, and behavior*. Academic Press, Orlando, FL.
- Peeke, H. V. S., and M. J. Herz. 1973. *Habituation*. Academic Press, New York. Habituation, once considered a functionally insignificant form of behavior, is more likely an adaptive modification of behavior (i.e., learning). The papers collected in this volume explore the behavioral and physiological bases of habituation. Most of the text focuses on laboratory experiments performed with invertebrates and amphibians — habituation in mammals is not discussed while one paper describes a natural habituation response in birds. Topics covered across the seven chapters include the role of habituation in learning, conditioning, evolution, and territorial aggression as well as temporal characteristics of habituation and the effects of stimulus change.
- Randler, C. 2003. Reactions to human disturbances in an urban population of the Swan Goose *Anser cygnoides* in Heidelberg (SW Germany). *Acta Ornithologica* **38**:47-52. This observational study examined trends in goose reactions to disturbance from 127 interactions at an urban park. Similar to many studies, dogs caused the strongest reactions in geese. The authors discuss the habituation of geese to urban environments.

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.

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.

Recarte, J. M., J. P. Vincent, and A. J. M. Hewison. 1998. Flight responses of park fallow deer to the human observer. *Behavioral Processes* **44**:65-72.

The response of ungulates to humans likely depends on the immediate environment as well as level of prior human exposure. Researchers used an enclosed population of fallow deer to measure flight responses in relation to a number of factors: sex-age class, group size, distance from transect, habitat type, etc. Deer in open habitat or in large groups were less likely to flee humans. Deer exhibited a significant habituation effect where human disturbance was higher, and the authors discuss habituation with regard to enclosed populations and regular, predictable disturbance.

Reimers, E., and S. Svela. 2001. Vigilance behavior in wild and semi-domestic reindeer in Norway. *Alces* **37**:303-313.

Vigilance behavior in ungulate herds may be tied to recent evolutionary history with regard to human disturbance, domestication, or predation in the area. Researchers compared vigilance behaviors of a wild and a semi-domestic reindeer population across three time periods. Wild reindeer spent far more time in vigilance behaviors, while the semi-domestic herd spent more time in predator-vulnerable activities. A number of contributing factors are discussed, including habituation to humans, presence of predators, hunting, and evolution.

Rubin, E. S., W. M. Boyce, C. J. Stermer, and S. G. Torres. 2002. Bighorn sheep habitat use and selection near an urban environment. *Biological Conservation* **104**:251-263.

The full impact of urban development on wildlife is unknown for many species. This paper compared habitat use between two subpopulations of endangered bighorn sheep — one that used an urban environment and one that did not. The subpopulation that used the urban environment had better diet quality but also had a high prevalence of an intestinal worm not found in other populations. Habituation is discussed, but the article focuses on the idea that while urban areas may provide bighorn sheep with forage and water resources, the use of these areas may have substantial costs.

- Russell, D., R. L. Knight, G. T. Allen, M. V. Stalmaster, and C. W. Servheen. 1980. Occurrence and human disturbance sensitivity of wintering bald eagles on the Sauk and Suiattle rivers, Washington. Proceedings of the Washington Bald Eagle Symposium. The Nature Conservancy, Seattle, WA, June 14-15, 1980: 165-174. This conference paper examines the relationship between the level of human use on a river and eagles' response to disturbance. The author used a raft to census eagles on two relatively undisturbed rivers. Eagles demonstrated a significant relationship between flight initiation distance and level of disturbance. The author discusses the results in terms of to habituation to disturbance.
- Schneider, W. n.d. Bears or hikers? Backpacker **8**:36-42.
- Schultz, R. D., and J. A. Bailey. 1978. Responses of National Park elk to human activity. *Journal of Wildlife Management* **42**:91-100. Elk in national parks are commonly subject to recreational disturbance, and it is important to understand how they are affected by different forms of disturbance. The authors measured responses of elk to a variety of disturbance factors. Elk had a much higher flight response to humans approaching off-road than they did to vehicle traffic. The article does not discuss habituation explicitly, but examines tolerance of elk to regular disturbance and discusses differences in tolerance and flight response between hunted and non-hunted populations.
- Scott, G. W., A. R. Niggebrugge, and B. Sweeney. 1996. Avian habituation to recreational disturbance on the North Yorkshire coast. *Naturalist* **121**:11-15. 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.
- Serrouya, R. 1999. Permeability of the Trans-Canada highway to black bear movements in the Bow River Valley of Banff National Park. Thesis. University of British Columbia, Vancouver.
- Skagen, S. K., R. L. Knight, G. T. Allen, M. V. Stalmaster, and C. W. Servheen. 1980. Behavioral responses of wintering bald eagles to human activity on the Skagit River, Washington. Proceedings of the Washington Bald Eagle Symposium. The Nature Conservancy, Seattle, WA, June 14-15, 1980: 231-241. Eagles engaged in different activities may react differently to human disturbance. Responses of wintering bald eagles to humans were measured during two winters. Eagles were more disturbed when eating compared to perching and when approached on foot compared to by vehicle. Eagles in an area with high human use were more tolerant of humans, indicating habituation.

- Smith, T. S., and B. A. Johnson. 2004. Modeling the effects of human activity on Katmai brown bears (*Ursus arctos*) through the use of survival analysis. *Arctic* **57**:161-166.
Human disturbance through wildlife viewing may alter behavior patterns of brown bears. This paper examined temporal activity patterns of bears by measuring time spent foraging on the Kulik River in the presence and absence of humans. Researchers conducted observations in 1993, 1995, and 1997, finding that humans only affected bear activity when they shared a river zone. The authors found increased use of the river by bears over the course of their study which they attribute to habituation to humans.
- Spanier, E. 1980. The use of distress call to repel night herons (*Nycticorax nycticorax*) from fish ponds. *Journal of Applied Ecology* **17**:287-294.
Nuisance night herons may cause significant damage to commercial fish ponds. In response, researchers used conspecific distress calls to repel night herons from ponds. The calls were 80% effective, and despite a long period of continual playbacks, the birds did not become habituated. The lack of habituation is in contrast to several other studies.
- Stalmaster, M. V., and J. R. Newman. 1978. Behavioral responses of wintering bald eagles to human activity. *Journal of Wildlife Management* **42**:506-513.
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.
- Stanger, M. C., J. C. Cresto, G. W. Workman, and T. D. Bunch. 1986. Desert bighorn sheep-riverboat interactions in Cataract Canyon, Utah. *Desert Bighorn Council Transactions* **30**:5-7.
Transactions may be ordered directly from the Desert Bighorn Council at <http://www.desertbighornCouncil.org/about.html>.
- 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.
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.

- Steidl, R. J., and R. G. Anthony. 2000. Experimental effects of human activity on breeding bald eagles. *Ecological Applications* **10**:258-268.
This paper attempts to assess the effects of increased recreational activity in interior Alaska on breeding bald eagles. Researchers recorded activity budgets of breeding bald eagles when humans were camped at either 100 or 500 m for 24 hr. They observed a significant difference in activity patterns, with feeding, sleeping, and nest maintenance being reduced when humans were closer. Some habituation during the 24-hr observation period was observed, but eagles in proximity to humans still vocalized twice as much during the last 4 hr of observation. Consistent changes in behavior suggested that frequent human disturbance could negatively affect nesting success.
- Stolen, E. D. 2003. The effects of vehicle passage on foraging behavior of wading birds. *Waterbirds* **26**:429-436.
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.
- Swarthout, E. C. H., and R. J. Steidl. 2003. Experimental effects of hiking on breeding Mexican spotted owls. *Conservation Biology* **17**:307-315.
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.
- Taylor, A. R., and R. L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. *Ecological Applications* **13**:951-963.
When managing recreational disturbance, understanding recreationists' perception of their impact may be as valuable as studying the affected animals. This study combined observations of flight response of ungulate species from recreational disturbance with interviews of recreationists to examine the influence of visitors at Antelope Island State Park, Utah. Results showed that most recreationists underestimated the effect of certain behaviors, such as approaching wildlife. The paper provides some background on the habituation of ungulates to recreation and states that habituation could mitigate some effects of disturbance at the park. However, habituation was not evident in observations.

- 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.
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.
- The Wildlife Team, Denali National Park and Preserve. 2003. Bear-Human Conflict Management Plan.
(<http://www.nps.gov/dena/home/resources/Wildlife/Bearmgmt/Bearmgmt.html>).
This National Park Service document touches on habituation as the cause of most human injuries resulting from bear-human conflict. The document includes a table of management responses for habituated bears.
- Thiel, R. P., S. Merrill, and L. D. Mech. 1998. Tolerance by denning wolves, *Canis lupus*, to human disturbance. *Canadian Field-Naturalist* **112**:340-342.
Until recently, wolves were considered intolerant of human development or disturbance. In this short note, however, the authors describe several instances of wolves tolerating high levels of disturbance near denning pups in the context of wolves re-inhabiting areas where they had previously been extirpated. The note discusses briefly the ability of wolves to habituate to disturbance in the absence of harassment.
- Thompson, M. J., and R. E. Henderson. 1998. Elk habituation as a credibility challenge for wildlife professionals. *Wildlife Society Bulletin* **26**:477-483.
This commentary addresses the increases in elk habituation in the western United States. The authors relate discussions with wildlife managers from the area and propose management strategies to dissuade habituation. They explore biological factors that contribute to habituation and encourage management of these factors. They go on to explain the problems that elk habituation poses for elk, managers and the public.
- Tighe, T. J., and R. N. Leaton. 1976. Habituation: perspectives from child development, animal behavior, and neurophysiology. Halsted Press, New York.
Papers from a conference held at Dartmouth College's Minary Conference Center in Holderness, N.H., Sept. 12-17, 1974. Includes bibliographies and index.

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.

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.

Tracy, D. M. 1977. Reaction of wildlife to human activity along Mount McKinley National Park road. Thesis. University of Alaska, Fairbanks, AK.

Based on citations, this thesis concluded that some animals, particularly those within 100 m of the road, were adversely affected by increased visitation to the park. The results of this study were used as a point of comparison in more recent papers to demonstrate that some wildlife species have likely habituated to traffic and disturbance along the road. The thesis is available from the Alaska Resources Library and Information Services.

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**:1094-1099.

Though wildlife warning reflectors have been in use for decades, their long-term efficacy is questionable. This experiment was designed to eliminate extraneous noise and light factors and test fallow deer for reduction in response over several nights of exposure to reflected light. Despite nightly variations, the authors found that the percentage of deer not reacting to the reflectors increased significantly with time, and they expect that the result to be consistent across deer species. They conclude that the deer became habituated to the light and discuss the technical limitations of warning reflectors.

Ujvari, M., H. J. Baagoe, and A. B. Madsen. 2004. Effectiveness of acoustic road markings in reducing deer-vehicle collisions: a behavioural study. *Wildlife Biology* **10**:155-159.

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.

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.

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

Once common, red wolves have been extirpated from the vast majority of the United States. Recent efforts have focused on reintroducing red wolves to both mainland and island populations. This paper examines data from several red wolf releases to construct models that predict release success. The results indicated that habituation of wolves to humans prior to release was among the most important factors predicting release success.

Vuorisalo, T., H. Andersson, T. Hugg, R. Lahtinen, H. Laaksonen, and H. Lehtikoinen. 2003. Urban development from an avian perspective: causes of hooded crow (*Corvus corone cornix*) urbanisation in two Finnish cities. *Landscape and Urban Planning* **62**:69-87.

Crows were relatively absent from urban areas in Finland until the population exploded in the mid-1960s. This paper examines the colonization of urban areas by hooded crows in the context of natural history and changes in urban development. The authors hypothesize that the large urban population growth by crows coincided with a reduction in persecution that allowed crows to habituate to humans and traffic.

Waas, J. R., J. R. Ingram, and L. R. Matthews. 1999. Real-time physiological responses of red deer to translocations. *Journal of Wildlife Management* **63**:1152-1162.

Capture and transfer can be extremely stressful on wildlife. Using a remote blood and heart-rate testing monitoring device, the authors examined the physiological effects of translocations on red deer. They found that stress increased over time and spiked during periods of handling (i.e., loading and off-loading the transporter). There was no evidence that deer habituated to multiple translocations.

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

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.

Waller, A. J., C. A. Sime, G. N. Bissell, and B. G. Dixon. 1999. Semi-aquatic mammals. Pages 1-25 in Joslin, G., and H. Youmans. Effects of recreation on Rocky Mountain wildlife: a review for Montana. Montana Chapter of the Wildlife Society.

Due to use of multiple habitats, semi-aquatic mammals are subject to recreational disturbance occurring both on waterways and on shorelines. This disturbance may cause physiological stress, interrupt feeding, or cause displacement from preferred habitat, all with energetic consequences on affected animals. In this book chapter, the authors touch on the ability of semi-aquatic mammals to habituate to non-threatening recreation activity, providing it is regular and predictable. The authors conclude that the cumulative effects of habitat loss and recreational disturbance need to be considered when formulating a responsible management plan.

Watkins, R. W., E. L. Gill, and J. D. Bishop. 1995. Evaluation of cinnamamide as an avian repellent: determination of a dose-response curve. *Pesticide Science* **44**:335-340.

Cinnamamide has been proposed as a non-lethal repellent for reducing avian pest damage. Using a three-day, short-term, no-choice experiment the authors quantified a dose-response curve for cinnamamide with feral pigeons. The results showed that low doses led to habituation while higher doses resulted in conditioned aversion. This paper confirms that cinnamamide can be a useful avian repellent.

Watson, J. W., and D. J. Pierce. 1998. Ecology of bald eagles in western Washington with an emphasis on the effects of human activity. Washington Department of Fish and Wildlife, Olympia, WA.

Weaver, J. L., P. Paquet, and L. F. Ruggiero. 1996. Resilience and conservation of large carnivores in the Rocky Mountains. *Conservation Biology* **10**:964-976.

Large carnivores have evolved life-history traits that confer resilience to environmental disturbances at various temporal and spatial scales. This paper describes characteristics of grizzlies, wolves, and cougars that allow them to adapt to increasing human populations, habitat fragmentation, and dietary changes. Species are examined in terms of behavioral plasticity, demographic compensation, and dispersal. The authors touch on habituation of grizzly bears, pointing out that females who use road corridors to avoid large males may become habituated and be seen as nuisance animals.

- 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 with time, which may be interpreted as a habituation effect.
- Whittaker, D., and R. L. Knight. 1998. Understanding wildlife response to humans. *Wildlife Society Bulletin* **26**:312-317.
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.
- 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.
- Workman, G. W., P. D. Bunch, L. D. S. Nielson, E. M. Rawlings, W. Call, R. C. Evans, N. R. Lundburg, W. T. Maughan, and E. Braituwaite. 1992. Sonic boom animal disturbance studies on pronghorn antelope, elk, and bighorn sheep. US Air Force, Hill Air Base, Ogden, UT, Report F42650-97-C-0349.
- 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.
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.