

**The impacts of wildlife viewing and related non-consumptive outdoor recreation activities
on avian populations: An annotated bibliography**

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Introduction

This report is intended to be useful to land managers, planners, organizations and individuals who aim to develop or manage bird watching sites. The research highlighted in the bibliography will inform recreation planning to result in projects that minimize impact to the species and habitat we value. This report directs readers to research that addresses, or relates to, potential impacts to birds or bird habitat through bird watching and related activities (e.g. walking, hiking, and other relatively passive outdoor recreation).

This year the Colorado Division of Wildlife (in partnership with numerous public agencies, conservation organizations and private landowners) celebrated the "opening" of the Colorado Birding Trail. A culmination of several years of cooperative planning efforts, the Birding Trail, like a scenic byway, recommends wildlife viewing travel courses and birding sites. The initiative serves to increase opportunities for wildlife viewing enthusiasts, to benefit rural economies through sustainable tourism, and ultimately, to conserve habitat. Through this effort, both public and private land owners are being encouraged to evaluate their land for its potential value as a birding tourism destination, and to prepare for (and in some cases develop a site and promote) public recreation.

This bibliography project was undertaken to ensure that the Division of Wildlife (and our partners) are prepared to provide informed guidance for the development of satisfying and sustainable viewing recreation opportunities. Our aim is to learn from the available relevant research and to apply it to on-the-ground recreation development.

Bird watching and other wildlife-viewing recreation activities are often referred to, in recreation management literature, as "non-consumptive" activities. The term usefully defines a relatively newly recognized category of wildlife-related recreation that differs from hunting or fishing recreation. In other cases the term "passive recreation" is used to refer to bird watching, nature study, and walking. This reference helps managers recognize and plan for the diverse needs and preferences expressed by "passive" recreationists and "active" recreationists, such as bicyclists, boaters, skiers, and ATV users.

However, "non-consumptive" and "passive" do not necessarily equate to "no impact." As our communities continue to explore the benefits of wildlife-viewing recreation – benefits to individuals, to communities, and to wildlife – we are responsible for considering the potential impacts. This bibliography can provide a starting place for informed planning. Our hope is that it may also serve to suggest further research in related areas.

This bibliography is not an exhaustive list of all research conducted on disturbance and birds. It does not list or review the literature related to active outdoor recreation such as biking or boating. It does not list or review any literature relative to habitat loss or fragmentation, or to numerous environmental factors such as pesticide use, electric lines, etc. Research related to the impacts of urbanization is included only when it also addresses the associated potential increase in human use of bird habitat. To assist the reader, we have categorized disturbance types accordingly.

Watchable Wildlife

This report is provided by the Watchable Wildlife program of the Colorado Division of Wildlife. This program aims to inspire wildlife conservation by providing and supporting satisfying wildlife viewing opportunities while minimizing resource impacts.

Acknowledgments

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Peer-Reviewed Articles

Author	Title of study	Purpose of Study	Data Collection Method	Publication Type	Disturbance Category	Important Findings	Keywords
Ballenger, N Ortega, C	Effects of ski resort fragmentation on wintering birds in southwestern Colorado. Colorado Field Ornithologists Journal 35 (3) July 2001	Dramatic differences were seen in the bird populations between an undisturbed site and the ski mountain at Durango Mountain Resort.	Empirical	Newsletter	Habitat change due to recreation	Significantly more corvids and fewer non-corvids were at the Durango Ski Mountain. This could be explained by the possibility that nest predation of the non-corvids at the ski mountain was attributed to corvid predation.	Human disturbance, skiing, winter sports, corvids, population biology, nesting success
Baines, D Richardson, M	An experimental assessment of the potential effects of human disturbance on Black Grouse, <i>Tetrao tetrix</i> , in the North Pennines, England. Ibis 149 (Supp. 1) 56-64, 2007	Black Grouse were radio-tagged and subjected to one of three disturbance categories: no disturbance (low), fortnightly disturbance (moderate), or twice-weekly disturbance (high)	Empirical	Research article	Non-consumptive recreation	No differences in clutch size, hatching success or breeding success across disturbance categories. Disturbance effects should be re-assessed if human visitation of the study area increases.	Human disturbance, recreation, differing disturbance levels, breeding success
Bathe, G	Political and social drivers for access to the countryside: the need for research on birds and recreational disturbance. Ibis 149 (Supp. 1) 3-8, 2007	Introductory article to the March, 2007 Ibis journal, which deals exclusively with the effects of recreation on birds	Review	Research article	General recreation activities	Suggests need for assessing human disturbance to birds on a site-by-site basis, and the overall need for more research on the subject	Recreation, disturbance, quality-of-life, rural area access
Bautista, LM Garcia, JT Calmaestra RG Palacin, C Martin, CA, Morales, MB Bonal, R, Vinuela, J	Effect of weekend road traffic on the use of space by raptors. Conservation Biology 18(3) 726-732 June 1994	Correlates human road activity at various times of the day and days of the week to changes in raptor behavior patterns.	Observation	Research Article	Traffic	On weekends, numbers of eagles and vultures decreased near the road. On weekdays, numbers of eagles, vultures and the other 18 species observed did not significantly change.	Noise, weekly, roads, raptors, human activity
Beale, CM Monaghan, P	Behavioural responses to human disturbance: A matter of choice? Animal Behaviour 68 (5) 1065-1069, 2004	Provided supplemental food to Turnstones to determine if avoidance of humans was based on their condition (i.e. – do birds who are in greater need of food tolerate more disturbance on their feeding area?)	Empirical	Research article	Non-consumptive recreation	Turnstones who were supplementally fed, and therefore in better body condition, reacted to disturbance by flushing at a higher distance from observers and flying longer distances away. This indicates that birds who are in a more vulnerable physical condition will tolerate higher levels of disturbance so that they might feed longer.	Human disturbance, flushing distance, flight distance, body condition, avoidance response
Beale, CM Monaghan, P	Human disturbance: People as predation-free predators? Journal of Applied Ecology 41(2) 335-343 April 2004	Investigates why cliff-dwelling birds become disturbed by people in the first place	Empirical	Research article	Non-consumptive recreation	Effects of disturbance increased with increasing number of visitors. Need to promulgate set-back distances or buffers that are calculated for the largest party likely to visit the site at any given time.	Visitor access, visitor management, breeding success, human disturbance
Beissinger, SR Osborne, DR	Effects of urbanization on avian community organization. Condor 84 (1): 75-83 1982	An avian community of a mature residential area was studied and compared with an undisturbed climax beech-maple forest.	Empirical	Research article	Habitat change due to urbanization and associated recreation	Urbanization was apparently responsible for decreasing species richness and diversity, increasing biomass and density, and favoring dominance by a few species. Differences in avian community organization between the forest and urban are discussed in relation to urban habitat manipulation and population-suppressing factors.	Behavioral biology, beech forest vegetation, human, foraging guild, habitat structure, species diversity, biomass, population density
Belanger, L Bedard, J	Responses of staging Greater Snow Geese to human disturbance. Journal of Wildlife Management 53 (3) 713-719, 1989	Measured responsiveness of geese flocks to many types of human activities	Empirical	Research article	General recreation activities	Low-flying aircraft were most disruptive to geese flocks. General human disturbances recorded in the fall on a given day influenced goose use of the study area the following day.	Human disturbance, staging flocks, return time

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Berry, ME Bock, CE Haire, SL	Abundance of diurnal raptors on open space grasslands in an urbanized landscape. Condor 100 (4) 601-608, 1998	Assessed presence of raptors in relation to the amount of urbanization around Boulder, CO.	Empirical	Research article	Habitat change due to urbanization	Red-tailed Hawks, Swainson's Hawks, and American Kestrels were not adversely affected by urbanization up to 30% of the landscape. Bald Eagles, Ferruginous Hawks, Rough-legged Hawks, and Prairie Falcons, were much more sensitive to the amount of urban habitat present	Urbanization, raptors, urban landscape thresholds
Blumstein, DT Fernandez-Juricic, E Zollner, PA Garity, SC	Inter-specific variation in avian responses to human disturbance. Journal of Applied Ecology 42 (5) 943-953, October 2005	Reviewed existing literature on species' disturbance responses in the context of anti-predator behavior.	Review	Research article	General recreation activities	Examined avian alert and response distances for 150 species; larger birds showed more alertness and response to disturbance than did smaller birds	Disturbance, alert distance, response, body size, anti-predator behavior
Blumstein, DT Anthony, LL Harcourt, R Ross, G	Testing a key assumption of wildlife buffer zones: is flight initiation distance a species-specific trait? Biological Conservation 110(1) 97-100 March 2003	Examines the distance at which animals flee an approaching intruder.	Empirical	Research article	Non-consumptive recreation	Discovered that both species and site influenced the FID behaviors of eight species of shorebirds when approached by a human intruder. Wildlife managers must view FID as a species specific trait which requires more conservative than liberal choices of buffer or set-back zones.	Flight initiation distance, buffer zones, human activity, human impact, set-back distances
Bolduc, F Guillemette, M	Human disturbance and nesting success of Common Eiders: interactions between visitors and gulls. Biological Conservation 110(1) 77-83 March 2003	Investigates the effects of frequency and timing of human disturbance on Common Eider colonies.	Empirical	Research Article	Non-consumptive recreation	Human disturbance did significantly alter eider nesting success probability. While frequency of visits was not significant, timing of intrusion was a major detrimental influence. Researchers and recreationists should visit eider colonies as late as possible to reduce increase in egg predation in colony.	Human impact, man-induced effects, reproduction, bird eggs, aquatic birds
Bouton, SN Frederick, PC	Stakeholders' perceptions of a wading bird colony as a community resource in the Brazilian Pantanal. Conservation Biology 17(1) 297-306 February 2003	Analyzes the impact of tourism on large breeding colonies of ciconiiform wading birds.	Stakeholder analysis with questionnaires and interviews	Research article	Non-consumptive recreation	Found a strong conservation ethic among stakeholders and an awareness of the negative consequences of human disturbance. An economic incentive for conservation outweighed the importance of consumption of bird eggs and chicks.	Human disturbance, national parks management, social carrying-capacity
Boyle, SA Samson, FR	Effects of nonconsumptive recreation on wildlife: a review. Wildlife Society Bulletin 13: 110-116, 1985	Review and synthesize literature on the effects of nonconsumptive recreation.	Review	Research paper	Non-consumptive recreation	"Light" uses of recreational areas (e.g., hiking, camping) are less detrimental to wildlife than "heavy" uses, such as off-road vehicle use. However, light uses are also disruptive to some degree	Recreation, disturbance, nonconsumptive use, wildlife response
Brown, KM Morris, RD	The influence of investigator disturbance on the breeding success of Ring-Billed Gulls (<i>Larus delawarensis</i>). Colonial Waterbirds 17(1) 7-17 1994	Effects of investigator disturbance on the breeding success of individual pairs of Ring-Billed Gulls.	Empirical	Research article	Non-consumptive recreation	Plots were subjected to various levels of investigator disturbance. Disturbances before and during the egg-laying phase had no effect on hatching success. Visits during brooding period apparently had no negative effect as chicks had an abundance of cover to crouch under during disturbances.	Human disturbance, gull colonies, investigator disturbance
Burger, J Jeitner, C Clark, K Niles, LJ	The effect of human activities on migrant shorebirds: successful adaptive management. Environmental Conservation 31(4) 283-288 December 2004	Use 20 years of data from 1982-2002 to examine trends in human disruptions and shore bird behavior over time.	Empirical	Research article	Non-consumptive recreation	Disturbance durations of over 10 min were common in the 1980's when birdwatchers concentrated on easy to walk pathways with no restrictions. By 2002, after viewing platforms were built to contain ecotourists, only one birdwatcher disturbed the birds in 2002. Education was also vital to encourage local residents not to walk dogs or fish along these beaches during spring migration.	Conservation, habitat use, abundance, human disturbance

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Burger, J Gochfeld, M	Effect of human presence on foraging behavior of Sandhill Cranes (<i>Grus canadensis</i>) in Nebraska. Bird Behavior 14 (2) 81-87 2001	Examined the potential for bird-human encounters and disturbance that could negatively affect cranes while at this critical stopover site.	Empirical	Research article	Non-consumptive recreation	Number of cranes feeding and watching vehicles were directly correlated to how close the vehicles got to each flock. When more than 300 m from the road, there was no response. Over this six-week stopover, cranes might deplete the habitat far from the road first, then be more subject to human disturbance when required to forage near roads.	Foraging behavior, human impact, man-induced effects, migratory species, <i>Grus Canadensis</i> , behavioral responses
Burger, J Gochfeld, M	Effects of ecotourists on bird behaviour at Loxahatchee National Wildlife Refuge, Florida. Environmental Conservation 25 (1) 13-21 March 1998	Responses of five species of waterbirds were observed while people were present or absent.	Observation	Research article	Non-consumptive recreation	Variation in feeding behavior was largely explained by whether people were present, how many people were present, and the amount of noise made by people. Percentage of time spent foraging and number of pecking strikes were inversely related to the noise by the people. Birds close to paths flushed more often than birds that were farther away. Birds usually swam or flew away from the path while people were present.	Human disturbance, bird-watchers, ecotourists
Burger, J Gochfeld, M Niles, LJ	Ecotourism and birds in coastal New Jersey contrasting responses of birds, tourists, and managers. Environmental Conservation 22(1) 56-65 Spring 1995	Looks at several ways that ecotourists affect behavior, reproductive success, and population levels of breeding and migratory birds in New Jersey.	Empirical	Research article	Non-consumptive recreation	Ecotourists created lower nesting rates and lower reproductive success in Least Tern colonies than other types of human disturbance. Swimming was found to be less intrusive to vital nesting habitat.	Nest site selection, human disturbance, gulls, behavior, swimming
Burger, J	The effect of human disturbance on foraging behavior and habitat use in Piping Plover (<i>Charadrius melodus</i>). Estuaries 17 (3) 695-701 September 1994	Habitat use of Piping Plovers on beaches with either lots of human competition or very little human competition.	Empirical	Research article	General recreation activities	In habitats with few people, plovers can spend 90% of their time foraging. On beaches with many people, only 50% of their time is spent foraging. Vigilance time is directly related to number of people near them. Diversity of habitats allows birds to move between high and low disturbed habitats to ensure successful foraging.	Human impact, aquatic birds, conservation, human disturbance
Burger, J Gochfeld, M	Tourism and short-term behavioral responses of nesting Masked, Red-Footed Boobies in the Galapagos. Environmental Conservation 20 (3) 255-259, 1993	Examines the impact of human-seabird interactions involving ecotourists walking by.	Empirical	Research article	Non-consumptive recreation	Whether boobies walked, flew or remained on their station was dependant on the distance from the trail. If only up to 2 m from trail, they walked or flew between 62-95% of the time. All the boobies performed more calls, body turns and head throws after tourists passed by than before. All boobies avoided nesting right along the trail despite similarities in nesting substrate.	Human disturbance, reproductive success, conservation, islands
Burger, J	Shorebird squeeze. Natural History 102 (5) 8-12 May 1993	Examines how the extensive development of beaches has caused a precipitous decline of many beach-nesting species.	Review	Research article	Habitat change due to urbanization	Study of how some beach-nesters such as skimmers, gulls and terns can cope with people better than other beach-nesters. Looks into if birds have any strategies that allow them to co-exist with people, find enough food to fuel their migration and to raise healthy young. Examples of such strategies include foraging at night to compensate for daytime disruptions.	Beaches, population biology, human disturbance, human activity, endangered species, piping plovers, skimmers, terns and bird behavior
Burger, J Gochfeld, M	Human activity influence and diurnal and nocturnal foraging of Sanderlings (<i>Calidris alba</i>). Condor 93 (2) 259-265 May 1991	Foraging behavior of sanderlings (<i>Calidris alba</i>) was studied in the winters of 1986, 1988 and 1990 to determine if the presence of people influenced foraging behavior.	Empirical	Research article	Non-consumptive recreation	Numbers of people within 10 m of foraging Sanderlings during the day did not increase from 1986 to 1990. But the number of people within 100 m rose dramatically and foraging time per minute also decreased between 1986 and 1990. During the night, time devoted to avoiding people was less than during the day or dawn or dusk. But Sanderlings continued to forage even at night.	Sanderling, Shorebirds, nocturnal foraging, human disturbance

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Burger, J Gochfeld, M	Human distance and birds – tolerance and response distances of resident and migrant species in India. Environmental Conservation 18 (2) 158-165 Summer 1991	This study measures the distance to which birds will allow a person to approach them before flying off (flush distance).	Empirical	Research article	Non-consumptive recreation	Over 18% of the variance of resident birds in flush distance was accounted for by the number of people situated within 50 m, the distance to the closest person, the time of day and the birds body length including tail. Over 43% of the variance of migratory birds was accounted for by distance to closest person, time of day, number of people within 50 m and number of people approaching. Migratory species were less tolerant of people.	Human disturbance, gulls, flocking, vigilance, shorebirds, success
Burger, J	Foraging behavior and the effect of human disturbance on the Piping Plover (<i>Charadrius melodus</i>). Journal of Coastal Research 7 (1) 39-52 Winter 1991	Foraging behavior in the presence or absence of human disruption was analyzed between 1985-1986.	Empirical	Research article	Non-consumptive recreation	Variations in vigilance were explained by beach, reproductive stage, brood size, time of day and number of people nearby. Plovers at sites less disturbed by people generally devoted more time to foraging and less time to vigilance. As the number of people increased, time devoted to running and crouching increased and time devoted to feeding decreased. The presence of people is stressful for both breeding adults and chicks.	Shorebirds, habitat destruction, defense, coastal nesting species, endangered species, human disturbance
Burger, J	Effects of demolition and beach clean-up operations on birds on a coastal mudflat in New Jersey Estuarine. Coastal and Shelf Science 27 (1) 95-108 1988.	Investigated the effects of demolition, clean-up on resident and migrant birds on a coastal mudflat in New Jersey.	Empirical	Research article	Habitat change due to urbanization	Foraging efficiency was significantly impacted when work began and did not return to previous levels until 60-90 minutes.	Human impact, marine birds, population number, anthropogenic factors, coastal engineering, coastal environments
Burger, J	The effect of human activity on shorebirds in two coastal bays in northeastern United States. Environmental Conservation 13 (2) 123 1986	Effects of human activities on migrating shorebirds were examined during late April to late October 1982.	Empirical	Research article	General recreation activities	People walking accounted for 43% (Raritan Bay) and 50% (Delaware Bay) of the disturbances. Only eight species accounted for 95% of the total population in Raritan Bay.	Man-induced effects, aquatic birds, migratory birds, human impact, population levels, human disturbance
Burger, J Gochfeld, M	Behavioral responses to human intruders of Herring Gulls <i>Larus Argentatus</i> and Great Black-backed Gulls <i>Larus Marinus</i> with varying exposure to human disturbance. Behavioural Processes 8 (4) 327-344 1983	Differences of responses to humans approaching nests of incubating gulls were examined.	Empirical	Research article	Non-consumptive recreation	Gulls nesting in frequently disturbed areas sat more tenaciously, responded more slowly and returned to the nest more quickly following the intruder's retreat, than birds nesting in less disturbed areas. Stage of incubation had little effect. Herring g/Gulls did return to the nest more quickly in late incubation period. Weather variables affected responses of great backed gulls.	Human disturbance, breeding behavior, reproductive biology, animal behavior
Burger, J	The effect of human activity on birds at a coastal bay. Biological Conservation 21 (3) 231-241 1981	Examines direct and indirect effects of human activity on birds at a coastal bay.	Empirical	Research article	Non-consumptive recreation	Birds were present 72% of the time that people were absent. Birds were present only 17% of the time that people were present. When rapid human movement was involved such as jogging or lawn mowing or close proximity, birds usually flushed.	Flushing, aquatic birds, human impact
Burger, J	Least Tern Populations in Coastal New Jersey USA: Monitoring and Management of a regionally endangered species. Journal of Coastal Research 5(4) 801-811 1980	Ten year study of the effects of habitat loss from increased predation, increased human disturbance and increased human population. Discusses methods to protect colonies and improve reproductive success rates.	Empirical	Research article	Non-consumptive recreation	Found that a program of monitoring, protection from predators and people, manipulating vegetation, and actively attracting terns with decoys has improved reproductive success over the ten-year study.	Human disturbance, reproductive success, Least Terns, human population, resource management, conservation management

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Burton, NHK	Landscape approaches to studying the effects of disturbance on waterbirds Ibis 149 (Supp. 1) 95-101, 2007	Reviews case studies in which several disturbance factors, including land use, help predict changes in bird populations	Review	Research article	Non-consumptive recreation, habitat change due to urbanization	Assessment of changes in bird populations due to disturbance must take into account, preferably via experimentation, landscape-level factors (such as food supply, habitat quality, etc.) that will alter outcomes.	Human disturbance, landscape-level assessment, populations, distribution
Carney, KM Sydeman, WJ	A review of human disturbance effects on nesting colonial waterbirds. Waterbirds 22 (1) 68-79 1999	Review of 64 studies that investigate effects of human disturbance on nesting colonial waterbirds.	Review	Research article	Non-consumptive recreation	Articles are summarized and reviewed. Most studies found significant negative effects but mitigation was found to minimize impacts for some species. Guidelines for minimizing investigator and ecotourist impacts are discussed.	Birdwatching, human disturbance, water birds, water sports, buffer zones
Clark, KL Euler, D Armstrong, E	Predicting avian community response to lakeshore cottage development. Journal of Wildlife Management 48 (4) 1239-1247 1984	Breeding songbird species were studied in both developed and undeveloped lake shore habitats in central Ontario.	Empirical	Research article	Habitat change due to urbanization	Disturbed ground vegetation layer was significantly correlated with a number of avian variables. Avian species were found in one of 3 groups including only undeveloped habitats, only highly developed habitats and both habitats. Information is presented for managing lake shore for human recreational development with significant loss of wildlife values.	Human-wildlife interaction, human recreation, human disturbance, human disruption, tolerance, bird behavior
Cooke, AS	Observations on how close certain passerine species will tolerate an approaching human in rural and suburban areas. Biological Conservation 18 (2): 85-88 1980	Information was obtained on how close passerines tolerate an approaching human before flying away.	Empirical	Research article	Non-consumptive recreation	Species tended to be significantly more approachable in suburban areas than rural areas. There was also a significant association between degree of tolerance and size, with small birds, such as tits (Paridae), allowing a closer approach than larger species, such as corvids.	Human activities, Human disturbance, bird behavior, foraging behavior, tolerance, body mass, comparative behavior, suburban and rural.
Datta, T Pal, BC	The effect of human interference on the nesting of the Openbill Stork <i>Anastomus oscitans</i> at the Raiganj Wildlife Sanctuary. India Biological Conservation 64 (2) 149-154 1993	Identify which human activities at the sanctuary created the highest disturbance. Followed Openbill Stork responses to these intrusions.	Empirical	Research article	Non-consumptive recreation	Human activity varied as the sanctuary has different levels of protection. Direct human interference severely hampered nesting success but the openbill stork also demonstrated considerable tolerance to subtle disturbances. Even if it is not their preferred nesting substrate, birds chose to nest in the undisturbed zone or higher in the undisturbed zone.	Human disturbance, reproductive success
DeMauro, MM	Colonial nesting bird responses to visitor use at Lake Renwick Heron Rookery. Illinois Natural Areas Journal 13 (1) 4-9. 1993	Bird responses to a new public viewing area with observation station were analyzed.	Empirical	Research article	Non-consumptive recreation	Monitored bird responses to visitor activities for 33 hours on Saturdays. Any visible bird responses from either on or off-site were tabulated. Nesting behavior showed no overt responses to any visitor activities.	Visitor impact, aquatic, nesting, wildlife management, disturbance behavior, response, human impact
Dhindsa, MS Boad, DA	Influence of age on the flushing distance of marked and unmarked Black-billed Magpies. Ornis Scandinavica 20(1): 76-79 1989	Effect of the age of the magpie on flushing distance from an approaching human intruder.	Empirical	Research article	Non-consumptive recreation	Juvenile magpies tolerated closer approach than adults. Between the ages of 1 and 5 months, distances at which they flushed from human intruder increased significantly. Among adults, the flushing distance increased steadily up to the age of 3 yr. After that, flush distances were constant.	Escape behavior, learning, human intruder, human disturbance
Erwin, RM	Responses to human intruders by birds nesting in colonies: experimental results and management guidelines. Colonial Waterbirds 12 (1) 104-108 1989	Flushing distances to human intrusion were studied in wading and seabirds in Virginia and North Carolina.	Empirical	Research article	Non-consumptive recreation	Mixed colonies of cormorant and Black Skimmers responded at greatest distances. Disturbance distances in this study were much greater than the guidelines set in a 1976 National Park Service report. Greater buffer zones should also be implemented as these birds become more and more established at a site.	Conservation, wildlife management, outdoor recreation, environmental protection

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Fernandez, C Azkona, P	Human disturbance affects parental care of marsh harriers and nutritional-status of nestlings. Journal of Wildlife Management 57 (3) 602-608 July 1993	Subtle human intrusions were studied in Marsh harriers at Dos Reinos Lake. Changes in reproductive activities and nutritional condition of chicks were analyzed.	Empirical	Research article	Non-consumptive recreation	Even with low level disturbances, number of food items delivered and time spent by parents in the nesting area diminished. Stress-induced behaviors such as alarm calling, chasing and flying time all increased. Although annual productivity was not significantly effected, stressed nestlings exhibited different blood chemistry than nonstressed nestlings.	Blood-chemistry values, behavioral responses, Buteo, human disturbance
Fernandez-Juricic, E Sallent, A Sanz, R Rodriguez-Prieto, I	Testing the risk-disturbance hypothesis in a fragmented landscape: Nonlinear responses of House Sparrows to humans. Condor 105 (2) 316-326 May 2003	House Sparrows (<i>Passer domesticus</i>) were used to assess responses to different levels of human visitation in a fragmented urban landscape.	Empirical	Research article	Non-consumptive recreation , urbanization and associated recreation	In this study, consumption rates were actually higher with the artificial food within the fragments. Breeding densities peaked with intermediate pedestrian rates. Consumption rates did decrease at high pedestrian rates due to reduction in foraging time due to vigilance. Sparrows balance the direct or indirect benefits from human presence with appropriate vigilance and avoidance.	Behavior, species distributions, breeding success, human intrusion, human impact, gradients, human-wildlife interactions
Fernandez-Juricic, E	Can human disturbance promote nestedness? A case study with breeding birds in urban habitat fragments. Oecologia 131 (2) 269- 278 April 2002	Nestedness is created by a combination of factors such as area, isolation, habitat structure etc. This study analyzes if human disturbance skews the natural nestedness patterns in bird species composition.	Empirical	Research article	Non-consumptive recreation	At the community level, the distribution of nesting patterns was significantly effected by pedestrian rate, fragment and the diversity of substrate stems. Pedestrian rate was directly associated with 41% of the species nestedness to certain areas. Human disturbance can be as influential as habitat diversity in nesting behavior.	Species subsets, forest fragmentation, woodland fragments, patterns, diversity, human disturbance
Fernandez-Juricic, E Jimenez, MD Lucas, E	Alert distance as an alternative measure of bird tolerance to human disturbance: implications for park design. Environmental Conservation 28 (3) 263-269 September 2001	Alert distances to human approach were studied to apply as tolerance indicators of each species to human intervention.	Empirical	Research article	Non-consumptive recreation	Alert distances have been frequently used with waterbirds. This study utilizes it for other bird species at a pedestrian trail in a woody suburban landscape in Spain. Bird tolerance was greater with greater cover availability. Large species were less tolerant than small species. Alert distance may be applied to allow people to enjoy park areas while birds use foraging/breeding patches without being displaced.	Group size, human intrusion, waterbirds, vigilance, behavior, refuge
Fernandez-Juricic, E	Local and regional effects of pedestrians on forest birds in a fragmented landscape. Condor 102 (2) 247-255 May 2000	Examined the effects of pedestrians on the distribution of forest bird species in wooded parks in Madrid.	Empirical	Research article	Non-consumptive recreation	Within woodland fragments, increasing levels of pedestrians reduced species richness and overall abundance within circular plots. At the species level, increased pedestrians reduced the probability of occupation in 16 of the species studied. Locally, these short-term behavioral responses may reduce breeding densities, probability of occupation and persistence in staying in a breeding area.	Human disturbance, consequences, tolerance, persistence, populations, selection, distances
Fernandez-Juricic E Telleria JL	Effects of human disturbance on spatial and temporal feeding patterns of <i>Turdus merula</i> in urban parks in Madrid, Spain. Bird Study 47 13-21 Part 1 March 2000	Investigates how human presence in three urban parks might effect blackbird densities by changing feeding behavior patterns.	Empirical	Research article	Non-consumptive recreation	Pedestrians were the main source of flushing responses in all parks. Blackbird responses to visitors entailed being more vigilant and moving away from people rather than spending time searching for food. Numbers of active birds decreased with increasing pedestrians. Increasing numbers of pedestrians created larger distances from birds to trails.	Predation, distances, quality, risk, human disturbance
Finney, SK Pearce-Higgins, JW Yalden, DW	The effect of recreational disturbance on an upland breeding bird, the Golden Plover (<i>Pluvialis apricaria</i>). Biological Conservation 121 (1) 53-63 January 2005	Examine the response of Golden Plovers to recreational disturbance along a busy footpath in the United Kingdom.	Empirical	Research article	Non-consumptive recreation	After the Pennine Way, a busy footpath, was resurfaced, pedestrians were observed. Before resurfacing, 30% of participants strayed from the footpath and movement was widespread and unpredictable. After resurfacing, 96% of participants stayed on the designated trail. Impacts to Golden Plover were significantly reduced as plovers needed to avoid areas only 50 m from the footpath instead of 200 m before the resurfacing.	Recreationists, human impact, human disturbance, upland breeding birds, conservation, recreation

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Fitzpatrick, S Bouchez, B	Effects of recreational disturbance on the foraging behavior of waders on a rocky beach. Bird Study 45 pt 2 157-171 July 1998	Comparison study of oystercatcher, curlew and Redshank responses to undisturbed versus disturbed areas.	Empirical	Research article	Non-consumptive recreation	These wading birds delayed arrival and departed earlier with disturbed by human contact. Their scan rates (vigilance) increased with human activity. Prey capture rates increased with moderately close human disturbance but undisturbed birds may not have been foraging at maximum rates either. Avoidance behavior differed between species. Habituation may create an important response to regular intrusions.	Food intake, vigilance, predation, recreation, human disturbance
Flemming, SP Chiasson, RD Smith, PC Austin-Smith, PJ Bancroft, RP	Piping plover status in Nova Scotia related to its reproductive and behavioral responses to human disturbance. Journal of Field Ornithology 59 (4) 321-330 1988	Censuses and behavioral observations were made to assess species status and response to human disruption.	Empirical	Research article	Non-consumptive recreation	Populations declined as human contact increased. As disturbance increased, mating birds went from 54-48 pairs. Fewer chicks survived to 17 days. Disturbed chicks exhibited both decreased feeding and brooding. They also exhibited increased vigilance. Feeding rate for chicks was reduced in disturbed areas. Chick mortality was higher and contributed to a trend for declining plovers in Nova Scotia.	Juveniles, man-induced effects, populations, human impact, feeding behavior
Fletcher Jr., RJ McKinney, WT Bock, CE	Effects of recreational trails on wintering diurnal raptors along riparian corridors in a Colorado grassland. Journal of Raptor Research 33(3) 233-239, 1999	Assessed raptor diversity and abundance at grassland/riparian areas with and without recreational trails	Empirical	Research article	Non-consumptive recreation	Overall raptor species diversity and abundance was greater at sites without trails. Bald Eagle abundance was greater at sites without trails, while Red-tailed Hawks showed similar abundance at sites with and without trails. Perching distances across species was greater at sites with trails.	Recreation, site selection, abundance, diversity
Foppen, R Reijnen, R	The effects of car traffic on breeding bird populations in woodland .2. Breeding dispersal of male Willow Wrbles (<i>Phylloscopus trochilus</i>) in relation to the proximity of a highway. Journal of Applied Ecology 31 (1) 95-101 February 1994	Dispersal activities of male willow warblers who inhabited woodland next to a busy highway were analyzed.	Empirical	Research article	Traffic	Breeding dispersal distances of yearling males were larger than those males that were farther from the highway. Breeding dispersal was significantly directed away from the road. Yearlings close to the highway moved more frequently than others. During dispersal, unsuccessful males moved more frequently and further (294 m) than successful males (120 m).	Breeding success, natal dispersal, source-sink, disturbance, site fidelity, tenacity, nesting success
Forman, RTT Reineking, B Hersperger, AM	Road traffic and nearby grassland bird patterns in a suburbanizing landscape. Environmental Management 29 (6) 782-800 June 2002	Evaluates the impact of increasing traffic in a suburban/rural landscape on nearby grassland bird patterns.	Empirical	Research article	Traffic	Bird presence did significantly correlate with both distance from road and habitat patch size. Distance to nearest other open patch was not significant. Except for one species, adjacent land use, was not significant. While light and moderate traffic volumes were not significant, high traffic volumes decreased both bird presence and breeding for 700 m.	Road, traffic, human disturbance, nesting success
Francel, KE Schnell, GD	Relationships of human disturbance, bird communities, and plant communities along the land-water interface of a large reservoir. Environmental Monitoring and Assessment 73 (1) 67-93 2002	Investigated the relationships of human activity, bird communities and plant communities around the land-water interface of Lake Texoma.	Empirical	Research article	Non-consumptive recreation	Quantitative analysis found that most bird and plant measures were highly correlated with the disturbance variable. Birds and human disturbance were more highly correlated than plants and human disturbance. Bird species composition was more regulated by human activity than plant community composition.	Human disturbance, correspondence analysis, principle components analysis
Frederick, PC Collopy, MW	Researcher disturbance in colonies of wading birds: effects of frequent visit and egg-marking on reproductive parameters. Colonial Waterbirds 12 (2) 152-157 1989.	Two closely matched Tricolored Heron (<i>Egretta tricolor</i>) colonies were compared between frequency of human visitation.	Empirical	Research article	Non-consumptive recreation	Limited colony visitations (<16) visits) did not significantly effect reproductive parameters of these colonies. These visits began after courtship and discontinued after laying. Authors do caution that results might be affected by the lack of ground predators in these colonies. Results could also be affected by incorrect egg marking technique used in the study.	Human impact, aquatic birds, avoidance reactions, disturbance, bird eggs

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Frid, A Dill, L	Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6 (1) Art. No. 11 June 2002i	Discusses the role of human disturbance both directly and indirectly to bird fitness and population dynamics.	Commentary	Research article	General recreation activities	Predation and/or nonlethal disturbance stimuli directly influence fitness enhancing activities such as feeding, parental care and mating. Authors purport that these disturbances can indirectly influence such variables as population dynamics, energy expenditure, lost opportunities due to risk avoidance behavior. Human disturbance needs to be highly considered when mitigating and regulating human activities in wildlife areas.	Flight initiation distance, habitat selection, disturbance, predation, population dynamics
Gill, JA	Approaches to measuring the effects of human disturbance on birds. Ibis 149 (Supp. 1) 9-14	Describes and critiques comparative and experimental approaches to determining the effects of recreation on birds	Review	Research article	General recreation activities	Examples of approaches to studying human recreational disturbance to birds	Human disturbance, methods/approaches to measuring disturbance
Gloutney, ML Clark, RG Afton, AD Huff, GJ	Timing of nest searches for upland nesting waterfowl. Journal of Wildlife Management 57 (3) 597-601	Nest searching data was analyzed to determine the proper time to search for active nests yet minimize nest abandonment.	Empirical	Research article	Non-consumptive recreation	Forty-four duck nests were monitored. Females of most species attended nests from 0800-1400 central standard time. Nest searches for upland nesting waterfowl should be initiated after 0800 and terminated by 1400. Three hours after sunrise. Searching for nests at these times should minimize the chances of finding nests early in laying when the probability of inducing nest abandonment is greatest.	Incubation, human disturbance, nest abandonment
Gotmark, F Ahlund, M	Do field observers attract nest predators and influence nesting success of Common Eiders <i>Somateria somateria mollissima</i> ? Journal of Wildlife Management 48 (2) 381-387 1984	Incubating Common Eiders were flushed to test whether avian predators were attracted to disturbed nest sites.	Empirical	Research article	Non-consumptive recreation	Although many nests were exposed after disturbance, crows did not increase their predation success rate. Gulls did increase their predation success rate. Although more depredations were observed after disturbance than before, clutch size and frequency of robbed nests did not differ between experimental and control plots.	Human disturbance, Common Eiders, reproductive success, conservation management, natural resources management, Sweden, behavioral biology
Grubb, TG King, RM	Assessing human disturbance of breeding Bald Eagles with classification tree models. Journal of Wildlife Management 55 (3) 500-511	Human activities in the vicinity of 13 Bald Eagle nesting sites analyzed. Pedestrian, aquatic, vehicle, noise, and aircraft were all compared with eagle behavior responses.	Empirical	Research article	General recreation activities	Bald Eagles were more often flushed from perches than nests and were most easily disturbed when foraging. Pedestrians were the most disturbing activity and aircraft was the least.	Responses, human disturbance, human activity
Grubb, TG Bowerman, WW Giesy, JP Dawson, GA	Responses of breeding Bald Eagles, <i>Haliaeetus leucocephalis</i> , to human activities in northcentral Michigan. Canadian Field Naturalist 106 (4) 443-453 October-December 1992	Analyzed eagle behavior responses to potentially disturbing activities such as vehicles, pedestrians, aircraft and aquatic activities.	Empirical	Research article	General recreation activities	75% of all alert and flight responses were precipitated by activities within 500 m and 200m. Adults responded more frequently than nestlings and at greater distances to the disturbance. More significant behavioral response when perched rather than brooding the nest. Most human disruption occurred on weekends (60%) and after 1200 (72%). Vehicles and pedestrians elicited the highest response frequencies.	Human disturbance, management, behavior, breeding behavior, human activity
Gutzwiller, KJ Riffell, SK Anderson, SH	Repeated human intrusion and the potential for nest predation by gray jays. Journal of Wildlife Management 66 (2) 372-380 April 2002	Human activity near nests is known to cause nest abandonment or nest failure in some species. Wildlife scientists are still investigating whether repeated human intrusion increases probability of nest predation.	Empirical	Research article	General recreation activities	Gray Jays are known to approach recreationists. There were significantly more Gray Jays on intruded sites than control sites. Levels of human intrusion do impact the presence of other potential nest predators. More work is necessary to see if increased Gray Jays do increase probability of nest predation. Intrusion induced attraction of predators must be considered when determining levels of recreational activity in wildlands.	Human intrusion, predation, recreationists, ecotourists, gray jays, human disturbance, investigator disturbance

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Gutzwiller, KJ Anderson, SH	Spatial extent of human-intrusion effects on subalpine bird distributions. Condor 101 378-389 1999	Bird abundances in a subalpine forest in Wyoming were analyzed when human intrusion was present.	Empirical	Research article	Non-consumptive recreation	Intrusions did not displace birds during most years of the study. Moderate and large abundance changes were readily detectable but small abundance changes were more difficult to assess. Knowledge of the distance at which low levels of intrusion do and do not alter bird distributions is essential for protecting intrusion-sensitive species.	Richness, abundance, human intrusion, human activity, forest, counts, populations
Gutzwiller, KJ Clements, KL Marcum, HA Wilkins, CA Anderson, SH	Vertical distributions of breeding season birds: is human intrusion influential? Wilson Bulletin 110(4) 497-503 1998	Intrusion-induced changes in vertical distributions were studied in a Wyoming subalpine forest. Intrusion could reduce access to forest strata, increase interspecific competition, heighten energetic expenditures, and reduce nesting success.	Empirical	Research article	Non-consumptive recreation	Intrusion by one person for 1-2 hours/week is similar in intensity to intrusion by hikers. We found little evidence that intrusion altered vertical distributions of four passerines that nest, forage, sing and seek refuge in subalpine forest. These results could indicate that some species are able to tolerate low levels of intrusion. More studies of other species are necessary to define the range of intrusion intensity of other subalpine forest species.	Nesting success, human disturbance, habitat quality, vocalization
Gutzwiller, KJ Marcum, HA Harvey, HB, Roth, JD, Anderson, SH	Bird tolerance to human intrusion in Wyoming montane forests. Condor 100 (3) 519-527 August 1998	Passerine responses to human intrusion during the breeding season were studied in a Wyoming montane forest.	Empirical	Research article	Non-consumptive recreation	Detectability period was significantly shorter and intrusion tolerance was lower when fewer conspecifics were nearby. Approach distance was significantly longer and intrusion tolerance was lower for more conspicuous species and for species that are active closer to the ground. Intrusion-induced behaviors such as nest abandonment and decreased nest attentiveness vary by each species. With knowledge of factors that influence species tolerance, the risk of disturbing birds that are sensitive to intrusion can be reduced.	Bird disturbance, human intrusion, intrusion tolerance, montane forest, Wyoming
Gutzwiller, KJ Kroese, EA Anderson, SH Wilkins, CA	Does human intrusion alter the seasonal timing of avian song during breeding periods? Auk 114 (1) 55-65 January 1997	Seasonal timing of male song during breeding when human intrusion is a factor.	Empirical	Research article	Non-consumptive recreation	Human intrusion has the potential to influence avian singing behavior. Intruder walked through habitats 5 hours each week for 10 weeks. Singing activity was not significantly different between control and experimental sites. Only moderate to large differences in singing timing were detectable in this study. Intrusion-induced effects often are context-specific and can vary between individuals and species so further investigation is needed.	Populations, behavior, success, wintering, human intrusion, human impact, human disturbance
Gutzwiller, KJ Wiedenmann, RT Clements, KL Anderson, SH	Effects of human intrusion on song occurrence and singing consistency in sub-alpine birds. Auk 111 (1) 28-37 January 1994	Experiments were conducted on 30 1.0 ha sites to assess whether human intrusions during a 10 week period influenced the occurrence and consistency of primary song in breeding subalpine birds.	Empirical	Research article	Non-consumptive recreation	Weekly visits to each site determined that most species were not influenced by intrusion. Song occurrence and singing consistency was higher on control sites than intruded sites for several other species. Because song is essential in territory defense, mate acquisition, and other reproductive activities, levels of intrusion have the potential to effect reproductive fitness of males that are sensitive to this form of disturbance.	Human disturbance, breeding success, mating, increase, avian nest defense, vocalization
Griffiths, M Van Schaik, CP	The impact of human traffic on the abundance and activity periods of Sumatran rain-forest wildlife. Conservation Biology 7 (3) 623-626 September 1993	Study to determine the impact of traffic patterns on the behavior of local avian species.	Empirical	Research article	Traffic	Determined that traffic patterns on the edge of breeding areas did significantly reduce the ability of breeding birds to successfully fledge their young.	Biodiversity conservation, ecology, environmental sciences

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Hand, JL	Human disturbance in Western Gull <i>Larus occidentalis</i> livens colonies and possible amplification by intraspecific predation. Biological Conservation 18 59-63 1980	Study of human disturbances at the Western Gull's breeding areas.	Empirical	Research article	Non-consumptive recreation	Study indicated that human intruders did amplify the occurrence of intraspecific predation.	Human disturbance, breeding biology, predation, nesting success, bird behavior
Havera, SP Boens, LR Georgi, MM Shealy, RT	Human disturbance of waterfowl on Keokuk pool, Mississippi River. Wildlife Society Bulletin 20 (3) 290-298 Fall 1992	Study of the effects of human disturbance on the waterfowl inhabiting the Keokuk pool on the Mississippi River.	Empirical	Research article	General recreation activities	Study found that human activities did effect some waterfowl species more deleteriously than other waterfowl species.	Human disturbance, recreation, waterfowl habitat, foraging behavior, breeding behavior, nesting success
Heil, L Fernandez-Juricic, E Renison, D Cingolani, A Blumstein, DT	Avian responses to tourism in the biogeographically isolated Cordoba Mountains, Argentina. Biodiversity and Conservation 16: 1009-1026, 2007	Assessed bird responses to recreation at three levels: community, guild, and population	Empirical	Research article	Non-consumptive recreation	Human presence decreased avian species diversity and reduced density of insectivorous birds. Six of 28 species (four of the six are of conservation concern) showed population decreases. The authors suggest that this area, which is high in endemism and degree of isolation, may not be suitable for increasing ecotourism.	Disturbance, recreation, isolation, population level response, diversity.
Holmes, TL Knight, RL Stegall, L Craig, GR	Responses of wintering grassland raptors to human disturbance. Wildlife Society Bulletin 21 (4) 461-468 Winter 1993	Study of the flush response of wintering grassland raptors to various kinds of human disturbances.	Empirical	Research article	Non-consumptive recreation	Analyzes the responses of wintering grassland raptors to various kinds of mild, moderate and severe human disturbances.	Human disturbance, flush distances, bird behavior, wintering behavior, grassland, raptors
Hulbert, IAR	The response of Ruddy Shelduck <i>Tadorna ferruginea</i> to tourist activities Royal Chitwan National Park of Nepal. Biological Conservation 52 (2) 113-123 1990	Study on the effect of tourist canoes on the distribution and daily activity of ruddy shelduck <i>Tadorna ferruginea</i> wintering on the River Rapti in Nepal.	Empirical	Research article	Non-consumptive recreation	Average length of time a bird was disturbed each day was 11 minutes. Canoes filled with tourists accounted for 26% of the total time disturbed on the downstream journey. On the upstream trip, tourists accounted for 76% of the total time disturbed as the boats had to be hauled back upstream. Suggest that disruptions could be reduced if they moved through in convoys.	Tourism, man-induced effects, aquatic birds, sanctuaries, spatial distribution
Humphrey, PS Livezey, BC Seigel-Causey, D	Tameness of birds of the Falkland Islands south Atlantic: An index and preliminary results. Bird Behavior 7 (2) 67-72 1987	Simple quantitative analysis of tameness in Falkland Island birds compared with their continental conspecifics.	Empirical	Research article	Non-consumptive recreation	Approach distance was measured with the Falkland Island birds compared with their continental conspecifics. Approach distance was correlated positively with body mass in both insular and continental birds but the relationship was more pronounced in the continental population. Possible selective advantages of these approachability patterns are discussed.	Human settlement, body mass, flock size, approachability, synanthropy, selective advantage, correlation analysis and geographic variation
Ikuta, LA Blumstein, DT	Do fences protect birds from human disturbance? Biological Conservation 112 (3) 447-452, 2003	Assesses disturbance to birds, as measured by flight distance, from visitors at a high visitation, low visitation and protected sites	Empirical	Research article	Non-consumptive recreation	Birds in areas with no human visitation reacted similarly to human presence compared with birds in low visitation areas, but significantly differently from birds at the high human visitation site.	Human disturbance, flight distance, protective barriers, visitation rates
Ingold, P Huber, B Neuhaus, P Mainini, B Marbacher, H Schnidrigpetrig, R Zeller, R	Tourism and sport in the Alps – A serious problem for wildlife. Revue Suisse de Zoologie 100 (3) 529-545 September 1993	Investigates to what extent increasing tourist and leisure activities are serious threats to ptarmigan in several areas of the Alps.	Empirical	Research article	General recreation activities	Ptarmigan heart-rates were measured when a person is approaching the nest. Decrease in heart rate frequency occurs when ptarmigan are disrupted by human intrusion.	Human activities, disturbance, approach, hikers, physiology

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Kenney, SP Knight, RL	Flight distances of Black-billed Magpies in different regimes of human density and persecution. Condor 94 (2) 545-547 1992	Study to determine what activities and distances provoked Black-billed Magpies to take flight.	Empirical	Research article	Non-consumptive recreation	Determined that the activity and distance from the Black-billed Magpies affected the flight responses seen in the study.	Persecution, flocking, nest-defense behavior, behavior responses, human disturbance
Kenow, KP Korschgen, CE Nissen, JM Elfessi, A Steinbach, R	A voluntary program to curtail boat disturbance to waterfowl during migration. Waterbirds 26 (1) 77-87	Effects of a voluntary waterfowl avoidance area to avian behavior responses were analyzed.	Empirical	Research article	General recreation activities	Boats intruded into the avoidance on 127 occasions. Rate of disturbance was significantly lower when compared to data that preceded the establishment of the program. Identified sensitive areas which were most likely to result in human intrusion and disturb waterfowl populations. Results enabled resource managers to target public education to make maximum use of the voluntary waterfowl avoidance area program.	Human impact, boating, man-induced effects, lakes, environmental management
Klein, ML Humphrey, SR Percival, HF	Effects of ecotourism on distribution of waterbirds in a wildlife refuge. Conservation Biology 9 (6) 1454-1465 December 1995	Assessed the extent of the effect of ecotourism on the distribution of 38 species of waterbirds.	Empirical	Research article	Non-consumptive recreation	Most resident species were less sensitive to disturbance than were migrants. Even at low levels of human intrusion, migrant ducks were most sensitive when they first arrived. Brown pelicans and anhingas were most likely to remain close to areas of high human activity. Shorebirds were displaced at intermediate distances and visitation levels. Public education can be used to create changes in management practices to reduce unnecessary disturbance.	Human disturbance, recreation, habitat, behavior responses
Klein, ML	Waterbird behavioral responses to human disturbances. Wildlife Society Bulletin 21 (1) 31-39 Spring 1993	Analyzes the response types and rates of waterbirds to nearby human activities.	Empirical	Research article	Non-consumptive recreation	Discerned that type and rate of waterbird responses were affected by both species and age. Some species did not react as drastically as other species. In general, mature birds were more apt to drastically react than immature birds.	Human disturbance, waterbird behavior, flushing distance, bird biology
Knight, RL Fitzner, RE	Human disturbance and nest site placement in Black-billed Magpies. Journal of Field Ornithology 56 (2) 155-157 1985	Active magpie nests were experimentally disturbed and then monitored during subsequent years.	Empirical	Research article	Non-consumptive recreation	Magpie nests in Russian olive trees tended to be at the same or higher height in the same plant. Magpie nests in willow trees tended to be either in the same site or in a different plant but no higher. Magpie nests in sagebrush bushes were almost always in different plants and resulted in fewer active nests each year. Russian olives had the greatest number of nest sites while sagebrush had the least.	Breeding sites, site selection, human impact, disturbance
Knight, RL	Responses of nesting ravens to people in areas of different human densities. Condor 86 (3) 345-346 1984	Measured the effects of adult Common Ravens to human intrusions of differing densities.	Empirical	Research article	Non-consumptive recreation	When humans are at a nest, Common Ravens leave immediately and remain at a distance. They can utilize a timid response of soar and call or an aggressive approach with diving and calling. Responses to human interference were measured between both a moderately populated agricultural area and sparsely populated rangeland area.	Avoidance behavior, aggressive behavior, human impact
Knight, RL Knight, SK	Responses of wintering Bald Eagles to boating activity. Journal of Wildlife Management 48 (3) 999-1004 1984	Investigates the effects of boating activity on wintering eagles.	Empirical	Research article	General recreation activities	Effects of eagle age, behavior, and eagle grouping to intruding canoeists are analyzed through flight distances and behavioral responses.	Activity patterns, disturbance, overwintering, boating, human activities
Lafferty, KD	Birds at a southern California beach: seasonality, habitat use and disturbance by human activity. Biodiversity and Conservation 10 (11) 1949-1962 November 2001	Bird abundance was analyzed with the presence of people and dogs at a Santa Barbara beach.	Empirical	Research article	Non-consumptive recreation	Crows and Western Gulls were attracted to areas with urban refuse. Interactions with people caused birds to move or fly away, particularly when people were within 20 m. More dogs disturbed birds (39%) than humans (10%). More than 70% of birds flew when disrupted. Most displacement was short in duration and did not alter large-scale patterns of beach use. Birds were less vigilant towards humans (but not dogs) when beach activity was low.	Human impact, recreation, man-induced effects, flight behavior, protective behavior, temporal variations

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Lafferty, KD	Disturbance to wintering western Snowy Plovers. <i>Biological Conservation</i> 101 (3) 315-325 October 2001	Nature of various disturbances to Snowy Plover populations were analyzed such as dogs, crows, humans and other birds.	Empirical	Research	Non-consumptive recreation	Disturbances on the public beach were 16 times more likely to flush the plovers than on protected beaches. Humans, dogs, crows and other birds were the main sources of disturbance. Each Snowy Plover was disturbed once every 27 minutes on the weekend and once every 43 minutes on the weekdays. Feeding rates declined with increased human activity. Plovers were less abundant at trailheads. Over short time scales, the plovers did not acclimate to or successfully find refuge from the disturbances.	Wildlife management, disturbance, feeding rate, human activity, public beach, wintering and behavior
Langston, RHW Liley, D Murison, G Woodfield, E Clarke, RT	What effects do walkers and dogs have on the distribution and productivity of breeding European Nightjars, <i>Caprimulgus europaeus</i> ? <i>Ibis</i> 149 (Supp. 1) 27-36, 2007	Determine the effects of proximate urban development and the associated increased disturbance to breeding European Nightjars by walkers and dogs	Empirical	Research	Habitat change due to urbanization and associated recreation	Failed nests were significantly closer to paths, closer to the main points of access to the heath habitat where nightjars bred, in areas with higher density of footpaths and higher levels of use, and in more sparsely vegetated locations. Recommendations include management practices that limit walkers and dogs in nightjar nesting areas.	Walkers, dogs, proximity to development, nesting success, productivity, footpaths, trails.
Leatherman, D	Crossbill attraction to salt: a Colorado episode. <i>Colorado Field Ornithologists Journal</i> 23 (3) Fall 102-103 1989	From March to May, crossbills of two species were attracted to the salt and grit over Cameron Pass in Larimer and Jackson Counties.	Observation	Newsletter	Traffic	High numbers of crossbills were struck and killed by vehicles using the roadway. Crossbills were attracted to the salt and grit that was put on the roadway by road crews.	Vehicles, human disturbance, salt, crossbills, mortality rates
Liley, D Sutherland, WJ	Predicting the population consequences of human disturbance for Ringed Plovers, <i>Charadrius hiaticula</i> : a game theory approach. <i>Ibis</i> 149 (Supp. 1) 82-94, 2007	Presentation of a population model predicting the effects of human visitation of a 9-km section of coastline on Ringed Plovers	Empirical	Research article	Non-consumptive recreation	Fencing of nesting areas to prevent human disturbance of Ringed Plovers would increase the population by 8%. Complete exclusion of human use of the 9-km section of coastline would cause an 85% increase in population.	Disturbance, population size, exclusion of humans
Lord, A Waas, JR Whittingham, MJ	Effects of human approaches to nests of northern New Zealand Dotterels. <i>Biological Conservation</i> 98 (2) 233-240 April 2001	Three types of human approach were tested to determine if disturbance may decrease nesting success including walking, running and leading a dog on a leash.	Empirical	Research article	Non-consumptive recreation	Distraction display intensity was not significantly correlated to approach type. Responses to walking and running did not differ significantly. Leading a dog caused the greatest disruption of incubation with these shorebirds. Human activity, particularly walking dogs, should be limited near nesting areas.	Human disturbance, behavioral responses, parental defense, shorebirds, nesting success
Lord, A Waas, JR Innes, J	Effects of human activity on the behaviour of northern New Zealand Dotterel <i>Charadrius obscurus aquilonius</i> chicks. <i>Biological Conservation</i> 82 (1) 15-20 October 1997	Examined how foraging and related behaviours of northern New Zealand Dotterel chicks were affected by human presence.	Empirical	Research article	Non-consumptive recreation	When people were present, chicks spent less of their feeding time in the littoral zone, and more in the supralittoral zone, and in general spent less time feeding when people were present. High levels of human disturbance in the littoral zone may infer energetic constraints on New Zealand Dotterel chicks. Fledging success of chicks may be increased if human access to feeding areas near to breeding sites are reduced during the chick-rearing phase of the breeding season.	Human disturbance, reproductive success, survival
Lukac, G Hrsak, V	Influence of visitor numbers on breeding birds in the Paklenica National Park, Croatia. <i>Ekologia-Bratislava</i> 24 (2) 186-199 2005	Impacts of visitors on the bird species community after the war in Croatia were investigated and compared to avian populations during the war when the park was closed.	Empirical	Research article	Non-consumptive recreation	More species were positively correlated with number of visitors than negatively correlated. Positively correlated species were Rock Dove, Chaffinch, House Martin, Blue Rock Thrush, Rock Nuthatch, Marsh Tit, Black Redstart, Sardinian Warbler, Short-toed eagle, wren, Grey Wagtail, Lesser Spotted Woodpecker, Golden Oriole, Blackcap. Negatively correlated species were Chiffchaff, Lesser Whitethroat, Eurasian Vulture, Rock Thrush, Long-Tailed Tit, Great Tit, Rock Bunting, Eagle Owl, Black-Eared Wheatear and Blackbird.	Human disturbance, visitor access, bird biology, population biology

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Mallord, JW Dolman, PM Brown, AF Sutherland, WJ	Linking recreational disturbance to population side in a ground-nesting passerine. Journal of Applied Ecology 44 (1) 185-195, February 2007	Assessed recreational disturbance to Woodlarks in heathland habitat; built model to determine the effects of disturbance over a broad range of situations	Empirical	Research article	Non-consumptive recreation	Woodlarks show a 17% reduction in productivity compared with that predicted in a completely undisturbed setting. The probability of suitable habitat being colonized by Woodlarks was reduced to <50% in areas where disturbance occurred 8 or more times per hour. However, there was no relationship between disturbance and daily nest survival rates.	Human disturbance, habitat use, colonization of disturbed areas, visitor-access levels
Melcher, C Giesen, K	Blue Grosbeaks: A Response to habitat changes and a late nesting record. Colorado Field Ornithologist Journal 30 (4) 158-160 1996	A 12 acre backyard was enhanced with a shelterbelt. New bird species were immediately attracted to the new vegetation.	Observation	Newsletter	Habitat change due to urbanization	During restoration, higher varieties of species occurred than before restoration. After the restoration, the variety of species declined slightly but stabilized. There is concern that the surrounding area around Ft Collins is experiencing intense development. Further observation needs to determine long-term fledgling success.	Human intervention, restoration, native plants, drought-tolerant, urbanization
Mendelssohn, H Yom-Tov, Y	A report of the birds and mammals which have increased their distribution and abundance in Israel due to human activity. Israel Journal of Zoology 45 (1) 35-47 1999	Determines the impact of human activity on certain bird communities in Israel.	Empirical	Research article	Habitat change due to urbanization	About 40 bird species have increased in number and/or distribution during the last 50 years in Israel. This is 20% of the breeding bird species and 10% of wintering species. Attributable to construction of fish ponds and water reservoirs, increased food availability either from garbage or agriculture. Thirteen of these bird species have become pests in part of their ranges and several introduced new species now have the potential to become nuisance species.	Human disturbance, man-induced effects, nuisance species, beneficial effects, detrimental effects
Miller, JR Wiens, JA Hobbs, NT Theobald, DM	Effects of human settlement on bird communities in lowland riparian areas of Colorado. Ecological Applications 13 (4) 1041-1059 August 2003	Investigated patterns of habitat use by birds at 16 lowland riparian sites representing a rural to urban gradient.	Empirical	Research article	Habitat change due to urbanization and associated recreation	As development increased, riparian woodlands tended to have fewer native trees and shrubs and cover. Bird species richness declined as urbanization increased. Migrant and low-nesting species were associated with lower-than average levels of development. Cavity-nesting and resident species increased with urbanization. Species that nested or foraged low for insects and seeds were also most sensitive to human trail use.	Avian guilds, bird communities, Colorado front range, habitat structure, recreational trails, riparian habitat, urbanization
Miller, JR Hobbs, NT	Recreational trails, human activity and nest predation in lowland riparian areas. Landscape and Urban Planning 50 (4) 227-236 August 30, 2000	Nest predator activity and nest predation was analyzed with the influence of recreational trails.	Empirical	Research article	Non-consumptive recreation	Artificial nests were constructed near a recreational trail and in an undisturbed area. Nests were baited with quail eggs. Predation rates were high everywhere (93%). There was a tendency for predation rates to increase with distance from trail. Mammals appeared to avoid nests near trails to some extent. Birds attacked more nests near trails than away from trails. Type of predator did predict depredation patterns.	Nest predation, artificial nests, habitat, predators
Miller, SG Knight, RL Miller, CK	Wildlife responses to pedestrians and dogs. Wildlife Society Bulletin 29 (1) 124-132 2001	Behavioral responses of two species of grassland songbirds were studied when either pedestrian, pedestrian accompanied by a dog or a dog alone.	Empirical	Research article	Non-consumptive recreation	For all species, area of influence, flush distance, distance moved was greater when activities occurred off- trail versus on-trail. For grassland species, the smallest area of influence and shortest flush distance was correlated with the dog alone. In the forest, the area of influence and flush distance did not significantly differ between pedestrian alone or pedestrian with dog. A dog alone created the greatest area of influence, alert and flush distance, and distance moved.	Wildlife management, land use, human impact, traffic, dogs
Miller, SG Knight, RL Miller, CK	Influence of recreational trails on breeding bird communities. Ecological Applications 8 (1) 162-169 February 1998	Influences of recreational trails on breeding bird communities in forest and mixed-grass prairie in Boulder, Colorado were examined.	Empirical	Research article	Non-consumptive recreation	Bird species composition was altered adjacent to trails in both ecosystems. Generalist species were more abundant near trails. Specialist species were less common. Birds were less likely to nest near trails in the grassland system. Nest predation in both systems was higher next to trails. These results might assist managers to determine policies regarding spatial arrangement of trails and trail use restrictions.	Nest predation, edge effects, nest parasitism, human disturbance, recreation, recreational trails

Author	Title of study	Purpose of Study	Data Collection Method	Publication Type	Disturbance Category	Important Findings	Keywords
Morse, JA Powell, AN Tetreau, MD	Productivity of Black Oystercatchers: effects of recreational disturbance in a national park Condor 108: 623-633, 2006	Studies effects of camping and walking on Black Oystercatchers in their stony-beach breeding habitat in Kenai Fjords National Park, Alaska	Empirical	Research article	Non-consumptive recreation	Black Oystercatcher breeding activities are not adversely affected by low levels of recreational use. The authors suggest that due to the increasing number of visitors to the Kenai Fjords National Park, managers move campsites away from oystercatcher breeding areas.	Recreation, camping, visitation levels, breeding habitat
Mullner, A Linsenmair, KE Wikelski, M	Exposure to ecotourism reduces survival and affects stress response in Hoatzin chicks (<i>Opisthocomus hoazin</i>). Biological Conservation 118 (4) 549-558 August 2004	Investigation of effects of ecotourists on reproductive success of Hoatzins (<i>Opisthocomus hoazin</i>) and on hormonal status of the chicks in the Amazonian rainforests.	Empirical	Research article	Non-consumptive recreation	Hatching success was similar in both control and experimental group. Chick survival was much lower at tourist-exposed nests than at undisturbed nests. Larger nestlings were even more vulnerable than smaller nestlings. Juveniles in disturbed nesting areas had lower body mass and showed a stronger hormonal response to experimental stress. Tourist induced stress could be responsible for lower survival rates. Flush distances were 50% lower for adult hoatzins at tourist-exposed nests. Individuals in different life stages show different susceptibilities to ecotourism.	Human disturbance, nesting success, behavior, tourism, wildlife observation
Murison, G Bullock, JM Underhill-Day, J Langston, R Brown, AF Sutherland, WJ	Habitat type determines the effects of disturbance on the breeding productivity of the Dartford Warbler, <i>Sylvia undata</i> Ibis 149 (Supp. 1), 16-26, 2007	Assessment of human disturbance across habitat types	Empirical	Research Article	Non-consumptive recreation	Disturbance effects were highest in heather habitat, and highest along bird territory borders.	Habitat, human disturbance, nesting success, proximity to territory
Pfister, C Harrington, BA Lavine, M	The impact of human disturbance on shorebirds at a migration staging area. Biological Conservation 60 (2) 15-126 1992	Human disturbance was investigated as a factor that might limit the capacity of a staging area to migrating shorebirds.	Empirical	Research article	Non-consumptive recreation	Long-term census data was used to see if human activities have negatively impacted the shorebirds at this migration station. Four of seven species showed one or more movement changes in response to human disturbance. Impacts were greater on species using the front side of the beach. Abundance of impacted species may be reduced by 50%. Impacts could be reduced or eliminated by closing small portions of the front beach to utilize as resting areas during migration.	Staging areas, man-induced, migrating populations, marine birds, human impact, human disturbance
Pfluger, D Ingold, P	Responses of Coots (<i>Fulica atra</i>) and Great-Crested Grebes (<i>Podiceps cristatus</i>) to human disturbances originating from land and waterside respectively. Revue Suisse de Zoologie 95 (4) 1171-1178 1988	Study to determine the sensitivity of two waterfowl to human leisure activities.	Empirical	Research article	General recreation activities	Both species breed under similar conditions. Coots were found to be more sensitive to disturbances originating from the waterside. Great-Crested Grebes were more sensitive to disturbances from landside.	Disturbance, avoidance reactions, man-induced effects, human impact, avoidance behavior
Pearce-Higgins, JW Finney, SK Yalden, DW Langston, RHW	Testing the effects of recreational disturbance on two upland breeding waders Ibis 149 (Supp. 1) 45-55, 2007	Assess to what extent avoidance is dependent upon visitor numbers, and to determine if previously recorded relationships between disturbance and habitat avoidance in Golden Plover apply to Dunlin. Determine if Golden Plover nest success is effected by footpath use.	Empirical	Research article	Non-consumptive recreation	Both Golden Plover and Dunlin showed high levels of disturbance when human visitation was not controlled. The provision of a paved footpath, which restricted human use of the birds' habitat, resulted in less avoidance by both species. Reproductive success was not reduced close to the footpath.	Recreation, disturbance, avoidance, restricted access, breeding success.
Plumpton, DL Lutz, RS	Influence of vehicular traffic on time budgets of nesting Burrowing Owls Journal of Wildlife Management 57 (3) 612-616	Characterize and assess time-budgets of nesting Burrowing Owls in the Rocky Mountain Arsenal and determine the influence of environmental clean-up traffic	Empirical	Research article	Traffic	Vehicular traffic caused only weak effects on nesting adult Burrowing Owls.	Nesting, disturbance response, vehicle traffic

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Randler, C	Reactions to human disturbances in an urban population of the Swan Goose <i>Anser cygnoides</i> in Heidelberg. Acta Ornithologica 38 (1) 47-52 Summer 2003	Human altercations with Swan Geese were categorized and analyzed.	Empirical	Research article	Non-consumptive recreation	Fed geese reacted more strongly than resting geese. Molting/flightless birds were more strongly sensitive as well as presence of hatchlings. Average disturbance occurred at 43 m distance to the cause and lasted 31-60 seconds. More than 50% of altercations were attributable to dogs. They affected significantly more geese, caused longer durations of disturbances and probably higher energy costs. Reactions to dogs on leads did not significantly differ than loose dogs.	Swan Goose, human disturbance, bird-dog disturbance, urban environment, habituation
Rees, EC Bruce, JH White, GT	Factors affecting the behavioural responses of Whooper Swans (<i>Cygnus c. cygnus</i>) to various human activities. Biological Conservation 121 (3) 369-382 February 2005	Analysis of variation of wintering whooper swan behaviour to human activity changes over time.	Empirical	Research article	Non-consumptive recreation	Disturbance frequency resulting from human activity was lower with increasing flock size and with increased distance to the nearest road or track. Distance at which more than 5% of the flock became alert because of human activity decreased with the number of previous disturbance incidents in the day. There was no evidence that habituation to disturbance persisted over longer periods. Time to regroup after disturbance depended on the type of disturbance involved.	Disturbance factors, feeding activity, alert response, recovery rates, spatial variation, temporal variation
Richardson, CT Miller, CK	Recommendations for protecting raptors from human disturbance. Colorado Field Ornithologist Newsletter 30 (3) 1004-107 July 1996	Discusses the use of buffer zones to protect raptors from the impacts of human associated disturbance caused by recreation and/or urbanization.	Empirical	Newsletter	Habitat change due to urbanization and associated recreation	Site specific information needs to be identified before establishing buffer zones. Recommendations range from 50-160 meters depending on the local species. Guidelines are available for different species. Discusses both temporal and spatial closures which can keep the raptors from serious harm.	Human disturbances, man-made structures, foraging behavior, breeding behavior, buffer zones
Riddington, R Hassall, M Lane, SJ Turner, PA Walters, R	The impact of disturbance on the behaviour and energy budgets of Brent Geese (<i>Branta b. bernicla</i>). Bird Study 43 269-279 Part 3 November 1996	Disturbance factors that cause fake flight in Brent Geese on a north Norfolk coast.	Empirical	Research article	Non-consumptive recreation	Pedestrians were the most frequent source of disturbance. Disturbances resulting in greatest energy expenditure were human caused. Birds fed less and were more vigilant the greater the disturbance. As a consequence of increased energy expenditure, geese may need to feed at night for up to an hour in mid-winter, to balance their daily energy budget. If they are not able to feed at night, disturbance may be a primary factor influencing local distributions of Brent geese in this region.	Habitat selection, foraging behavior, human disturbance, energy expenditure
Riffell, SK Gutzwiller, KJ Anderson, SH	Does repeated human intrusion cause cumulative declines in avian richness and abundance? Ecological Applications 6 (2) 492-505 May 1996	Assessed whether repeated human intrusion has the potential to accumulate through time and decrease reproductive fitness.	Empirical	Research article	Non-consumptive recreation	There was no evidence that solitary hikers contributed to cumulative decreases in overall richness and abundance, relative richness and abundance for common and uncommon species. While this study found that there were no cumulative declines, managers should still identify the levels of intrusion that will cause cumulative declines and find policies to control these intrusions.	Avian richness, abundance, community composition, cumulative impacts, disturbance ecology, guilds, mixed-conifer forest, repeated human intrusion, wildland management
Roberts, G Evans, PR	Responses of foraging sanderlings to human approaches. Behaviour 126 29-43 Part 1-2 August 1993	Investigation of the human disturbance variables that caused the Sanderlings induced flight response.	Empirical	Research article	General recreation activities	Nearest birds to the approacher tolerated approaches for an extended period of time. When the nearest birds flew, the other birds decreased the distance that they flew. The farther away the other birds were from the disturbance, the lower the distance flown if at all. Birds farther away from the approacher were more likely to fly if the birds near to the approacher flew toward rather than away from the intruder. Nearest birds tended to fly in behind the approacher while farther birds flew further ahead.	Flock size, flight distance, flight response, human disturbance

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Robertson, RJ Flood, NJ	Effects of recreational use of shorelines on breeding bird populations. Canadian Field Naturalist 94 (2) 131-138	Investigates the effects of recreational use of shorelines on breeding bird populations in Ontario.	Empirical	Research article	Habitat change due to urbanization and associated recreation	Degree of land development observed created extensive edge effect. Disturbed areas had significantly more birds but less diversity. Species richness remained fairly constant in both disturbed and undisturbed areas. Species evenness was significantly lower in the disturbed areas than the undisturbed areas. Disturbance did affect nesting success in some species but not others.	Human disturbance, urbanization, nesting success, nesting behavior, outdoor recreation, lakeshore, edge effect, population biology
Robinson, JA Pollitt, MS	Sources and extent of human disturbance to waterbirds in the UK: an analysis of Wetland Bird Survey Data, 1995/96 to 1998/99. Bird Study 49 205-211 Part 3 November 2002	Differences in causes of human disturbance were reviewed and investigated with the Wetland Bird Survey Data 1995/96 to 1998/99.	Empirical	Research article	General recreation activities	Just over 26% of disturbance events were attributed to human activities. Most common disturbances were caused by motor driven vehicles and shooters. Coastal waterbirds were more likely to be disrupted by walkers, shooters and large aircraft. Inland birds were more likely to be disturbed by motor-driven machines and unpowered boats. Use of volunteer-based surveys can be a useful tool to determine potentially disrupting activities over large spatial scales.	Populations, refuges, human activities, human disturbance
Rodgers, JA Smith, HT	Buffer zone distances to protect foraging and loafing waterbirds from human disturbance in Florida. Wildlife Society Bulletin 25 (1) 139-145 Spring 1997	Four types of human disturbances including walking, all-terrain vehicles, automobiles and boats were studied to determine if they impacted behavior of sixteen waterbird species in Florida.	Empirical	Research article	General recreation activities	Both intraspecific and interspecific variation was found in flight distances. Buffer zones of about 100 m should adequately minimize disturbance to most species of waterbirds in this study.	Shore birds, automobile, all-terrain vehicles, sanderlings, colonies, motor boats, pedestrians, set-back distance, buffer zone
Rodgers, JA Smith, HT	Set-back distances to protect nesting bird colonies from human disturbance in Florida. Conservation Biology 9 (1) 89-99 February 1995	Three different mechanisms of human disturbance were applied to colonial waterbird nest areas to determine adequate buffer zones to mitigate negative human effects.	Empirical	Research article	General recreation activities	Both intraspecific and interspecific variation were observed in flushing response distances. Colonial waterbirds exhibited greater average flush distances in reaction to a walking approach than to approaching motorboats. Set-back distances of 100 m for wading birds and 180 m for mixed tern/skimmer colonies should be adequate to effectively buffer the sites.	Breeding success, reproductive success, behavioral responses, human disturbance
Ruhlen, TD Abbott, S Stenzel, LE Page, GW	Evidence that human disturbance reduces Snowy Plover chick survival. Journal of Field Ornithology 74 (3) 300-304 July 2003	Impact of human recreation on Snowy Plover chick survival.	Empirical	Research article	Non-consumptive recreation	Data was collected on Snowy Plover chick survival. Rates of human disturbance were greater on weekends than weekdays. This suggests that human recreation on weekends and holidays on Point Reyes negatively impacts chick survival.	Disturbance, recreation, human impact, nesting success
Safina, C Burger, J	Effects of human disturbance on reproductive success in the Black Skimmer. Condor 85 (2) 164-171 1983	Six subcolonies of Black Skimmers were daily or weekly nest checked in order to study the effects of human activity on reproductive success.	Empirical	Research article	Non-consumptive recreation	Nest density, late nesting, hatchling fledging success were inversely correlated with disturbance. Low fences placed around groups of nests depressed fledging success in disrupted areas that were checked weekly. Low fences placed around groups of nests increased fledging success in disrupted areas that were checked daily.	Human impact, disturbance, breeding success, man-induced effects, population density
Sandvik, H Barrett, RT	Effect of investigator disturbance on the breeding success of the Black-legged Kittiwake. Journal of Field Ornithology 72 (1) 30-42 Winter 2001	Effects of investigator activity on Black-legged Kittiwakes were assessed.	Empirical	Research article	Non-consumptive recreation	Effects were small. Investigator disturbance decreased adult nest attendance and increased daily chick loss rates. Overall chick survival to day 18 was significantly lower in the high disturbance plot. Herring Gulls, the primary chick predators for Black Skimmer may have been more susceptible to the effect of disturbance than the kittiwakes themselves. Researchers hypothesize that an indirect consequence of investigator intrusion was to reduce number of predators at the nest site.	Behavioral response, human disturbance, investigator disturbance, observers, predators, reproductive success

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Schummer, ML Eddleman, WR	Effects of disturbance on activity and energy budgets of migrating waterbirds in south-central Oklahoma. Journal of Wildlife Management 67 (4) 789-795, 2003	Effects of several different types of recreation activities on waterfowl	Empirical	Research article	General recreation activities	Different recreational activities had varying effects on disturbance and energy expenditure of American Coot, American White Pelican, Blue-winged Teal, Franklin's Gulls, and Black Terns. Fishing from boats caused the greatest disturbance.	Human disturbance, disturbance distance, energy expenditure, aquatic activities.
Sekercioglu, CH	Impacts of birdwatching on human and avian communities. Environmental Conservation 29 (3) 282-289 September 2002	As birdwatchers form the largest group of ecotourists, there is a need to understand the economic benefits of birdwatching and foster its growth. It improves the conservation value of natural resources as well as is financially lucrative for small and large communities alike.	Review	Research article	Non-consumptive recreation	This commentary reviews the economic potential of birdwatching and its application to community-based conservation. It outlines potential benefits associated with birdwatching. Provides suggestions about how to improve the financial and environmental well-being of communities through birdwatching marketing.	Community based conservation, ecotourism, birdwatching
Skagen, SK Melcher, CP Muths, E	The interplay of habitat change, human disturbance and species interactions in a waterbird colony. American Midland Naturalist 145 (1) 18-28 January 2001	Effects of a wildlife viewing area for Crested Cormorants and Great Blue Herons on their reproductive success and displacement behavior at a Colorado wetland.	Empirical	Research article	Non-consumptive recreation	Colony was studied two years before and two years after the construction of a wildlife viewing area. No evidence was found that nesting birds were adversely affected in either distribution of nests, nesting and fledging success, breeding chronology and adult nest attention behavior. There were no apparent effects from being closer rather than farther from the viewing area either with nest attendance patterns or chick behavior.	Habitat quality, disturbance, colony, Colorado, man-induced effects, wildlife management, breeding behavior, nesting behavior, population dynamics,
Skagen, SK Knight, RL Orians, GH	Human disturbance of an avian scavenging guild. Ecological Applications 1 (2) 215-225 May 1991	Examines intra-guild dynamics of eagles, crows and gulls in the presence of human activities.	Empirical	Research article	Non-consumptive recreation	Uncovered both single species effects from human disturbance as well as guild interspecific effects. Spatial and temporal patterns of resource use varied with the presence or absence of human activity at the feeding stations. Eagles preferred to feed > 100 from vegetative cover, gulls fed <50 m from cover. In the absence of eagles, gulls and crows preferred feedings far from cover. Numbers of both increased at feeding stations. Guild dynamics and human disturbance both combine to create unique behavior modifications.	Aggression, scavengers, foraging guild, guild theory, human disturbance, niche shifts, recreation, wildlife management
Stalmaster, MV Kaiser, JL	Effects of recreational activity on wintering Bald Eagles. Wildlife Monographs 137: 5-46, 1997	Assessed effects of recreation on eagle use of river for feeding activities	Empirical	Research article	General recreation activities	The number of Bald Eagles in the study area was negatively correlated with the daily number of recreational events. Foot traffic was more disturbing to eagles than fishing or eagle-viewing boats, though less so than motorboats. Fewer eagles used the river on weekends when human disturbance was highest, as compared to relatively low traffic on weekdays. Some eagles were displaced to secluded areas during disturbances, and disturbance was greatest (response of eagles was highest) in the early morning.	Bald Eagle, disturbance, recreational activity, flushing distance, flushing response, wintering habitat.
Stalmaster, MV Newman, JR	Behavioral responses of wintering Bald Eagles to human activity. Journal of Wildlife Management 42 (3): 506-513 1978	Effects of human activity on wintering bald eagles was studied in Washington. Tolerance to disturbance was determined by analyzing eagle distribution related to human activity and measurement of flight distances from simulated human disturbances.	Empirical	Research article	Non-consumptive recreation	Human and simulated human activity affected eagle distribution and behavior adversely. Distribution patterns were significantly changed, resulting in displacement of eagles to areas of lower human activity. Older birds were more sensitive to disturbances. Flight distances were highest for simulated disturbances in water and on gravel bars. They were intermediate on land and shortest under the vegetation canopy. Habituation to normal activities did seem to occur.	Buffer zones, human activity, human disturbance, flushing distance, flight distances, distribution and habituation

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Steidl, RJ Anthony, RG	Experimental effects of human activity on breeding Bald Eagles. Ecological applications 10 (1) 258-268 February 2000	Assesses the consequences of increased recreational activity on Bald Eagles in wilderness areas in the interior of Alaska.	Empirical	Research article	Non-consumptive recreation	Activity budgets changed considerably when humans were camped 100 m from nests. Adult eagles decreased the time they preened, maintained nests, fed themselves and their nestlings. They increased the time they brooded their nestlings. Amount of time away from nest was also increased when humans were nearby. Frequent human activities near nests could adversely affect nestling survival and reproductive success.	Human disturbance, behavioral responses, reproductive success, nesting behavior, raptors, recreation, wilderness
Stillman, RA Goss-Custard, JD	Seasonal changes in the response of Oystercatchers <i>Haematopus ostralegus</i> to human disturbance Journal of Avian Biology 33 (4) 358-365. December 2002	Assesses the effects of seasonality on Oystercatchers' response to human disturbance	Empirical	Research article	Non-consumptive recreation	Behavioral response of Oystercatchers (e.g., flushing distance) decreases as winter progresses. This response is based on the birds' increased vulnerability, as late in winter it is more difficult to find food, therefore in avoiding human disturbance, they are placed at a greater risk of starvation.	Human disturbance, avoidance, vulnerability, seasonality
Stolen, ED	The effects of vehicle passage on foraging behavior of wading birds. Waterbirds 26 (4) 429-436 December 2003	Effects of passing vehicles on the foraging behavior of wading birds were studied using observational and experimental methods at the Merritt Island National Wildlife Refuge in Florida.	Empirical	Research article	Non-consumptive recreation	Foraging wading birds were more likely to be disturbed when vehicles slowed or stopped adjacent to them than when they continued to drive by. With a high rate of human visitation, some individual wading birds responded more strongly to passing vehicles than did others, suggesting that some were habituated to the disturbance. Proximity of the vehicle influenced the probability of flushing in a species-specific manner. By concentrating ecotourism in certain areas and educating ecotourists, the effects of the visitors on wading birds can be minimized.	Buffer zone distances, human disturbance, wildlife refuge, populations, efficiency, waterbirds, vehicles
Stone, E	Separating the noise from the noise: A finding in support on the Niche Hypothesis that birds are influenced by human-induced noise in natural habitats. Anthrozoos 13 (4) 225-231 2000	Investigated if ambient noise alone could play a role in structuring bird communities in riparian habitats in Boulder, Colorado.	Empirical	Research article	Habitat change due to urbanization and associated recreation	Point counts of birds were conducted in open space/minimally disturbed areas, residential, commercial and industrial neighborhoods. Species richness and PIF scores (a weighted value based on species' importance) consistently and significantly decreased as ambient noise increased. Wildlife species acoustic niches are adversely affected by human induced noise pollution.	Acoustic interference, breeding birds, populations, grasslands, proximity, aircraft, behavioral response, density, woodland, highway
Swan, M Ortega, C Davies, B Wicks, E Otway, A	Effects of urbanization on raptors along the front range of Colorado. Colorado Field Ornithologist Journal 34 (1) 32-40 January 2000	Analyzed 22 years of Christmas count data to determine population trends of six raptor species from the Colorado front range.	Empirical	Newsletter	Habitat change due to urbanization	In the analysis, red-tail and ferruginous hawks increased significantly over this time period. Rough-legged Hawks declined over this time period. Sharp-shinned and American Kestrel populations remained the same. Northern Harriers had an insignificant decline. Results indicated that some species coped better with anthropogenic changes than others.	Human disturbance, urbanization, Christmas bird count data, trend analysis, population analysis, bird biology
Swarthout, CH Steidl, RJ	Experimental effects of hiking on breeding Mexican Spotted Owls. Conservation Biology 17 (1) 307-315, 2003	Examined changes in activity budgets of nesting Spotted Owls as influenced by a controlled amount of hiking activity	Empirical	Research article	Non-consumptive recreation	Nesting female owls in proximity to hikers decreased prey-handling time by 57% and daytime maintenance behavior by 30%. Hikers caused male and female owls to increase their frequency of contact vocalizations by 58% and 534%, respectively. The authors suggest that high levels of recreational hiking may be detrimental to this species.	Hiking, recreation, nesting behavior, responses to human activity.
Taylor, EC Green, RE Perrins, J	Stone-curlews <i>Burhinus oedicnemus</i> and recreational disturbance: developing a management tool for access Ibis 149 (Supp. 1) 37-44, 2007	Describes the management tool Stone-Curlew Access Response Evaluator (SCARE).	Review	Research article	Non-consumptive recreation	SCARE is a method to assess the effects of changing recreational disturbance, including new routes and frequency of use, on Stone-curlew breeding sites.	Disturbance, frequency, walking routes, recreation, management.
Ten Brink, J	Birds of Parker, Colorado. Colorado Field Ornithologists Journal 29 (2) 77-79, April 1995	Changes in a Parker, Colorado greenbelt over two years.	Observation	Newsletter	Habitat change due to urbanization and associated recreation	Native bird populations at this Parker, Colorado greenbelt decreased significantly after a vacant field was mowed and replaced with a volleyball area. Since construction, nobody really used the volleyball area. All that was accomplished was to destroy a vital food/foraging area for many native species in this locale.	Urbanization, human disturbance, foraging behavior, population biology, bird biology

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Tershy, BR Breese, D Croll, DA	Human perturbations and conservation strategies for San Pedro Martir Island, Islas del Golfo de California Reserve, Mexico. Environmental Conservation 24 (3) 261-270 September 1997	Frequency and variety of activities concerning human visitors to San Pedro Martir Island were studied over 14 months of field work.	Empirical	Research article	General recreation activities	Over 350 people on average visited the near shore waters each month. Types of visitors included commercial fishers in small crafts, commercial fishers in large crafts, commercial environmental-tourism groups and private sport-fishing crafts (most common). Disturbances caused by all tourists can be reduced at minimal costs with just education and policy making. Commercial fisherman were responsible for most of the apparent disturbances to seabirds.	Human disturbance, ecotourism, seabirds, exotic species, nesting success, populations
Titus, JR Van Druff, LW	Response of the common loon to the recreational pressure in the boundary waters canoe area, northeastern Minnesota. Wildlife Monographs 79(1) 1981	Determined the impact of outdoor recreationists upon nesting and brood-rearing success in the Common loon.	Empirical	Research article	General recreation activities	Compared present population levels and territorial pair distribution to earlier data. Investigated the recreational factors that affect reproductive success. Developed recommendations about breeding pairs in the canoe area that could maintain a healthy population.	Recreational waters, canoeing, human impact, population levels, nesting success, behavioral response
Tuite, CH Hanson, PR Owen, M	Some ecological factors affecting winter wildfowl distribution on inland water in England and Wales, and the influence of water based recreation. Journal of Applied Ecology 21 (1) 41-62	Multiple regression analysis was used to examine the distribution of nine common freshwater wildfowl areas in Britain that are used for water recreation.	Empirical	Research article	General recreation activities	Amount of variation varied considerably among species. Large areas held more wildfowl than small areas. Winter wildfowl distribution was also affected by water recreationists. Impact on different species also varied widely. Most of the deleterious impacts were associated with coarse fishing, sailing and rowing. Because of the low impact of birdwatching, it was correlated with higher than expected variety of species.	Recreational waters, man-induced effects, boating, sailing, behavioral response, recreation
Underhill-Day, JC Liley, D	Visitor patterns on southern heaths: a review of visitor access patterns to heathlands in the UK and the relevance to Annex I species Ibis 149 (Supp. 1) 112-119, 2007	Review unpublished reports on visitor numbers and activities in heathlands; make management recommendations	Review	Research article	Non-consumptive recreation	Managers must take into account the purpose of visits and manage accordingly; for example, create paths to minimize visitor impact in natural areas	Recreation, visitor demography, human activities, management
Urñi, AJ GossCustard, JD Durell, SEALD	The ability of Oystercatchers <i>Haematopus ostralegus</i> to compensate for lost feeding time: Field studies on individually marked birds. Journal of Applied Ecology 33 (4) 873-883 August 1996	Investigates whether oystercatchers can compensate for lost feeding time when disturbed by human intrusion.	Empirical	Research article	Non-consumptive recreation	Disturbances were either human or raptor. Disturbed and undisturbed rates were not significantly different. There was no evidence that these birds increased their rate of feeding to compensate for lost feeding time. Instead, they extended their feeding time by remaining longer on the mussel bed. Flight distances tended to shorten over increased presence of the human disturbance so it is likely that the birds were able to habituate to frequent intrusions and reduce lost time by not leaving the feeding area at all.	Intake rates, reaction distance, flight distance, flushing distance, human disturbance, raptors
Van de Zande, AN Vos, P	Impact of a semi-experimental increase in recreation intensity on the densities of birds in groves and hedges on a lake shore in the Netherlands. Biological Conservation 30 (3) 237-259 1984.	Disturbance field experiment which was conducted along a lake shore with hedges and groves to determine any negative impact to breeding bird densities.	Empirical	Research article	Traffic	Visitors and breeding birds were counted the breeding season both before and after the car park opened. All but one of the 12 most abundant species was negatively effected by construction of the car park.	Man-induced effects, population density, recreation, human impact, human disturbance, point count data

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Van de Zande, AN Berkhuizen, JC Van Latesteijn, HC Ter Keurs, WJ Poppelaars, AJ	Impact of outdoor recreation on the density of a number of breeding species in woods adjacent to urban residential areas. Biological Conservation 30 (1) 1-39 1984	Possible effects of recreation intensity upon bird densities were studied in seven units adjacent to urban residential homes.	Empirical	Research article	Non-consumptive recreation	Of the 31 species found, only 13 were present in a majority of the units. Significant negative correlations between recreation and bird densities were found for 8 of these 13 species. Recreation intensity on weekends also proved to be significantly more detrimental than recreation intensity during the week.	Recreation, human impact, population density, urban environments, human disturbance
Verbeek, NAM	Egg predation by northwestern crows: its association with human and eagle activity. Auk 99 (2) 347-352	Predation by crows in the presence of human and eagle disturbance was analyzed in a cormorant colony.	Empirical	Research article	Non-consumptive recreation	When bald eagles were present, more cormorant eggs were lost to crows than on days when eagles were absent. An estimated 22% of all eggs in the first clutches were consumed by crows. Crows were more prevalent on weekends than on weekdays, presumably because the local eagle population was displaced by people seeking recreation on the water.	Predation, nest success, breeding behavior, competition
Verhulst, S Oosterbeek, K Ens, BJ	Experimental evidence for effects of human disturbance on foraging and parental care in Oystercatchers. Biological Conservation 101 (3) 375-380 October 2001	Investigates effects of human disturbance on Oystercatcher foraging and parental care.	Empirical	Research article	Non-consumptive recreation	Disturbance significantly reduced the proportion of time the clutch incubated. Also, it negatively affected the proportion of time that the parents spent on the mudflat. With increased disturbance levels, smaller proportions of food were collected for the chicks. This demonstrates that human disturbance reduces the amount of parental care in Oystercatchers which can inversely affect reproductive success.	Breeding success, human disturbance, foraging behavior, reproductive success
Vos, DK Ryder, RA Graul, WD	Response of breeding Great Blue Herons to human disturbance in north-central Colorado. Colonial Waterbirds 8(1) 13-22, 1985	Determine Great Blue Heron response to human disturbance in nesting areas	Empirical	Research article	Non-consumptive recreation	Overall, herons showed a minimal response to human disturbance. Land-based human activities were more disruptive to the colony than water-based activities (e.g., canoeing).	Disturbance, nest abandonment, land-based activity.
Watson, A	Dotterel <i>Charadrius morinellus</i> numbers in relation to human impact in Scotland. Biological Conservation 43 (4) 245-256 1988	Spring densities and breeding success were measured at nesting areas which were frequented by human visitors.	Empirical	Research article	Non-consumptive recreation	Soil erosion and vegetation damage at one site was compared to a remote less disturbed site. Evidence indicates that dotterels avoid the damaged nesting areas. Human intruders have not yet reduced dotterel population or breeding success at either the disturbed or undisturbed plots.	Population density, breeding success, human impact, reproductive success, soil erosion, vegetation damage, habitat quality
Westmoreland, D Best, LB	The effect of disturbance on Mourning Dove nesting success. Auk 102 (4) 774-780 1985.	Disturbed and undisturbed Mourning dove nests were compared for several variables including survival probability, nest-site features, nest attendance and flushing distance.	Empirical	Research article	Non-consumptive recreation	During incubation, disturbed nests had significantly lower daily survival rates. There were no similar results at the nestling stage. These results indicate that nest-checking procedures could influence nesting success and confound interpretation of relationships of nest-site features and nesting outcomes.	Human disturbance, investigator disturbance, nest substrate, nesting success, nest quality, habitat quality, nest-site features, breeding success, human impact
Yalden, DW	The influence of recreational disturbance on Common Sandpipers <i>Actitis hypoleucos</i> breeding by an upland reservoir in England. Biological Conservation 61 (1) 41-49 1992	The reaction of breeding Common Sandpipers to anglers and other park visitors was analyzed in Ladybower Reservoir in England.	Empirical	Research article	General recreation activities	Common Sandpipers breeding around the reservoir are 29% more likely to take flight in disturbed rather than undisturbed areas. They take flight at an average of 27 m. But when guarding their chicks, they react at 75 m. Common Sandpipers tended to avoid using the favored angling beaches on the north shore of the reservoir. As a consequence in disturbed areas, there is a reduction in the size of the breeding population but breeding success is unaffected.	Breeding success, anglers, recreation, human disturbance, breeding behavior

Author	Title of study	Purpose of Study	Data Collection Method	Publication Type	Disturbance Category	Important Findings	Keywords
Yalden, PE Yalden, DW	Recreational disturbance of breeding Golden Plovers (<i>Pluvialis paricaria</i>). Biological Conservation 51 (4) 243-262 1990	Detailed observations of the effect of people walking on the moors on breeding Golden Plovers.	Empirical	Research article	Non-consumptive recreation	During the pre-incubation period, the birds were sensitive to human approach at 200 m and flew more often. Incubation took much longer with people and dogs around than without. In the disturbed plots during the post-hatching period, chick guarding and avoidance behaviors limited feeding time and significantly increased energy requirements of both chicks and adults.	Human disturbance, breeding behavior, flushing distance, human activities, dogs, avoidance, energy expenditure, guarding
Yasue, Mai	The effects of human presence, flock size, and prey density on shorebird foraging rates Journal of Ethology 23 (2), 2005	Assessed whether foraging shorebirds displayed reduced feeding rates based on human presence; flock size and prey availability were taken into account.	Empirical	Research article	Non-consumptive recreation	Semipalmated plovers decreased feeding rates in correlation with the amount of human disturbance. Decreases in feeding my Least Sandpipers were also affected by flock size and arthropod availability. The author suggests that all factors in a disturbance-response situation be measured and accounted for.	Human disturbance, feeding rates, ecological factors, avoidance response.

Books, Proceedings, Technical Reports, and Theses
regarding the impacts of outdoor recreation and ecotourism

Author	Title/Citation	Purpose of Study	Publication Type	Important Findings	Keywords
Bennett, KA Suelke, E	The effects of recreation on birds: a literature review. Smyrna, DE: Delaware Natural Heritage Program 1999.	Reviews current literature regarding the impact of recreational activities on birds.	Report	Synthesizes current findings on recreational impacts. Studies show that all recreation activities have at least temporary effect on bird behavior. Sources are given that provide recommendations on mitigating the impacts of recreation.	Recreation, disturbance, bird populations, bird behavior.
Bird, DM Varland, DE Negro, JJ	Raptors in human landscapes: adaptations to built and cultivated environments. San Diego: Academic Press 1996	Symposium proceedings regarding human altered environments held in Charlotte, NC.	Proceedings	Sponsored by the Raptor Resarch Foundation, this symposium gathered empirical evidence regarding raptor adaptation to human altered environments.	Urban animals, birds of prey, adaptation, Raptor Research Foundation
Boo, E	Ecotourism: the potentials and pitfalls. Washington, D.C.: World Wildlife Fund 1990	Discusses ecotourism with special attention to wildlife preservation and conservation.	Book	Discusses ecotourism with special attention to wildlife preservation and conservation. Includes country case studies. Comes in two volumes.	Wildlife, wildlife preservation, wildlife conservation, ecotourism, bird biology, World Wildlife Fund
Boyle, SA Samson, FB	Non-consumptive outdoor recreation: An annotated bibliography of human-wildlife interactions. US Fish and Wildlife Service Special Report no. 252 1983	Annotated bibliography of research that analyzes the problems and potential solutions that arise with human-wildlife interactions.	Technical report	List of 166 articles with original data pertaining to hiking, camping, wildlife observation, photography, swimming, vehicle/snowmobile and rock climbing. Assesses 20 years of current research that discusses outdoor recreation and successful wildlife management	Human interaction-wildlife, human disturbance, outdoor recreation, bird biology
Bradshaw, GA Marquet, PA	How landscapes change: human disturbance and ecosystem fragmentation in the Americas. New York: Springer 2003	Human disturbance at the continental level is discussed with regard to wildlife conservation.	Book	Human disturbance and ecosystem fragmentation at the continental level are reviewed and analyzed.	Ecological studies, fragmented landscapes, nature, human effects on nature, bird biology
Burgess, RL Sharpe, DM	Forest island dynamics in man-dominated landscapes. New York: Springer-Verlag 1981	Overview of bird population dynamics within a disturbed landscape and how to counteract negative impacts.	Book	Review of avian research that indicates how to counteract the negative influences found in man-dominated forest island habitats.	Forest ecology, ecological studies, human disturbance, fragmented landscapes
Cole, DN Knight, RL	Wildlife preservation and recreational use: the conflicting goals of wildland management. Transactions of the North American Wildlife and Natural Resources Conference 56 th 233-237 1991	Review of research that demonstrates the difficulty of partnering both wildlife preservation and recreational access.	Proceedings	Discusses the conflicting goals between wildlife preservation and recreation. Includes ideas to ameliorate these conflicting policies.	Human disturbance, outdoor recreation, wildlife management, bird biology
Conard, S	Disturbance in boreal forest ecosystems: human impacts and natural processes. Proceedings of the International Boreal Forest Research Association 1997 Annual meeting Duluth, Minnesota: North Central Research Station – Forest Service 2000	Proceedings from empirical studies that reflect human disturbance in the boreal forest ecosystem.	Proceedings	Technical Report NC-209 in which studies are highlighted that analyze how significantly human disturbance has impacted the natural processes of the boreal forest ecosystem.	Taiga ecology, ecological disturbance, North Central Research Station
Dahlgren, RB Korschgen, CE	Human disturbances of waterfowl: An annotated bibliography. U.S. Fish and Wildlife Service Division of Migratory Birds and Refuge Biology Region: Washington, DC 1992	Reviews literature about the effects of human interactions that disrupt normal behavior in waterfowl. Both visible and obvious as well as subtle and overlooked effects are considered.	Technical report	Reviews the literature regarding human disturbance of waterfowl. Includes 211 articles with information about effects of human disturbance of waterfowl. Produced from a request by resource managers to gather information on the types, magnitude, and effect of disturbances from human contact with wildlife.	Human impact, disturbance, aquatic birds
Edington, JM Edington, MA	Ecology, recreation and tourism. New York: Cambridge University Press 1986	Discusses outdoor recreation with attention to nature conservation.	Book	Discusses research findings and successful wildlife management programs that can mitigate the detrimental effects of outdoor recreation on wildlife conservation.	Ecotourism, outdoor recreation, nature conservation, environmental conservation, tourism and bird biology

Author	Title/Citation	Purpose of Study	Publication Type	Important Findings	Keywords
Eley, DL	Effects of recreational trail use on bird communities in riparian areas of Rocky Mountain National Park. MS Thesis Colorado State University 1996	Empirical study of recreational trail use at Rocky Mountain National Park on local bird communities.	Thesis	Analyzes the effects of recreational trail use on bird communities in the riparian areas of Rocky Mountain National Park.	Human beings, nature, riparian ecology, outdoor recreation
Faaborg, J	Saving Migrant Birds: developing strategies for the future. Austin: University of Texas Press 2002	Information and ideas regarding the preservation of important habitat for our migrating bird populations.	Book	Reviews the types of techniques that can be used to preserve important migrating bird habitat regardless of human settlement patterns and human disturbance.	Migrant birds, migration, habitat, wildlife conservation, wildlife preservation, human disturbance
Fraterrigo, JM	Low density human settlement in the Rocky Mountain West: effects on bird communities and landscape patterns. MS Thesis Colorado State University 2000	Examines if low density human settlement can significantly effect the composition of bird communities and landscape patterns.	Thesis	Analysis uncovers that there are no significant detrimental effects of low-density human settlement on bird communities and landscape patterns in the Rocky Mountain West.	Nature, human effects on nature, birds, habitat Colorado
Gutzwiller, KJ	Assessing recreational impacts on wildlife: the value and design of experiments. Transactions of the North American Wildlife and Natural Resources Conference 56 th 248-255 1991	Discusses the value of including recreational impacts to wildlife to our conservation research.	Proceedings	Includes examples of experimental designs that will adequately analyze how recreation impacts our wildlife populations.	Human disturbance, experimental design, wildlife management, outdoor recreation, bird biology
Hamann, B Johnston, H Gobielle, J Hillis, M Johnson, S Kelly, L McClelland, P	Birds. Pages 3.1-3.34 in Effects of recreation on Rocky Mountain wildlife: A review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of the Wildlife Society, 1999.	Review existing literature on the effects of recreation on birds, across species and seasons.	Technical report	Birds show extreme variation across species in terms to how they respond to disturbance by human recreation activities. Human disturbance may cause nest abandonment, changes in foraging habits, and decreased foraging efficiency. Management practices should focus on species of conservation concern.	Disturbance, recreation, breeding birds, wintering birds, tolerance, avoidance.
Horak, G	Cumulative impacts of rapid urbanization on winter avian diversity in Northeastern Colorado. MS Thesis Colorado State University 1986	Empirical study of the impacts of rapid urbanization on the winter avian populations in northeastern Colorado.	Thesis	Analyzes the deleterious cumulative impact of rapid urbanization on the avian populations of northeastern Colorado.	Bird populations, urbanization, Colorado, Fort Collins
Jordan, M	Ecological impacts of recreational use of trails: a literature review. The Nature Conservancy, Cold Spring Harbor, NY. 2000	Compiles 30 references on the impacts of hiking , jogging, horseback riding, and other "light" recreational uses.	Technical report	Provides list of recreation effects: Trampling, erosion, disturbance, pollution, etc., and which recreation activities contribute to those effects.	Recreation, trails, ecological impacts.
Knight, RL Cole, DN	Effects of recreational activity on wildlife in wildlands. Transactions of the North American Wildlife and Natural Resources Conference 56 th 238-247 1991	An overview of the difficulties that outdoor recreationists pose to successful wildlife management on our public lands.	Proceedings	Presents documentation of the multidimensional problems that arise when recreational activities occur in the same locations as wildlife populations reside.	Human activity, outdoor recreation, human disturbance, wildlife management, bird biology
Korschgen, CE Dahlgren, RB	Waterfowl management handbook: Human disturbances of waterfowl: Causes, effects and management. Washington, DC: US Fish and Wildlife Service 1992	Publication that discusses human-waterfowl interactions.	Technical report	Explains the causes, effects and management of human disturbances on waterfowl populations.	Waterfowl management, Human-animal relationships
Liddle, M	Recreation ecology: the ecological impact of outdoor recreation. Cambridge, UK: Springer, 1997	Review ecological knowledge pertaining to countryside areas used for recreation.	Book	Summarizes our current understanding about recreation as an ecological factor affecting wildlife and the landscape; makes management recommendations and suggestions for future research.	Recreation, ecological effects.
Lunney, D Burgin, S	Urban wildlife: more than meets the eye. Mosman NSW: Royal Zoological Society of New South Wales 2004	Proceedings of a forum held at the Royal Zoological Society of New South Wales discussing urban wildlife management.	Proceedings	Discusses urban wildlife management as an emerging discipline of utmost importance to wildlife conservation.	Urban wildlife, urban animals, urban wildlife management

Author	Title/Citation	Purpose of Study	Publication Type	Important Findings	Keywords
Lyons, JR	Non-consumptive wildlife-associated recreation in the U.S.: identifying the other constituency. Transactions of the North American Wildlife and Natural Resources Conference 47 th 677-685 1982	Reviews available information regarding non-consumptive wildlife recreationists and how native wildlife populations need to be valued equally in order to maximize positive outcomes for the recreationists.	Proceedings	Identifies the role of wildlife in non-consumptive outdoor recreation.	Human disturbance, wildlife management outdoor recreation, bird biology
Marzluff, JM Bowman, R Donnelly, R	Avian ecology and conservation in an urbanizing world. Boston: Kluwer Academic Publishers 2001	Historical perspective on urban bird research including worldwide urbanization and its effects on bird populations.	Book	Discusses linking urban planning to ecological principles and behavioral needs of urban bird species.	Urbanization, birds-conservation, wildlife conservation-birds
Marzluff, JM	Effects of urbanization and recreation on songbirds. Pages 89-102 in USDA Forest Service Gen. Tech. Rep. RM-GTR-292, 1997.	Reviews the relatively small body of current literature on the effects of recreation specifically on songbirds.	Technical report	Birds' ability to respond to disturbance depends to some extent on how specialized their needs are. If their habitat is by nature varying and unpredictable, they are more able to deal with disturbance in the form of recreation. Urbanization and human disturbance cause a variety of responses and changes in behavior depending upon species and habitat.	Urbanization, recreation, increased disturbance, life history traits.
Miller, CK	Environmental impacts of recreational trails on riparian areas. 6 th Annual Proceedings of the Colorado Riparian Association Conference 97-105 1994	Researches data regarding recreational trails and their affect on naturally occurring wildlife populations.	Proceedings	Human intruders in riparian areas do have a significantly inverse effect on the naturally populations of wild birds. Educational efforts, including interpretive signs and lessons in viewing etiquette have improved populations. Also, aesthetically pleasing fencing and native planting can prohibit human interference in bird activities. Trails that are closed seasonally are the best way to ensure that bird populations stay viable.	Human disturbance, human activities, detrimental effects, bird biology, foraging behavior
Newton, I Brockie, K	Population limitation in birds. San Diego: Academic Press 1998	Reviews empirical research which reveals how bird populations are vulnerable to external environmental stimuli.	Book	Reviews the types of external stimuli that negatively impacts bird populations.	Bird populations, birds, human disturbances, bird ecology
Office of Migratory Bird Management	Caution, feeding waterfowl may be harmful! Regular feeding can cause dependency on people for food, conflicts with people, and spread of disease. Office of Migratory Bird Management: Arlington, VA 2000	Publication with vital information regarding the dangers of feeding waterfowl.	Technical report	Analysis of how regular feeding of waterfowl can be very deleterious to their health.	Birds, disease, waterfowl, feeding, foraging, human effects on birds
Purdy, KG	A guide to managing human activity on national wildlife refuges. US Fish and Wildlife Service: Ft Collins, CO 1987	Study to ascertain the mild, moderate and severe categories of human intrusion that impact avian populations on the wildlife refuge.	Technical report	Guidelines developed which can control the negative impacts of human activity that are found at our national wildlife refuges.	Wildlife conservation, wildlife refuges, human disturbance
Pye, Kenneth Allen, John RL	Past, present and future interactions, management : challenges and needs in coastal and estuarine environments. Coastal and Estuarine Environments: Sedimentology, Geomorphology and Geoarchaeology . Geological Society Special Publications 175 1-4 2000	Discusses how recreation interests such as birdwatching must be included as a stakeholder interest on coasts and estuaries.	Book	Suggests how decisions regarding coasts and estuaries can be analyzed and decided using progressive management and conflict resolution skills. To formulate reliable framework, adequate background information on stakeholders and a suitable understanding of the coastal ecosystem must be part of the decision-making process.	Coastal environment, conservation, environmental marketing, future, estuaries, shorelines, depositional environment
Robinson, SK	Reappraisal of costs and benefits of habitat heterogeneity for non-game wildlife. Transactions of the North American Wildlife and Natural Resources Conference 53rd 145-155 1988	Discusses the ramifications of overlooking the value of non-game wildlife when creating management plans for public lands.	Proceedings	A clear and convincing discussion of the costs and benefits of non-game wildlife when developing management plans for public access areas.	Human disturbance, human activities, wildlife management, habitat fragmentation, non-game wildlife, outdoor recreation

Author	Title/Citation	Purpose of Study	Publication Type	Important Findings	Keywords
Shaw, WW King, DA	Wildlife management and non-hunting wildlife enthusiasts. Transactions of the North American Wildlife and Natural Resources Conference 45 th 219-225 1980	Review of the current knowledge and perceptions within natural resources agencies regarding non-hunting wildlife watchers.	Proceedings	Reviews the current trends within natural resources agencies regarding the role of non-hunting wildlife watchers in wildlife management planning.	Wildlife management, human activities, outdoor recreationists
Tapper, R	Wildlife watching and tourism: a study on the benefits and risks of a fast growing tourist activity and its impacts on species. UNEP/CMS Secretariat, Bonn, Germany, 2006.	Review of the current state of ecotourism, wildlife watching, and their economic and ecological impacts.	Technical report	Presents current knowledge on the effects of ecotourism on tourist destinations. Includes twelve case studies detailing the positive and negative impacts of ecotourism, and how negative effects may be mitigated.	Wildlife, ecotourism, economic impacts, ecological impacts, species response
Vaske, JJ Graefe, AR Kuss, FR	Recreation impacts: a synthesis of ecological and social research. Transactions of the North American Wildlife and Natural Resources Conference 48 th 96-107 1983	Reviews the ecological and social research regarding outdoor recreationists and wildlife management.	Proceedings	Develops the history of ecological and social research which analyzes the affects of outdoor recreationists on wildlife populations.	Outdoor recreation, human disturbance, human activities, wildlife management, population biology, bird behavior
Wood, ME	Ecotourism: Principles, practices and policies for sustainability. UNEP International Ecotourism Society Paris, France, 2002	Basis guidelines for developing any ecotourism project.	Book	Suggestions and international guidelines form the International Ecotourism Society which should be utilized when instituting ecotourism projects.	Ecotourism, International Ecotourism Society