

# **THE EFFECTS OF RECREATION ON BIRDS: A LITERATURE REVIEW**

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## **Introduction**

In recent decades increased visitation to national parks, recreation areas, and wildlife refuges by ecotourists and recreationists has spawned discussion about balancing the needs of visitors, protecting wildlife, and preserving natural resources. Delaware is no exception, and recently has been faced with addressing this challenge with regard to state-owned park land.

The Division of Parks and Recreation is charged with management of thousands of acres in the State of Delaware. Their management responsibility lies not only with providing recreation and cultural opportunities for the public, but also with management and protection of natural resources found in state parks and natural areas. The latter issue is becoming especially critical as development pressure increases throughout Delaware. The Division recognizes that current approaches to land use and natural resource management need to be adjusted to address increased visitation and demands to have more access to park resources. In response to these issues, the Division has begun developing master plans for priority park lands.

One such plan currently being developed for Cape Henlopen State Park (CHSP) in Sussex County, Delaware brought attention to the issue of providing recreational opportunities for park visitors while minimizing disturbance to wildlife and destruction of habitat. In particular, there has been much debate over the proposed alignment for a pedestrian / bike path through the southern portion of the park, and the potential effect of its use on birds that feed and rest in an adjacent 80 ha (200 acre) brackish pond (i.e., Gordons Pond).

The Division of Parks and Recreation, in recognizing the need to incorporate sound scientific research into planning decisions, requested the assistance of the Delaware Natural Heritage Program (DNHP) in conducting a literature search for research pertaining to the effects of recreation, specifically pedestrians and bicycles, on birds. This paper summarizes the results of the literature search and the findings reported in the most relevant studies.

## **Methods**

We conducted a thorough search of the scientific literature for research pertaining to the effects of human disturbance, particularly as it relates to outdoor recreation, on bird populations. Due to the nature of the project that is being proposed by the Delaware Division of Parks and Recreation (i.e., bike path), our search specifically focused on the impacts of bicycle and pedestrian traffic on bird populations.

Several methods were used to locate publications addressing bird disturbance issues. Organizations that specialize in researching bird populations were

contacted by telephone or email to inquire about their knowledge of such studies and were asked to forward citations related to this subject (Table 1). Additionally, several online databases (Table 2), many of which include abstracts, that are available at the University of Delaware or on the Internet were searched using a variety of keyword combinations (Table 3). Finally, the literature cited sections of

**Table 1:** Organizations contacted for information regarding research pertaining to human disturbance related to outdoor recreation to bird populations.

- ❑ **Cornell Lab of Ornithology**  
Marie Eckhardt, Research Assistant, Education Department  
159 Sapsucker Woods, Ithaca, NY 14850
  - ❑ **Florida Cooperative Fish and Wildlife Research Unit**  
H. Franklin Percival, Unit Leader  
P.O. Box 110450, University of Florida, Gainesville, FL 32611
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Brian Harrington, Senior Scientist  
PO Box 1770, Manomet, MA 02345
  - ❑ **Colorado Natural Heritage Program**  
Mary Klein, Director  
254 General Services Bldg  
Fort Collins, CO 80523
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relevant articles and books were reviewed to identify pertinent articles. References for articles that appeared to be applicable were uploaded or hand entered into a bibliographic database housed in the DNHP office.

We reviewed article abstracts to determine the applicability of a given publication prior to acquiring full copies for review. If an abstract or title suggested particular relevance to the Division of Parks and Recreation project (e.g., specifically mentioned the effects of pedestrians and/or bicycle activity on bird populations), then copies were obtained, reviewed, and summarized in the final report to the Division of Parks and Recreation.

**Table 2:** Online databases used to search for publications pertaining to impacts of outdoor recreation on bird populations.

<b><u>Database</u></b>	<b><u>Description</u></b>
<input type="checkbox"/> DELCAT University of Delaware	Catalogue of the University of Delaware Library holdings.
<input type="checkbox"/> Carl UnCover The UnCover Company	Internet accessible database of articles from over 18,000 multidisciplinary journals from 1988 to date.
<input type="checkbox"/> Biological Sciences Set Cambridge Scientific Abstracts	Citations, with abstracts, for articles, books, conference proceedings, monographs, and reports relating to the biological, medical, and agricultural sciences from 1982 to date.
<input type="checkbox"/> Biological Abstracts Biological Abstracts, Inc.	Citations, with abstracts, for articles in scholarly journals relating to life science from 1990 to date.
<input type="checkbox"/> ProQuest Digital Dissertations UMI Company, A Bell & Howell Company	Citations and abstracts (1980 onwards) for dissertations and theses from 1861 to date.
<input type="checkbox"/> Impact/ACCESS Government Documents Catalogue Service Auto-Graphics, Inc.	Complete <i>Monthly Catalogue of U.S. Government Publications</i> from 1976 to date.
<input type="checkbox"/> Fish & Wildlife Reference Service U.S. Fish & Wildlife Service	Primarily unpublished research reports produced by State agencies under Federal Aid in Sport Fish and Wildlife Restoration projects. Database contains some published research and U.S. Fish and Wildlife Service title publications.
<input type="checkbox"/> Park Science National Park Service	Catalogue of issues published from 1980 to present.

**Table 3:** Keywords used to search online databases for literature addressing impacts of outdoor recreation on bird populations. The (\*) wildcard character was used to search for variations on root keywords (e.g., bik\* searches for BIKE, BIKES, and BIKING).

**Keywords:**

- |  |  |
|--|--|
| <input type="checkbox"/> Recreation* and wildlife        | <input type="checkbox"/> Disturbance* and bik*         |
| <input type="checkbox"/> Recreation* and bird*           | <input type="checkbox"/> Disturbance* and cycl*        |
| <input type="checkbox"/> Human disturbance* and bird*    | <input type="checkbox"/> Disturbance* and mountainbik* |
| <input type="checkbox"/> Human disturbance* and wildlife | <input type="checkbox"/> Bik* and trail*               |
| <input type="checkbox"/> Human impacts and bird*         | <input type="checkbox"/> Bik* and path*                |
| <input type="checkbox"/> Human impacts and wildlife      | <input type="checkbox"/> Bicycl* and trail*            |
| <input type="checkbox"/> Disturbance* and trail*         | <input type="checkbox"/> Bicycl* and path*             |

## **RESULTS and DISCUSSION**

### ***Overview***

The study of recreation and wildlife has developed into a discipline of natural resource / ecological management over the past few decades. This is attributed mostly to the increased interest and participation in ecotourism and outdoor recreation, particularly in natural areas, parks, and refuges (Boyle & Samson 1985; Knight & Gutzwiller 1995; Liddle 1997). Within the past five years, three texts have been published on issues related to the topic of recreation and wildlife including *Wildland Recreation: Ecology and Management* (Hammitt & Cole 1998), *Recreation Ecology* (Liddle 1997), and *Wildlife and Recreationists: Coexistence through Management and Research* (Knight & Gutzwiller 1995). These treatises examine the environmental impacts of recreation, including impacts on wildlife, with discussions of how negative effects can be mitigated in areas where both recreation and protection of natural resources are often dual, but conflicting, goals. Each also includes an extensive bibliography.

Research articles discovered during this review ranged from summaries of the literature on the impacts of recreation activity on birds (Boyle & Samson 1983, 1985; Vaske et al. 1983; Hockin et al. 1992; Burger et al. 1995; Knight & Gutzwiller 1995; Hill et al. 1997; Liddle 1997) to methods for quantifying the effects of human disturbance on wildlife (Pomerantz et al. 1988, Gill et al. 1996) and controlled experiments and cursory observations on the effects of different types of outdoor recreation on bird populations (van der Zande et al. 1980; Burger 1981; Burger 1986; van der Zande et al. 1984; Klein 1993; Klein et al. 1995; Rodgers & Smith 1995, 1997; Gill et al. 1996; Burger & Gochfeld 1998).

Although an exact count of references for this project was not tallied, hundreds of articles pertaining to the impacts of outdoor recreation on wildlife, including bird populations, were discovered using the search methods described above. However, because our primary objective was to identify research specifically focused on the effects of bicycle and pedestrian traffic on birds, many papers were rejected from the full review process if the abstract lacked relevance to the proposed Division of Parks and Recreation project. We primarily limited our discussion of the existing research to groups of birds that are likely to occur in habitats in and around Gordons Pond (e.g., waterfowl, shorebirds, and wading birds) and to landscapes similar to those found at CHSP (e.g., trails or unimproved roads on dikes adjacent to impoundments). Exceptions were made for studies that demonstrated relevance in other respects.

A review of literature conducted more than 15 years ago by Boyle & Samson (1983, 1985) identified 536 references concerning the effects of "non-consumptive" outdoor recreation on wildlife. Of these, 106 contained original data on the effects

on birds of hiking and camping (27), boating (34), wildlife observation and photography (21), off-road vehicles (9), snowmobiles (2), swimming and shore recreation (8), and rock climbing (5). Hill et al. (1997) conducted a review of bird disturbance research published from 1970 to 1995 and found studies addressing the following types of activities: boating, sailing, windsurfing (31), swimming and shore based activities including ORVs (31), and walking (22), hunting (18), and angling (12). Additional studies on the effects of tourism and recreation on birds were found during this literature search including the effects of jogging, horseback riding, dog walking, children, and worm and clam digging (Burger 1981, Burger 1986, Burger & Gochfeld 1998). Clearly, there is a variety of research addressing the impacts tourism and recreation activities on birds and other wildlife.

### ***Bicycling***

Surprisingly, despite the indication that cycling is increasing both in millions of people participating (second only to swimming in 1992) and frequency of participation (in 1992 nearly 1.5 times higher than any other recreation activity not dependent on wildlife; Flathers & Cordell 1995), none of the studies reviewed for this project specifically examined the effects of bicycle riding versus other types of recreation on birds. Nor was cycling listed in reviews of studies on recreation effects on birds (Liddle 1997; *and see above*). Either cycling has not been perceived as having an effect on wildlife or it may not be an activity that has occurred with great frequency in areas where wildlife management and recreation activities are both goals. For example, a survey of U.S. Fish and Wildlife refuge managers did not identify cycling as a visitor activity, much less one that negatively impacts wildlife (Pomerantz et al. 1988). The lack of information on cycling activity and its effect on birds makes it difficult to interpret its importance as a disturbance factor relative to other types of recreation.

One study found during this literature search compared the effects of mountainbiking with hiking and jogging on a mammal population (i.e., chamois, a small goat-like mammal of the mountains of Europe) in Switzerland (Gander & Ingold 1997). In this experimental study, the alert and escape distances of chamois were influenced both by time of day and mode of travel along a trail through their habitat. Late in the morning, the disturbance response of chamois to joggers and mountainbikers was slightly stronger than their response to hikers. The authors suggest the faster pace of the former recreationists may have posed an increased threat to the chamois. Although this study indicates a varying response of a mammal species to different types of recreation, these data should not be directly applied to other taxonomic groups. Rather, this study indicates that bicycling could cause different levels of disturbance to wildlife and should be further investigated.

Although not compared with other types of recreation, cycling occurred during four different studies of bird disturbance. In each of these studies, the authors considered the effects of cycling in different ways.

- 1) Gill et al. (1996) lumped cycling with other activities that they assumed had similar effects on wildlife (e.g., horseback riding).
- 2) Van der Zande et al. (1984) assumed cycling contributed less to levels of recreation intensity than other types of recreation. Compared to walking, the authors assumed cycling contributed less to recreation intensity due to the higher speed with which cyclists travel, thus exposing birds to disturbance for shorter periods. The authors also assumed the behavior of cyclists, which travel along a consistent path, posed less of a threat to birds than unleashed dogs, which exhibit rapid, erratic movements.
- 3) Van der Zande et al. (1980) assumed cycling was not a significant disturbance factor related to other modes of travel (e.g., motorized vehicles) being studied and thus cycling activity was not recorded.
- 4) Klein (1993) lumped cycling with other modes of travel because she assumed the mode of travel (e.g., car, bus, bicycle, or moped) was not as important as the behavior of the visitor (e.g., slow versus quick movements, direct versus tangential approach, noise levels) and purpose for the visit to the refuge (e.g., photography, nature observation, fishing, fitness, driving). [NOTE: Mary Klein was contacted and agreed to provide more data regarding cycling activity during her study, but this information was not yet available by the end of the project period.]

Two authors noted that cycling or activity related to fitness (i.e., includes jogging and possibly cycling) occurred so infrequently during their studies that inferences about the data could not be drawn (Klein 1993, Gill et al. 1996). Otherwise, for studies which did not mention cycling, 1) it may not have occurred, 2) the authors assumed it had insignificant effects thus ignored cycling during their study, or 3) lumped cycling with other types of recreation without disclosure in their publications.

Two environmental assessments for bike trail projects in National Parks were found during this literature search: Everglades National Park and Cape Cod National Seashore (National Park Service 1987, 1989). These EAs merely list wildlife species found within park boundaries, including rare or endangered species and habitats where they are found. Neither study, however, directly addresses potential impacts to wildlife populations or plans for mitigating impacts. Overall, Hill et al. (1997) noted that EAs written for impacts of sports and recreation on birds generated descriptive results with little assessment of significant effects.

An M.S. thesis titled *Development of a Bike Path in the Ecologically Sensitive Lake Tahoe Basin* (Holderman 1991) was requested through inter-library loan but had not yet been delivered to the DNHP by the end of the project period. This document may address wildlife issues, and upon delivery it will be reviewed and pertinent contents will be forwarded to the Division of Parks and Recreation.

Of the research reviewed above, Klein (1993) incorporated two important factors (i.e., visitor behavior and purpose of visit) into her study of recreation impacts on birds (Knight & Cole 1995a). Klein's approach makes sense because the actions of people engaged in one type of recreation activity may vary greatly, and even the effects of different recreation activities may be difficult to separate based on mode of travel alone. Cyclists, for example, in effect become pedestrians if they stop and walk away from their bicycles. If they then proceed to approach a bird for closer observation or photography, or engage in boisterous conversation with companions, they may cause more disturbance to birds than visitors engaged in quiet, consistently paced hiking or cycling activities. With regard specifically to cycling, speed and course (straight vs. erratic) may also have differential effects on birds (Knight & Cole 1995a). Thus in order to identify which aspects of recreation affect birds the most, it is important to include visitor behaviors in addition to the mode of travel as disturbance factors.

### ***General Impacts of Recreation and Ecotourism on Birds***

Although our literature review revealed a lack of research on the specific effects of bicycle activity on bird populations, more general studies conducted on the effects of recreationists and ecotourists on birds should be helpful for making decisions about the placement and management of a pedestrian / bike trail through CHSP. The findings from these studies, as they pertain to the proposed CHSP trail project, are summarized below.

Several studies have examined the effects of recreationists on birds using shallow-water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981; Burger 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers & Smith 1995, 1997; Burger & Gochfeld 1998). The juxtaposition of landscape features in these studies is similar to what one would find at CHSP, though the project site at CHSP is much smaller in size than some of the refuge study sites and motorized vehicles would not be permitted on the proposed trail at CHSP.

Overall, the existing research clearly demonstrates that disturbance from recreation activities always have at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers & Smith 1997; Burger & Gochfeld 1998). The

findings that were reported in these studies are summarized below in terms of visitor activity and avian response to disturbance.

### Visitor Activity

- **Presence:** Birds avoided places where people were present and when visitor activity was high (Burger 1981; Klein et al. 1995; Burger & Gochfeld 1998).
- **Distance:** Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.
- **Approach Angle:** Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger & Gochfeld 1981; Burger et al. 1995; Knight & Cole 1995a; Rodgers & Smith 1995, 1997).
- **Photographers:** Photographers were more likely to approach birds and thus were more likely to disturb them (Klein 1983).
- **Type and Speed of Activity:** Joggers and landscapers caused birds to flush more than fishermen, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and thus birds likely perceive these activities as less threatening (Burger 1981, 1986; Burger et al. 1995; Knight and Cole 1995a). Alternatively, birds may tolerate passing by with unabated speed whereas if the activity stops or slacks birds may flush (Burger et al. 1995).
- **Noise:** Noise caused by visitors resulted in increased levels of disturbance (Burger 1982, 1986; Klein 1993; Bowles 1995; Burger & Gochfeld 1998), though noise was not correlated with visitor group size (Burger & Gochfeld 1998).
- **Children:** Groups with children caused increased disturbance probably because children created more noise and made rapid, erratic movements (Burger 1986).
- **Dogs:** In general, the presence of dogs caused birds to flush (Burger 1986; Pomerantz et al. 1988; Knight & Cole 1995b). Unleashed dogs, however, pose a direct threat to birds because they can chase and kill them (Burger 1986), and they may disturb birds more by making more rapid, erratic movements (van der Zande et al. 1984) than leashed dogs. Dogs can also create noise disturbance.
- **Horses:** People on horseback did not seem to threaten birds even though they frequently moved rapidly (Burger 1986). Birds flushed only to avoid trampling. Burger (1986) surmised that the birds perceived only the horse and not the person riding.

### Avian Responses:

- **Migrants vs. residents:** Migrants, including waterfowl, herons and egrets, and shorebirds, tended to be more sensitive to disturbance than resident birds, but variations existed within and among species and family groups (Burger 1981; Klein 1993; Burger et al. 1995; Klein et al. 1995; Burger & Gochfeld 1998). Variations within species may have been due to habituation of resident versus migrant sub-populations (Klein 1993; Burger 1981; Burger et al. 1995; Burger & Gochfeld 1998). Migrants are particularly sensitive to reduced or lost feeding opportunities because it is critical for them to increase energy reserves to complete migration and initiate breeding (Burger 1986; Burger et al. 1995).
- **Feeding:** Feeding time decreased and vigilance increased when people were present and with increased noise levels (Burger & Gochfeld 1998). Increased use of paths near foraging and loafing habitats caused birds to feed farther from path or to leave the area. Once disturbed birds tended to stay farther from path (Burger 1981, Klein et al. 1995, Burger & Gochfeld 1998).
- **Cover:** Birds tended to retreat to vegetation, if available, while people were present and returned to forage as visitors left area (Burger & Gochfeld 1998).
- **Habituation:** Depending on the species (especially migrants vs. residents), some birds may habituate to some types of recreation disturbance and either are not disturbed or will immediately return after the initial disturbance (Hockin et al. 1992; Burger et al. 1995; Knight & Temple 1995; Madsen 1995; Fox & Madsen 1997). More sensitive species will be displaced from their habitat for longer periods of time or will not return, and thus may be denied access to resources they need to survive.
- **Habitat preferences and quality:** Habitat preferences and quality may confound or override disturbance effects (i.e., birds that appear to avoid habitat because of disturbance may actually be exhibiting preference for microhabitats that happen to be farther from disturbance, or high quality feeding sites may cause birds to ignore disturbances; Klein 1993).

### ***Published Recommendations for Mitigation of Recreation Effects on Birds***

Several recommendations for mitigating the effects of recreation on birds have been made by various authors. These include:

- **Buffer zones:** Rodgers & Smith (1997) calculated buffer distances that minimize disturbance to foraging and loafing birds based on experimental flushing distances for 16 species of waders and shorebirds. They recommended 100m as an adequate buffer against pedestrian traffic, however, they suggest this distance may be reduced if physical barriers (e.g., vegetation screening) are provided, noise levels are reduced, and traffic is directed tangentially rather than directly toward birds.

- ❑ **Screening:** Vegetation that effectively conceals visitors and provides cover for birds if disturbance occurs will help mitigate impacts of people using trails adjacent to habitat (Hockin et al. 1992; Rodgers & Smith 1997; Burger & Gochfeld 1998). Impacts from wildlife viewing and photography can be reduced by providing observation blinds (Boyle & Samson 1985; Klein 1993).
- ❑ **Prohibit or restrict activity:** Seasonally restricting or prohibiting recreation activity may be necessary during spring and fall migration to alleviate disturbance to migrant birds (Burger 1981,1986; Boyle & Samson 1985; Klein et al. 1995; Hill et al. 1997)
- ❑ **Restrict noise levels:** Screening may not effectively buffer noise impacts, thus visitors should be educated on the effects of noise and noise restrictions should be enforced (Burger 1981, 1986; Klein 1993; Bowles 1995; Burger & Gochfeld 1998).
- ❑ **Education:** Education is critical for making visitors aware that their actions can have negative impacts on birds, and will increase the likelihood that visitors will abide by restrictions on their actions. For example, Klein (1993) demonstrated that visitors who spoke with refuge staff or volunteers were less likely to disturb birds.
- ❑ **Enforcement:** Increased surveillance and imposed fines may help reduce visitor caused disturbance (Knight & Gutzwiller 1995).
- ❑ **Monitoring:** Monitoring is recommended to adjust management techniques over time, particularly because it is often difficult to generalize about the impacts of specific types of recreation in different environments. Local and site-specific knowledge is necessary to determine effects on birds and to develop effective management strategies (Hockin et al. 1992; Klein et al. 1995; Hill et al. 1997).

### ***Closing Comments***

The existing research clearly demonstrates that disturbance from recreation activities have at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers & Smith 1997; Burger & Gochfeld 1998). However, alteration of bird behavior may not necessarily be negative if they can acquire necessary amounts of food (Burger et al. 1995; Madsen 1997). Disturbance that prevents access to feeding habitat may have negative effects on regional populations if alternative habitats, equal to or better than the quality of the one from which they were displaced, are lacking nearby (Madsen 1995; Hill et al. 1997; Burger & Gochfeld 1998). Wildlife refuges, for example, frequently contain impoundments where human access is prohibited, thus providing alternative disturbance-free feeding opportunities (Boyle & Samson 1985; Hockin et al. 1992; Burger & Gochfeld 1998). It is important to consider the relative significance of a

given habitat on local and regional scales prior to introducing increased levels of disturbance.

The results of studies reviewed indicate wide variation in responses among species and to different disturbance factors (e.g., speed of movement). Many of these differences may be related to regional, local, or site-specific factors. To begin understanding the potential effects of a pedestrian / bike path on birds using Gordons Pond at CHSP, the temporal and spatial patterns of bird activity at this site should be determined prior to establishing a trail. Furthermore, if the Division proceeds with plans to develop the path through this area, the effects of recreation and visitor behavior on birds should be monitored to determine if and how management strategies need to be adjusted.

## **LITERATURE CITED**

**NOTE:** Citations in **bold** print were reviewed and cited in this document. Other citations listed below were either not available in time for review, or were not directly relevant to this particular project but may be useful to the Division for similar project proposals in the future.

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