Human Disturbances to Waterfowl: An Annotated Bibliography

1. Atkinson-Willes, G. 1969. Wildfowl and recreation: a balance of requirements. British Water Supply 11:5-15.

The author accepts human disturbance to waterfowl as a given and proposes that compromises be worked out among water-based recreation interests to provide for the important role that Britain plays as wintering habitat for European waterfowl. Suggestions are given for consideration of the needs of waterfowl in working out these compromises. Sailing, canoeing, rowing, water-skiing, speed-boating, hydroplaning, fishing, bird-watching, picnicking, and shooting are considered as to how they affect waterfowl and how resource use might be partitioned. There is no literature cited section.

2. Austin, J. E. 1988. Winter ecology of Canada geese in northcentral Missouri. Ph.D. thesis, University Missouri, Columbia. 284 pp.

Canada geese (*Branta canadensis*) tended to spend more time alert in agricultural habitats, which were probably more exposed to disturbances than seasonal wetlands in the refuge interior or the water roost sites. Vigilance did not differ among the habitats in the hunting season), thus the effects of hunting disturbances are far-reaching. All wetland use in late fall occurred in the refuge interior, which is not hunted. However, geese in the refuge interior often responded to gunshots from the hunting zone by ceasing other activities and becoming alert or vigilant at least briefly. Canada Geese may habituate to disturbances in some locations, which may account for the lower vigilance of geese on pastures in winter. These pastures appeared to be traditionally used by geese and may be considered as safe fields. Geese appeared to avoid or leave locations where excessive disturbances in an area restricted feeding and where geese did not habituate to the disturbances.

3. Balát, F. 1969. Influence of repeated disturbance on the breeding success in the mallard, *Anas platyrhynchos* Linn. Zoologicke Listy 18:247-252.

In a regularly flooded bottomland forest, some 10 ha in size, 98 nests of the mallard were found and regularly inspected. They were situated on pollarded willows (*Salix* spp.). After their first arousal from their nests, the mallard became much more sensitive to approaching man. Water bodies inside that forest are visited by sports anglers who stay there from early morning till dusk on days of rest. The mallard aroused by them cannot return to their nests for several days. This fact resulted in 56 (or 57.2%) abandoned clutches, including those shortly before hatching and, in three cases, even hatching young. On the contrary, breeding was not disturbed in places (even very frequented) where the incubating females were not roused by the inspection.

4. Barngrover, L. 1974. W. E. Kirch Wildlife Management Area resource inventory and long range plan summary. Nevada Department of Fish and Game. 12 pp.

In the late 1950's the Nevada Fish and Game Commission recognized the wildlife values of what is now the Kirch Wildlife Management Area. The area was purchased in April 1959 with Pittman-Robertson funds primarily for waterfowl, with secondary considerations to be given to fish and other wildlife species. Fishing is the most popular activity on the management area in terms of public use days. A conflict apparently exists between public fishing interests and waterfowl production from prime waterfowl habitat. Modification of future fishing regulations would then depend upon maximum assurance that high waterfowl production from prime waterfowl habitat would continue.

5. Bartelt, G. A. 1987. Effects of disturbance and hunting on the behavior of Canada goose family groups in eastcentral Wisconsin. Journal of Wildlife Management 51:517-522.

Disturbances on roosting areas resulted in increased separation of family members of Canada geese in 1979 may have contributed to the large number of family members shot that year. The cohesiveness of family groups was affected after a family member was shot. Family (after hunting losses) and random groups used the same roosting areas less as the season advanced. Intact family groups used the same roosting areas at the same rate throughout the season. A disintegration of family structure appears to be related to the extent of disturbance and hunting pressure present during the years of this study.

6. Batten, L. A. 1977. Sailing on reservoirs and its effects on water birds. Biological Conservation 11:49-58.

Mallard (*Anas platyrhynchos*), tufted duck (*Aythya fuligula*), and common pochard (*Aythya ferina*) still use the Brent reservoir in autumn and winter despite intensified sailing activities because part of the reservoir which is shallow and marshy is not accessible to boats. During the autumn of 1975 Canadian pondweed (*Elodea canadensis*) choked the northern arm and boating had to be suspended after August, resulting in a build-up of 159 common pochards, 30 tufted ducks, 17 northern shovelers (*Anas clypeata*), and 12 gadwalls (*Anas strepera*). Distances at which flocks of ducks would move from an oncoming sailing dinghy were estimated for tufted duck at 275 m and common pochard at 450 m, and small groups of smew (*Mergellus albellus*) to within 100 m. Mallard (*Anas platyrhynchos*) were similar to smew. Green-winged teal (*Anas crecca*), Eurasian wigeon (*Anas penelope*), and northern shoveler are more sensitive than mallard by an unknown amount. Green-winged teal and Eurasian wigeon have already stopped using the reservoir due to sailing activities. Perhaps screening vegetation on reservoir banks and provision of large floating vegetated rafts would reduce disturbance.

7. Beard, E. R. 1953. The importance of beaver in waterfowl management at the Seney National Wildlife Refuge. Journal of Wildlife Management 17:398-436.

If certain areas are opened to the public for recreational use, such as fishing, use by waterfowl will sharply decrease. as demonstrated in 1947 when Study Area IV was included within the area open to fishing. During that year only two broods and 70 adult ducks were seen. In the two years that followed, however, when this marsh was closed to fishing, a marked increase in both broods and adults was noticed. Study Area IV has the highest interspersion index (45/9) and was foremost in duckling production in 1948 and 1949. By contrast its 1947 output was very low

because that year it was included within the open-to-fishing zone. Because of the constant disturbance from fishermen, was virtually abandoned as a duckling-rearing marsh.

8. Bélanger, L., and J. Bédard. 1989. Responses of staging snow geese to human disturbance. Journal of Wildlife Management 53:713-719.

Authors studied the effects of human disturbance on staging in snow geese (*Chen caerulescens atlantica*) spring and fall in the Montmagny bird sanctuary, Québec, 1985-87. They recorded 652 disturbances (any event causing all or a part of the snow goose flock to take flight) in 471 hr of observation. Rate of disturbance was higher in fall (1.46/hr) than in spring (1.02/hr) ($P < 0.001$). The entire flock was disturbed in 20% of all cases. Mean time in flight was 56 and 76 sec in fall and spring ($P = 0.049$). Transport-related activities, particularly low-flying aircraft, caused > 45% of all disturbances in spring and fall. In 40% of all cases ($P > 0.05$) snow geese stopped feeding following a disturbance. Mean time to resume feeding was 726 sec in fall compared to 122 sec in spring ($P < 0.001$). Disturbance level on a fall day was related to snow goose use the following day ($P < 0.01$). When disturbance exceeded 2.0/hr, 50% fewer snow geese were present the next day. Low-level aircraft flights over goose sanctuaries should be strictly regulated.

9. Bélanger, L., and J. Bédard. 1990. Energetic cost of man-induced disturbance to staging snow geese (*Chen caerulescens atlantica*). Journal of Wildlife Management 54:36-41.

Energetic cost of man-induced disturbance to fall-staging snow geese in Québec was estimated. Two responses of birds to disturbance were considered: (1) birds fly away but promptly resume feeding following a disturbance (Response A), and (2) birds interrupt feeding altogether (Response B). Daylight foraging time decreased by 4% to 51% depending on disturbance levels. Average rate of disturbance (1.46/hr) in Response A resulted in a 5.3% increase in hourly energy expenditure (HEE) combined with a 1.6% reduction of hourly metabolizable energy intake (HMEI). In Response B, HEE increased by 3.4% and HMEI decreased by 2.9% to 19.4%. A 4% increase in night feeding could compensate for energy losses caused solely by disturbance flights (Response A), but a 32% increase in nighttime feeding was required to restore energy losses incurred in Response B. No increase in daily feeding rate was observed between days with different disturbance levels ($P > 0.05$). Authors concluded that man-induced disturbance had significant energetic consequences for fall-staging greater snow geese.

10. Bell, D. V., and L. W. Austin. 1985. The game-fishing season and its effects on overwintering wildfowl. Biological Conservation 33:65-80.

The trend in Great Britain towards extending the game-fishing season may lead to increased encounters between anglers and overwintering wildfowl. This paper considers the effects on wildfowl due to the start of angling activity in March at Llandegfedd Reservoir. The reservoir is large, but anglers and waterfowl exploit the same restricted areas. Eurasian wigeon (*Anas penelope*), green-winged teal (*Anas crecca*), common pochard (*Aythya ferina*) and mallard (*Anas platyrhynchos*) were all driven from their preferred feeding or roosting sites and departed from the reservoir prematurely. Temporary reserve areas are suggested at Llandegfedd Reservoir for wildfowl at the start of the fishing season. The correlation coefficient between waterfowl

numbers and availability of open grassland in each area shows the effect of angling in the following tabulation:

Species	Before angling activity	After angling activity
Wigeon	0.729*	0.038
Teal	0.784*	-0.034
Pochard	0.601*	-0.138

*Significant at 5% level (df = 11).

11. Bennett, L. J. 1938. The blue-winged teal, its ecology and management. Collegiate Press, Inc., Ames, Iowa. 144 pp.

It was found at the beginning of the nest studies that freshly made paths, trampled grass and weeds, film wrappings, nest markers and other disturbances in the immediate vicinity of a nest were very likely to attract predators. Two blue-winged teal nests (0.8%) were known to have been abandoned because of poor study technique during the early stages of work.

12. Berger, T. R. 1977. The Berger report: northern frontier, northern homeland. Living Wilderness 41:4-33.

During their stay on the staging grounds, snow geese (*Chen caerulescens*) are highly sensitive to human presence, noise, and aircraft. Dr. William Gunn described experiments where snow geese would not feed any closer than 1.5 mi (2.41 km) from a device simulating noise made by a compressor station, and birds flying over it diverted their course by 90 degrees or more. Snow geese show evidence of being disturbed by an aircraft by flushing at a mean distance of 1.6 mi (2.57 km) from small aircraft, 2.5 mi (4.02 km) from large aircraft, and 2.3 mi (3.70 km) from small helicopters. They also flushed in response to aircraft flying at altitudes of 8,000 to 10,000 ft (2,440 to 3,050 m), the maximum height at which the test flights were conducted. Deliberate harassing of flocks of snow geese in an area approximately 5 mi by 10 mi (8.05 km by 16.09 km) cleared them out of the area in 15 min. Jerald Jacobson inferred that snow geese may avoid an area as large as 20 mi^2 (32.18 km^2) around an operating drill rig, 28 mi^2 (45.05 km^2) around an operating compressor station, and 250 mi^2 (402.25 km^2) around an airstrip during takeoff and landing of aircraft.

13. Bergman, R. D. 1973. Use of southern boreal lakes by postbreeding canvasbacks and redheads. Journal of Wildlife Management 37:160-170.

Human disturbance of summer-molting ducks may adversely influence their selection of molting lakes. Disturbance by humans on Swan Lake was negligible and canvasbacks (*Aythya valisineria*) were widely distributed on the lake in summer. Dauphin Lake, however, was actively used for recreation by boaters and fishermen and only a few hundred canvasbacks passed their flightless stage at Dauphin Lake well out in the lake far from the nearest food plants and intense boating activity. During fall, thousands of flying canvasbacks readily used the pond-weed-rich southern end of the lake where few ducks were seen in summer. Human activity in

this region was no doubt less frequent during fall than summer, but canvasbacks with the power of flight may be more tolerant of disturbance. Similar circumstances could account for the paucity of summer-molting redheads (*Aythya americana*) at Sagemace Bay even though redheads intensively used nearby Long Island Bay. Sagemace Bay was proximal to the towns of Winnipegosis and Camperville and two roads paralleling the west and southwest shores, while Long Island Bay was relatively secluded.

14. Berry, J. 1939. International wildfowl inquiry, Vol. II, The status and distribution of wild geese and wild duck in Scotland. Cambridge Press. 190 pp.

The disappearance of greylag geese (*Anser anser*) from Scotland is attributed to excessive disturbance from continual shooting, an aerial bombing range, increasing motor traffic and summer trout fishing in lakes previously undisturbed, egg destruction by farmers who do not want greylag geese in their oat fields, the demand for eggs by collectors who offer the hill shepherds good sums for nests, and disturbance by aircraft. The book has sections on greater white-fronted geese (*Anser albifrons*), bean geese (*Anser fabalis*), pink-footed geese (*Anser brachyrhynchus*), snow goose (*Chen caerulescens*), brant (*Branta bernicla*), and Canada geese (*Branta canadensis*). Section II of the book covers 21 species of ducks. The summary for ducks covers natural enemies (crows, gulls, swans, rats, stoats, angler fish, and pike); destruction caused by man (oil pollution, stake-netting for fish, flight-netting, egg-taking, and excessive shooting); results of increasing traffic (road traffic, boats and shipping, and airplanes); and changes in available food supplies (agriculture, natural feeding, drainage and afforestation, and effects of climate).

15. Berry, R. F. 1988. Disturbance to tundra swans by barge and boat traffic. Loon 60:92.

Approximately 750 tundra swans (*Cygnus columbianus*) resting on the Wisconsin side of Pool 5 in the Spring Lake area of the Mississippi River left the water surface and departed the area in a downstream direction due to the upstream passage of a tow [barge]. In another instance, approximately 2,500 tundra swans located in the Weaver Bottoms between Swan and Mallard Islands and Minnesota 14 were disturbed by two small boats; all birds observable left the Weaver Bottoms, formed into V's and departed downstream.

16. Bishop, R. A., and R. Barratt. 1970. Use of artificial nest baskets by mallards. Journal of Wildlife Management 34:734-738.

Nest abandonment was responsible for most mallard (*Anas platyrhynchos*) nest losses in this study. Disturbance by observers was believed to be partly responsible for the abandoned nests.

17. Blokpoel, H., and D. R. M. Hatch. 1976. Snow geese, disturbed by aircraft, crash into power lines. Canadian Field-Naturalist 90:195.

On 8 May 1974 several thousand snow geese (*Chen caerulescens*) were feeding on a stubble field near Pilot Mound, about 145 km southwest of Winnipeg. The birds covered almost the whole field and some were feeding very close to a power line that bordered one side of the field. A light aircraft flying at an estimated height of 100 to 200 ft (30 to 60 m) approached the field

and caused panic among the snow geese. They took wing and in a chaotic mass rushed off the field on the side of the transmission lines. Many geese were injured or killed because they struck the wires, with the total number of birds involved varying from 25 to 75 depending on the person reporting the incident. Several reports of snow goose disturbance in southern Manitoba by light aircraft have been reported, some of which probably involved curious and ill-informed pilots but on other occasions, deliberate harassment.

18. Boag, D. A., and V. Lewin. 1980. Effectiveness of three waterfowl deterrents on natural and polluted ponds. Journal of Wildlife Management 44:145-154.

In 1975, three types of waterfowl deterrent (a model falcon, a moving series of reflectors suspended from a frame, and a human effigy) mounted on floats, were tested for efficacy in deterring waterfowl from entering a series of small natural ponds in the boreal forest of Alberta. Only the effigy appeared to be effective; diving ducks of the genus *Aythya* were affected most. In 1976, the human effigy was tested on an artificial tailings pond that received aqueous and bituminous effluent from an oil sands extraction plant near Fort McMurray, Alberta. Twenty-seven effigies were deployed over the 150-ha pond. Their effectiveness was judged by comparing the number of waterfowl dying in and associated with this pond in 1975 (without deterrents) with number dying in and associated with it in 1976 (with deterrents). Kill figures in 1976 were significantly lower than expected on the basis of relative abundance of birds in the 2 years. It was assumed that this decline was due to the presence of the effigies.

19. Boldreghini, P., L. Casini, and R. Tinarelli. 1988. Lo svernamento delle Oche nell'area delle Valli di Comacchio (The wintering of geese in the Comacchio area [Po Delta, Northern Adriatic]). Supplemento alle Ricerche di Biologia della Selvaggini 14:51-76.

A comparative analysis of regularly or occasionally frequented sites by bean geese (*Anser fabilis*), greater white-fronted geese (*Anser albifrons*), greylag geese (*Anser*), red-breasted goose (*Branta ruficollis*), and barnacle geese (*Branta leucopsis*) showed that shooting pressure was the main factor affecting goose use.

20. Bordignon, L. 1985. Effetti del disturbo antropico su una popolazione di germano reale *Anas platyrhynchos*. (Effects of human disturbance on a population of mallard *Anas platyrhynchos*). Avocetta 9:87-88.

Mallards colonizing an artificial lake (0.47 km²) in northwestern Italy were censused from the 1977, when the lake was filled, to 1984. After 1980 the population was severely reduced as a result of disturbance by from 30 to 200 anglers each day on the shores).

21. Bossenmaier, E. F., and W. H. Marshall. 1958. Field-feeding by waterfowl in southwestern Manitoba. Wildlife Monograph 1, The Wildlife Society, Washington, D.C. 32 pp.

Hunting created disturbances on both lake and upland feeding sites. Field-feeding mallard (*Anas platyrhynchos*) and northern pintail (*Anas acuta*) flocks were dispersed from the easily reached shores, and gathered in less accessible regions in the northeastern and southwestern portions of

the lake. Since hunting from boats was banned these loafing concentrations were rarely disturbed. Well-defined goose flight lines formed during both autumns but usually dispersed after a few days, probably because of hunting pressure on the fields. Geese also preferred the fields near the lake but unlike ducks that were easily forced further away, constantly used them from their arrival until freeze-up almost regardless of weather or shooting. Disturbances by humans on the lake or on fields could not be definitely correlated with variation in flight schedules. However, Girard (1941) in Montana, Pitman (1947) in the British Isles, and Bellrose (1944) in Illinois claim that disturbances, chiefly hunting, caused changes to routines that permitted more peaceful feeding. Hunting pressure at Whitewater Lake may have been too low to influence feeding schedules significantly.

22. Bouffard, S. H. 1982. Wildlife values versus human recreation: Ruby Lake National Wildlife Refuge. Transactions of the North American Wildlife Natural Resources Conference 47:553-558.

This paper summarizes the controversy over conflicts between human recreation and wildlife production at Ruby Lake NWR in Nevada, based chiefly on U.S. Fish and Wildlife Service (FWS) documents and refuge records. The author provides information on the court case arising from a 1978 suit by Defenders of Wildlife. In its decision, the U.S. District Court, District of Columbia (1978:10, quoted from page 556), stated the following: "Neither poor administration of the refuge in the past, nor prior interferences with its primary purposes, nor past recreational uses, nor deterioration of its wildlife resource since its establishment, nor administrative custom nor tradition alters the statutory standard. The Refuge Recreation Act permits recreational use only when it will not interfere with the primary purpose for which the refuge 'was established.' The prior operation of the refuge in a manner inconsistent with that purpose does not change the base point for applying the statute's standard." The first test of the Refuge Recreation Act (1962) set some important precedents for lands managed for wildlife by the FWS. The act and court decision provided strong protection for wildlife from incompatible recreational pressures on NWR's.

23. Bouffard, S. H. 1983. Redhead egg parasitism of canvasback nests. Journal of Wildlife Management 47:213-216.

Nest failure of canvasback ducks (*Aythya valisineria*) was due mostly to human disturbance and cold weather during 1980 rather than to egg parasitism by redhead ducks (*Aythya americana*). However, some nest failures were caused by nest desertion immediately after a visit to the nest.

24. Bourget, A. A. 1970. Interrelationships of eiders, herring gulls, and black-backed gulls nesting in mixed colonies in Penobscot Bay, Maine. Masters of Science thesis, University Maine, Orono. 121 pp.

When Bourget's results are compared with those of Choate (1966) and Clark (1968), the higher nesting success in 1969 was caused by two things. First, in Bourget's study 54% of nests were in the open, with 46% located under nesting shelters which afforded better protection against avian predators. Secondly, human interference in the 1969 study did not involve long periods of disturbance while searching for nests, as performed by Choate and Clark. The present research

primarily involved observations from a blind which resulted in much shorter periods of disturbance to the colony. During this study, the observer's interference affected the breeding chronology of herring gulls (*Larus argentatus*), great black-backed gulls (*Larus marinus*), and common eider (*Somateria mollissima*). As a result of human disturbance the breeding cycles of the species concerned were delayed especially on the two major islands. It is probable that human disturbance, gull populations, gull species composition, and nesting cover have much more influence on common eider nesting success than eider nesting density on a given island.

25. Brakhage, G. K. 1965. Biology and behavior of tub-nesting Canada geese. Journal of Wildlife Management 29:751-771.

Desertions caused by human activities can be a problem in heavily populated areas, but at Trimble this loss was held to a minimum by regulating opening dates of fishing season and by closing nesting areas to trespassers. The author believes there is no evidence that the presence of the investigator causes nest destructions such as described by Hammond and Forward (1956) for dry-land nesting ducks. During the study, 45 female Canada geese (*Branta canadensis*) safely accumulated their clutches in ground nests and started to incubate. Humans and dogs destroyed eight nests, but 95% of the remainder hatched successfully.

26. Braun, C. E., K. W. Harmon, J. A. Jackson, and C. D. Littlefield. 1978. Management of National Wildlife Refuges in the United States: its impacts on birds. Wilson Bulletin 90:309-321.

National Wildlife Refuges (NWRs) are located in 49 of the 50 states and encompass more than 13,678,860 ha. Refuges are vital for habitats and overall conservation of many birds. In 1974, fishing was allowed on 171 refuges with fishing waters being stocked on at least 18 refuges. Excessive use of shallow vegetated areas of lakes and streams by wading and boating fishermen can disturb feeding and nesting waterbirds. Various publics have demanded and received access to 42 NWRs for motor boating and water skiing. Obvious and documented impacts of high speed boating are shoreline degradation, disruption of nesting and feeding with loss of production, and displacement of birds. Sport hunting of wildlife was permitted on portions of 184 national wildlife refuges in 1974, primarily for migratory waterfowl but also for resident game birds and big game. Where endangered species are involved, such as whooping cranes (*Grus americana*) and Mexican ducks (*Anas platyrynchos*), it is difficult to see the rationale for sport hunting of lookalike species. Some refuges have been used as practice areas for low flying military aircraft, others as convenient and inexpensive routes for highway and utility rights-of-way.

27. Brown, P. W., and M. A. Brown. 1981. Nesting biology of the white-winged scoter. Journal of Wildlife Management 45:38-45.

White-winged scoters (*Melanitta fusca*) are easily disturbed by human interference such as the recreational boating that often occurs on lakes that white-winged scoters prefer for breeding. According to the senior author, recreational boaters stopped at islands and disrupted nesting, and water ski enthusiasts and power boaters ran over hens and broods.

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

This paper deals with Jamaica Bay Refuge, which is administered by the National Park Service as part of the Gateway National Seashore. References often are made to human disturbance to loons, gulls, cormorants, and herons, all of which we excluded from coverage. Disturbances were tallied for people walking, worm diggers, horseback riders, joggers, men working, and aircraft. Ducks and brant (*Branta bernicla*) usually went to the water when disturbed on land, and often were not disturbed when on the water. Further, they were intermediate in response to disturbance, in that they do not immediately return to the area from where they were displaced. Birds generally did not respond to subsonic jets, but they always responded to the supersonic transport jets whenever it passed directly overhead. Birds respond to the supersonic noise by flushing although many returned to where they had been.

29. Burton, R. A., and R. J. Hudson. 1975. Activity budgets of lesser snow geese wintering on the Fraser River Estuary, British Columbia. Wildfowl 29:111-117.

Factors such as disturbance and changes in food availability may alter the feeding routine of snow geese (*Chen caerulescens*). One critical factor is the efficiency of feeding in relation to the amount of time available. The time spent in flight, both disturbed and undisturbed, was estimated to be at least 0.25 hrs. However, during periods of excessive wind or harassment this level could increase three-fold. Flight was estimated to constitute 1.0% of all time spent in major activities. Nocturnal feeding occurred both in and out of the hunting season. Fluctuating food availability due to changing tide levels seemed more important than hunter harassment. The early autumn migrants invariably first settled at Brunswick Point in October. This marsh was used both day and night for a short time, but hunting pressure during the day soon forced the snow geese on to Reifel refuge. Suitable conditions encountered at Brunswick apparently caused them to return each night.

30. Campbell, L. H. 1978. Patterns of distribution and behavior of flocks of seaducks wintering at Leith and Musselburgh, Scotland. Biological Conservation 14:111-124.

During 1972-73 there was considerable activity on the shore that affected greater scaup (*Aythya marila*), common goldeneye (*Bucephala clangula*), and common eiders (*Somateria mollissima*) between Leith and Seafield sewers, while the retaining walls for land reclamation at the new sewage works were under construction and completed by 1974-75. It seemed that the observed change in distribution pattern was a short-term response to localized increases in disturbance levels.

31. Campbell, L. H., and H. Milne. 1977. Goldeneye feeding close to sewer outfalls in winter. Wildfowl 28:81-85.

Common goldeneyes (*Bucephala clangula*) were obviously sensitive to sudden loud noises. On 11 occasions when such occurred (for example, blasting or ship sirens) they immediately took flight and left the bay. On 6 days no birds had returned after 2 hours and less than 10 of the original flock returned on the remaining 5 days, although these usually did so within 10 minutes

of the incident. While large vessels anchored in the bay had no effect, smaller boats approaching the flock caused the birds to take flight, normally to the southern part of the bay, from whence they gradually returned once the boat departed. Regular disturbance to birds in the sewer was caused by passers-by on the sea-wall. When approaching from the east, people were visible some distance from the flock, which merely swam further offshore. However, from the west, passers-by tended to come into view suddenly close to the sewer, and the birds usually took flight.

32. Campredon, P. 1981. Hivernage du canard siffleur *Anas penelope* L. en Camargue (France) stationnements et activités [Wintering of the widgeon *Anas penelope* L. in the Camargue region of (France) wintering grounds and their activities]. Alauda 49:161-193.

Disturbances of Eurasian wigeon by natural predators totaled 361, by man totaled 19, by planes totaled 19, and those for an unknown reason 58 (correspondingly as a percentage of the total disturbances: 82.7%, 3.4%, 3.4%, and 10.4%). Disturbances by man or plane generally affected a greater percentage of individuals at one time, 61.5% for man and 49.6% for planes. Time spent in flight per disturbance for predators varied from 8 sec to 58 sec while 34 sec was the duration of disturbance caused by man, and 9 sec by airplanes. Disturbances by man were chiefly by hunters, fishermen, planes, and especially helicopters at low altitude: these chiefly occurred during the day, and nocturnal disturbances were mostly caused by avian predators. Predators caused localized displacements, but those by man on a small body of water caused a total evacuation. If the disturbance occurred on a larger body of water, ducks regrouped in the middle. Ducks were very sensitive to fishermen who went into the water. Man's disturbances modified the periodicity of ducks' activities, and seriously affected feeding.

33. Catchpole, C. K., and C. F. Tydeman. 1975. Gravel pits as new wetland habitats for the conservation of breeding bird communities. Biological Conservation 8:47-59.

The mallard (*Anas platyrhynchos*) comprised 8.0% and the tufted duck (*Aythya fuligula*) 2.4% of the total breeding population in 10 sites studied. Reclamation, pollution, and recreation are obvious threats, but new pressures are continually arising. As the demand for water-based recreation continues to increase, it seems likely that gravel pits will face even more pressure than natural wetlands.

34. Choate, J. S. 1966. Breeding biology of the American eider (*Somateria mollissima dresseri*) in Penobscot Bay, Maine. Masters of Science thesis, University Maine, Orono. 173 pp.

A study area visited daily by Milne (1963) was compared with a relatively undisturbed control area. Although success of common eider was somewhat lower (3%) in the disturbed area, the difference was not significant. However, in this present study success was significantly lower in the disturbed area.

35. Choate, J. S. 1967. Factors influencing nesting success of eiders in Penobscot Bay, Maine. Journal of Wildlife Management 31:769-777.

Human disturbance was indirectly responsible for lowered nesting success. Observations from a blind showed that after an investigator left an island, herring gulls (*Larus argentatus*) and great black-backed gulls (*Larus marinus*) returned much sooner than common eiders (*Somateria mollissima*). Before common eiders returned, nests were highly vulnerable to predation by gulls. When the island was revisited one or more times on the same day, after setting nets or banding common eiders, many newly destroyed nests were evident. Gulls were seen flying back to the island as soon as workers left, and they no doubt destroyed many nests before the common eiders returned. Human disturbance did not appear to directly cause much nest desertion. A few clutches apparently were lost because of overexposure to heat when nests were checked on hot, sunny days. Overheating occurred when many common eiders were flushed from their nests for 2 hours or more. Goose Island, with more than twice as many visits, had 27% nest success--about two-thirds that for East Goose Rock (40%); the difference significant ($P < 0.01$).

36. Combs, D. L. 1987. Ecology of male mallards during winter in the Upper Mississippi alluvial valley. Ph.D. thesis, University Missouri, Columbia. 223 pp.

Hunting pressure was probably the primary factor influencing habitat shifts during early winter from Unit A and greentree reservoirs on Duck Creek Wildlife Management Area to unhunted areas on Mingo National Wildlife Refuge (MNWR). During all 3 years of this study, Unit A was used extensively by mallards (*Anas platyrhynchos*) before and after waterfowl hunting season but received little use during the season. Non-hunting disturbance (e.g. vehicular traffic) may have also influenced mallard distribution in the Mingo Swamp and warrants additional research. Lack of hunting probably contributed to reduced alert activity during early spring, and habitat shifts to unhunted areas on MNWR may have influenced a midwinter decline in alert behavior during 1985-86. Alert behavior was also greater in shallow habitats than in open water zones where disturbance was minimal because of distance from roads.

37. Cooch, F. G. 1958. The breeding biology and management of the blue goose (*Chen caerulescens*). Ph.D. thesis, Cornell University, Ithaca. 235 pp.

The fear of dogs was amply demonstrated at Boas River in 1953 when "waves" of snow geese ran wildly across the tundra pursued by a stray dog. The reaction of snow geese toward intrusion by man is variable, but seems density dependent. Development of tameness was noticed at Boas River, where the same route was followed each day and nests were always approached from the same direction. If the direction of approach was changed a completely different reaction was seen. In the first case, the birds would move away when the investigator was within 6.1 m of the nest, while in the second case birds moved at more than 45.7 m. Females followed a definite ritual when returning to the nest, after turning eggs; or when disturbed by predators or low-flying aircraft. When dense colonies suddenly became reduced to a few scattered incubating pairs, remaining females frequently deserted nests taking only dry young. When geese were disturbed by humans when one gosling was strong enough to follow, the rest of the brood was left to its fate.

38. Cooch, F. G. 1965. The breeding biology and management of the northern eider (*Somateria mollissima borealis*) in the Cape Dorset area, Northwest Territories. Canadian Wildlife Service Wildlife Management Bulletin, Ser. 2, No. 10. 68 pp.

Frequent flushing of birds in the study area and subsequent exposure of eggs to predators seemed to result in heavier than normal egg loss for the common eider. Personnel participating in the investigations agreed that the birds on the study area seemed to be tamer in 1956 than in 1955. There is a possibility that because of greater tameness the birds returned to their nests more quickly or were less prone to desert after being disturbed, thus reducing predation. Undoubtedly some desertion can be attributed to the presence of people in the nesting area.

39. Cooke, A. S. 1987. Disturbance by anglers of birds at Grafham Water. ITE Symposium No. 19:15-22.

Grafham Water in Cambridgeshire is one of the most important wintering sites for waterfowl in Britain. Sailing there has relatively little impact on waterfowl because it occurs only intermittently and disturbance is more or less confined to deep water avoided by most waterfowl. However, bank and boat fishermen arrive in large numbers on every day during the fishing season, and often fish the shallow, sheltered bays and creeks favored by the birds. Detailed observations and results are presented for effects of fishing on numbers and distribution of waterfowl, grebes (*Podiceps* and *Tachybaptus*), and Eurasian coot (*Fulica atra*); an increase of waterfowl at the conclusion of the angling season; effects of the close of angling on distribution of wildfowl species; tolerance distance of mallards (*Anas platyrhynchos*) in specific areas in relation to disturbance and changes after angling closed; comparative approachability of water birds by area of the reservoir; and overall ranking orders for species based on bird counts and controlled approach studies. But ranking lists derived for Grafham might not be applicable elsewhere.

40. Cooper, J. A. 1978. The history and breeding biology of the Canada geese of Marshy Point, Manitoba. Wildlife Monograph 61, The Wildlife Society, Washington, D.C. 87 pp.

During this study, 2,889 nest visits were made to 578 nests (first, continuation, and renests) for an average of five observer disturbances per nest. Only one desertion during the study was believed to have resulted from my activities.

This is in contrast to findings of others where observer disturbance has been cited as a cause of nest abandonment by Canada geese (*Branta canadensis*): Martin (1964:48) who concluded that his investigation contributed to 40% of the total nest losses at Ogden Bay, Utah, Dow (1943:13) who attributed 23% of the nest destruction in his study at Honey Lake, California, to man's activities, and in a more recent study, Hanson and Eberhardt (1971:23), who found that the Hanford, Washington, Canada geese deserted those nests visited most often at a higher rate (12 of 16 nests) than those visited least (3 of 7 nests, $P > 0.05$). Conversely, Geis (1956:416), working with Canada geese in Montana, concluded that disturbance by the investigator was not believed to be an important cause of desertion. Similarly, Weigand et al. (1968:903), who made daily visits to nests of captive geese in Michigan, could assign no nest losses to human disturbance.

41. Coulter, M. W., and W. R. Miller. 1968. Nesting biology of black ducks and mallards in northern New England. Bulletin 68-2, Vermont Fish and Game Department, Montpelier. 73 pp.

Tolerance to disturbance by waterfowl was an individual trait. Hens occasionally deserted their clutches after the first disturbance, but in 30 instances where hens were trapped only one deserted. Hen trapping was attempted at 291 nests and 223 (80%) hens were captured. Desertion of nests after a trap was set was 6% for ring-necked ducks (*Aythya collaris*), 9% for American black ducks (*Anas rubripes*) and 26% for mallards (*Anas platyrhynchos*). Ten of 18 desertions occurred with a group of especially intolerant mallards on Dameas Island. Certain other mallards were more tolerant and only 16% of 49 deserted nests at other islands. Nest abandonment was not as common during the last week of incubation. Human activity on islands is detrimental to successful waterfowl production; the presence of people may discourage nesting. Chances for avian predation were increased because: (1) some potential avian predators returned to the islands sooner than did most ducks, (2) hens flushed generally left nests uncovered, (3) flushing of hens often resulted in pieces of down being left on surrounding vegetation. In certain cases dispersal of broods caused losses.

42. Craighead, J. J., and D. S. Stockstad. 1961. Evaluating the use of aerial nesting platforms by Canada geese. Journal of Wildlife Management 25:363-372.

The exposed position of many nest boxes seemed to invite greater desertion but greatly reduced predation by the added security of an elevated site. Much desertion of Canada Geese (*Branta canadensis*) could be attributed to the disruptive influence of fishermen and sightseers who frequently came close to exposed nesting platforms in Flathead Lake or who occasionally inspected them at close range. There is little doubt that this human interference could be reduced by selecting more secluded sites.

43. Craven, S., and J. Ellis. 1982. Assessment of techniques used in a 5-year program of Canada goose dispersal. Page 56 in M. A. Johnson, ed. Transactions of the Canada goose symposium, 28-29 April 1982, Bismarck, N. Dak. The Wildlife Society, North Dakota Chapter and Central Mountains and Plains Section.

Problems associated with a large concentration of Canada geese (*Branta canadensis*) at Horicon National Wildlife Refuge prompted state and federal wildlife agencies to attempt a 50% reduction of the goose flock during the period 1976-1980. Cultivated foods were removed from the refuge, and water and sanctuary were reduced. Early in the program denial of sanctuary was identified as the critical component of successful flock reduction. Thus disturbance, or "hazing" by airboats, propane exploders, and a combination of the two became the primary techniques. Observations of Canada geese neckbanded at Horicon both within and between years suggested a movement of some birds to Illinois wintering areas during October; a time when, in absence of disturbance, they would likely have remained in Wisconsin. Increased mortality associated with a near doubling of the harvest quota (28,000 - 50,000) from 1976-1978 also appears to have been an important component of flock reduction.

44. Cronan, J. M., Jr. 1957. Food and feeding habits of the scaups in Connecticut waters. Auk 74:459-468.

Human activity did have a strong effect on lesser scaup (*Aythya affinis*) feeding. Areas that were heavily hunted were not subject to lesser scaup feeding during the hunting season. During the fall

and spring many of the feeding areas were not utilized when fishing and boating activities were going on. Even during mid-winter when a comparatively balmy Saturday or Sunday encouraged human activity along the shore, the lesser scaup would not be present in their normal feeding areas.

45. Davis, R. A., and A. N. Wiseley. 1974. Normal behavior of snow geese on the Yukon-Alaska North Slope and the effects of aircraft-induced disturbance on this behavior, September, 1973. Chapter II in W. W. H. Gunn, W. J. Richardson, R. E. Schweinburg, and T. D. Wright, eds. Studies on snow geese and waterfowl in the Northwest Territories, Yukon Territory and Alaska, 1973. Arctic Gas Biological Report Service, Vol. 27.

Up to 400,000 snow geese (*Chen caerulescens*) congregate on the North Slope where they accumulate energy for fall migration. This study documented undisturbed behavior and evaluated effects of overflights. Snow geese were observed at five camps along the North Slope during 663 hours for over 175 flocks; behaviors occurred during 73 natural disturbances and 163 non-experimental overflights. Experimental overflights at 2.5-hour intervals with a Cessna 185 Bell 206-B helicopter were made. Undisturbed snow geese spent 57% of daylight hours feeding (juveniles alone 65-70%). Snow geese were equally prone to flush from fixed-wing aircraft and helicopters, flushed at greater distances from helicopters, but flew longer in response to fixed-wing aircraft. Snow geese accommodated to a varying extent to increased frequencies of overflights. Non-experimental aircraft disturbances averaging 0.25 per daylight hour resulted in a potential decrease of 2.6% in time spent feeding. Experimental overflights at 2-hour intervals by fixed-wing aircraft caused an 8.5% decrease in feeding time, and could cause a reduction of 20.4% in energy reserves for juveniles; the corresponding figure for a helicopter is 9.5%.

46. Dennis, D. G., and N. R. North. 1984. Waterfowl use of the Lake St. Clair marshes during migration in 1968-69, 1976-77, and 1982. Pages 43-52 in S. G. Curtis, D. G. Dennis, and H. Boyd, eds. Waterfowl studies in Ontario, 1973-81. Occasional Paper No. 54, Canadian Wildlife Service.

Factors contributing to increased waterfowl use were larger local mallard (*Anas platyrhynchos*) and Canada goose (*Branta canadensis*) populations, more baited sanctuaries, increase in quantity of waterfowl food plant species as a result of higher lake levels, and the establishment of a National Wildlife Area closed to hunting. Factors that reduced waterfowl use included habitat destruction caused by agricultural drainage; marina developments on wetlands, with resulting increased boat traffic disturbing waterfowl; increased public hunting on areas that had previously been hunted at a low intensity; and population declines in species such as American black ducks (*Anas rubripes*) and ruddy ducks (*Oxyura jamaicensis*)

47. Dennis, D. G., G. B. McCullough, N. R. North, and R. K. Ross. 1984. An updated assessment of migrant waterfowl use of the Ontario shorelines of the southern Great Lakes. Pages 37-42 in S. G. Curtis, D. G. Dennis, and H. Boyd, eds. Waterfowl studies in Ontario, 1973-81. Occasional Paper No. 54, Canadian Wildlife Service.

Limited waterfowl use during both spring and autumn is due to scarcity of aquatic vegetation, although disturbance by pleasure craft also has a minor influence. Mallard (*Anas platyrhynchos*)

and Canada goose (*Branta canadensis*) population rose chiefly due to more use of legal baiting by hunting clubs, and establishment of the St. Clair National Wildlife Area in 1974 increased American black duck (*Anas rubripes*) use. Use by canvasbacks (*Aythya valisineria*), redheads (*Aythya americana*), and common mergansers (*Mergus merganser*) increased much during both spring and autumn as a result of extensive disturbance by boat traffic in the better habitat located in area D along the east shore of Lake St. Clair. Although increased ship traffic in the Outer Bay due to the Nanticoke Industrial Development will not greatly disturb waterfowl, increased potential for an oil spill exists for large portions of the continental populations of both canvasbacks and redheads. Shooting pressure forces most birds to leave shortly after opening of the hunting season. Lesser scaup (*Aythya affinis*) are moderately disturbed by increased power boat traffic.

48. Dennis, D. G., and R. E. Chandler. 1974. Waterfowl use of the Ontario shorelines of the southern Great Lakes during migration. Pages 58-65 in H. Boyd, ed. Canadian Wildlife Service studies in eastern Canada, 1969-73. Canadian Wildlife Service Report, Ser. No. 29.

In several bays there is not much boat traffic and large numbers of diving ducks are able to feed undisturbed. Baited sanctuary areas throughout the marshes increase the carrying capacity for dabbling ducks and Canada geese (*Branta canadensis*). Many redheads (*Aythya americana*) and canvasbacks (*Aythya valisineria*) are present during both spring and autumn in one section of the Detroit River near the mouth of the Canard River, which has limited boat traffic. Although marsh habitat appears to be fair quality, human disturbance and absence of suitable sanctuaries causes lower use by waterfowl than expected. Some dabblers use the area less during autumn because of power boat traffic. Although disturbance during autumn also affects diving ducks, they can rest on the open waters of Lake Erie during the times of peak disturbance on the bay. Dabbling duck habitat is of low quality, except in the Grand River marshes, where heavy hunting pressure and lack of suitable sanctuaries cause most of the dabbling ducks to leave shortly after opening day.

49. Denson, E. P., Jr. 1964. Comparison of waterfowl hunting techniques at Humboldt Bay, California. Journal of Wildlife Management 28:103-120.

The behavior of birds hunted by scullers differed radically from day to day. Sometimes nearer ducks would "leapfrog" no more than 200 yd (188.2 m) while at other times entire flocks would rise and move for 1 mile or more. Scullers disturbed birds and made them more difficult to approach, but movement of flocks of brant (*Branta bernicla*) by scullers were temporary, and probably benefitted shooters in open-water and shore blinds. Waterfowl suffered far more harassment from amateur crab fishermen and pleasure boaters equipped with high-powered outboard motors. Daily pressure exerted by hunters on the spit and the harassment by boaters have been chiefly responsible for eliminating the brant population which once spent November and December on Humboldt Bay. A sector of the bay should be closed to boats from October through April, when large numbers of waterfowl are present. An area of 200-300 acres (81-121.5 ha), less than 10% of the bay, should protect the birds.

50. Denson, E. P., Jr., and S. L. Murrell. 1962. Black brant populations of Humboldt Bay, California. Journal of Wildlife Management 26:257-262.

Few bays along the Pacific Coast of contiguous states have escaped development for commercial or recreational purposes. In most cases this process has greatly reduced the value of bays to waterfowl. Intensive recreational and industrial uses are rapidly depriving brant (*Branta bernicla*) of food and shelter on California bays. So few birds are present prior to January and February that starting the season one or more months before the first of January has little effect on overall harvest. However, hunters concentrate on the early arrivals and, at times, have driven these small flocks from the Bay.

51. Dillon, S. T. 1956. A nine-year study of fall waterfowl migration on University Bay, Madison, Wisconsin; Part 1. Transactions of the Wisconsin Academy of Science, Arts and Letters 45:31-57.

Fishing influences the use of the Bay by waterfowl. This sport is extremely popular during the fall months and the passage of boats through the Bay is often a source of considerable disturbance. On very calm days waterfowl of all species present tend to gather on the open waters of the lake. This may reflect a preference on their part or it may be the result of disturbance by the generally increased boat traffic under such conditions.

52. Dow, J. S. 1943. A study of nesting Canada geese in Honey Lake Valley, California. California Fish and Game 29:3-18.

On March 27, 1939, a Canada goose (*Branta canadensis*) nest containing six eggs was found on top of a haystack. On April 20, the incubating bird was disturbed by photographers and left the nest for approximately 2 hours during the heat of the day. The goose continued to incubate until June 22, when the eggs were taken, examined and found to contain dead embryos after at least 87 days of incubation. On March 18, 1940, a goose nest containing two eggs was found on the top of one end of a large haystack, more than 18 ft (5.5 m) from the ground. Two or more wagon loads of hay were being taken from the opposite end of the stack each day. A last visit to the nest revealed that the goose hatched two goslings in spite of the fact that she had been disturbed each day during the incubation period. Overall, six desertions were directly traced to man's activities. The disturbances of irrigators traveling the canal banks with their dogs were responsible for five, and one was deserted when the author flushed an incubating goose from her nest while two crows were circling overhead. Although the eggs were carefully covered, the goose never returned.

53. Duebbert, H. F., and J. T. Lokemoen. 1980. High duck nesting success in a predator-reduced environment. Journal of Wildlife Management 44:428-437.

Abandonment rates were low: 21 of 1,062 nests (2%) were abandoned during all years. Nearly all abandonments were the result of interference by the researcher when nests contained one to five eggs. Another 31 nests had other fates. Four were destroyed by search vehicles.

54. Dwernychuk, L. W., and D. A. Boag. 1972. How vegetative cover protects duck nests from egg-eating birds. Journal of Wildlife Management 36:955-958.

To simulate the condition of waterfowl nests during the laying period, the authors followed the history of 128 artificial nests that varied in visibility. Among these nests, success in avoiding egg loss to birds was directly correlated with the presence of overhead cover. However, even among those nests that were completely screened by vegetation, 34% were lost. It seemed obvious to the authors that egg-eating birds were reacting to other visual cues such as disturbed vegetation or nest markers left at and around the nests. Disturbed vegetation is much more likely to be the visual cue used by the predatory birds, because, in spite of all efforts to the contrary, it was impossible to approach and leave nest sites, particularly in dense vegetation, without leaving some vegetation disturbed.

55. Dzubin, A., and J. B. Gollop. 1972. Aspects of mallard breeding ecology in Canadian parkland and grassland. Pages 113-152 in Population ecology of migratory birds, papers from a symposium held at the Migratory Bird Population Station, Laurel, Maryland, 9-10 October 1969. U.S. Department of Interior, Fish and Wildlife Service, Wildlife Research Report 2.

The authors believed that wild mallards (*Anas platyrhynchos*) breeding under natural conditions are poor subjects on which to accumulate statistically sound population parameters. They believed this species is particularly sensitive to human interference, especially during brood-rearing.

56. Earl, J. P. 1950. Production of mallards on irrigated land in the Sacramento Valley, California. Journal of Wildlife Management 14:332-342.

Some desertions by mallards (*Anas platyrhynchos*) could have been caused by too frequent interference on the part of the observer. Early in the nesting period, nests were visited every other day. The time between visits later was extended to a week. The only other large loss by predation was in the wheat. The author believes that losses were due in part to trails made by himself in the process of visiting the nests. The author did not believe that predators, starting at random at the edge of a large wheat field, could account for almost a third of the nests without being led to the nests by an investigator.

57. Eberhart, L. E., R. G. Anthony, and W. H. Rickard. 1989. Movement and habitat use by Great Basin Canada goose broods. Journal of Wildlife Management 53:740-748.

Broods of Canada geese (*Branta canadensis*) seemed to be most susceptible to human disturbance during the first few weeks following hatching, but older broods were relatively tolerant of repeated human disturbance. Eight broods residing in the lower stretch of the river had access to shoreline areas within their home ranges that were adjacent to human habitation. These broods showed a significant avoidance of human habitation ($P = 0.02$) and concentrated their activities in portions of their home ranges comparatively free from human disturbance.

58. Edington, J. M. 1980. Recreation and wildlife. Nature in Wales Newsletter 3:10-16.

Edington reviews wildlife-based (bird-watching, angling, and shooting), aesthetic (scenic), and active recreation (climbing, caving, skiing, and sailing). Situations discussed are overzealous

bird-watchers, observation blinds, protective legislation, shooting, lead shot, angler's weights, discarded nylon lines, predator control, trampled vegetation, and sailing as related to disturbances of overwintering waterfowl.

59. Edwards, R. W., and D. V. Bell. 1987. The impact of angling on wildlife. Pages 161-166 in Proceedings of the 4th British Freshwater Fisheries Conference, 1-3 April 1985, University of Liverpool.

Recreational activities such as boating and angling have been reported to disturb some bird species. There are frequently interactions between these activities. Wildlife protection needs wider use of refuges and temporal restrictions on recreational activities at critical stages of overwintering and breeding. Interference of breeding birds which nest along the margins of water bodies by angling and other activities needs further investigation.

60. Edwards, R., and D. Bell. 1985. Fishing in troubled waters. New Science, No. 1446, 7th March:19-21.

At the Llandegfedd reservoir in the Usk Valley, where the fishing season has recently been advanced by 2 weeks to 20 March, anglers choose parts of the reservoir which birds such as Eurasian wigeon (*Anas penelope*) and green-winged teal (*Anas crecca*) also prefer. The reservoir is an important trout fishery, but it also supports the highest number of overwintering waterfowl in South Wales. As a result of the anglers' intrusion, these birds gathered in the center of the reservoir during the day, away from the shallow areas and shore where they would normally feed on grasses and herbs. Birds dispersed from the site after a few days, possibly because of increased sailing activity in central areas. The number of Eurasian wigeon, for example, fell from over 400 to about 60 within a week. This contrasted with a much more gradual emigration from a nearby, undisturbed site at Slimbridge on the Severn Estuary.

61. Einarsen, A. S. 1965. Black brant, sea goose of the Pacific coast. University of Washington Press, Seattle. 142 pp.

A plane flying even 1 or 2 miles away may cause either single or flocked brant (*Branta bernicla*) to take to the air. In some areas, boating activity continually molests birds seeking food in their usual places. During the last 5 years high-speed boats are commonly used from British Columbia to San Quintin Bay in northern Baja California. The use of power dredges intimidates feeding birds in daylight and tends to destroy eelgrass beds. A boating disturbance was observed on Mission Bay, San Diego Harbor, on January 19, 1958. Here at low tide the brant geese could find sanctuary only in small elbows off the main channel in the bay, where they could drift up a mud-bottomed slough for perhaps a few hundred yards (a few hundred meters); but the continual traffic of high-speed boats, traveling at velocities of from 8-40 mph (12.9-64.4 km/hr), prohibited the birds from foraging on eelgrass beds or occupying open water in the channel. Boating activity on Humboldt Bay, California, is also forcing brant geese to spend their nights on the ocean. Serious losses result, for sleeping brant drift unconsciously into the breakers where the heavy sand content beats them down to the ocean floor and they wash ashore as "sanded" dead.

62. Eisenhauer, D. I., and C. M. Kirkpatrick. 1977. Ecology of the emperor goose in Alaska. Wildlife Monograph 57, The Wildlife Society, Washington, D.C. 62 pp.

Emperor geese (*Chen canagica*) had the highest rate of nesting success because they were more reluctant than other species to leave their nests when the authors were in the area. For the 3 years, destruction of nests by natives amounted to 34% of the total number of unsuccessful emperor goose and brant (*Branta bernicla*) nests on the study area and 37% of the total nest losses attributed to predation; this probably will persist for many years. Increased human disturbance in 1972 corresponded to increased desertions and increased egg predation in 1972. Human-induced desertion amounted to 0 in 1971, 4.4% in 1972, 0.9% in 1973, and 1.9% of all eggs overall. About 57% of all emperor goose eggs lost on the study area were from nests classified as successful; investigator disturbance contributed to predation on eggs. Human disturbances frequently caused broods to break up and scatter, or frightened parents to run ahead of their goslings, and undoubtedly caused significant brood mortality. Banding operations can increase the predation of glaucous gulls (*Larus hyperboreus*) on young waterfowl.

63. Ellig, L. J. 1955. Waterfowl relationships to Greenfields Lake, Teton County, Montana. Montana Fish and Game Department Technical Bulletin No. 1. 35 pp.

Human interference is thought to have caused the desertion of three nests containing one egg each and five with complete clutches. Sixteen inactive deserted nests or nest forms of five species with one to nine eggs each were found, suggesting that females not uncommonly abandon uncompleted nests without human interference. Six nests were deserted for unknown reasons. Human intrusion is not believed to have increased nest vulnerability to striped skunks (*Mephitis*).

64. Ely, C. R., and D. G. Raveling. 1984. Breeding biology of Pacific white-fronted geese. Journal of Wildlife Management 48:823-837.

Only one human-induced and one natural nest desertion occurred for greater white-fronted geese (*Anser albifrons*) constituting 2% of 102 nests.

65. Evans, C. D., and K. E. Black. 1956. Duck production studies on the prairie potholes of South Dakota. U.S. Department of Interior, Fish and Wildlife Service, Special Science Report--Wildlife No. 32. 59 pp.

Human interference such as continual activity or a brood beatout, does not diminish use except for the occasional brood driven ashore during the actual beatout. The authors believed that even that brood driven ashore is likely to return once the activity has subsided.

66. Evans, C. D., A. S. Hawkins, and W. H. Marshall. 1952. Movements of waterfowl broods in Manitoba. U.S. Department of Interior, Fish and Wildlife Service, Special Scientific Report Wildlife: No. 16. 47 pp.

Human intrusion was found to influence brood movement in some instances, but it often had little effect and some broods could not be driven from their potholes.

67. Evans, R. D., and C. W. Wolfe, Jr. 1967. Waterfowl production in the Rainwater Basin area of Nebraska. Journal of Wildlife Management 31:788-794.

Miscellaneous causes of nest failure included human disturbance, flooding, burning, and undetermined. Three nests of blue-winged teal (*Anas discors*) were abandoned because of humans.

68. Evenson, D. E. 1974. Migratory waterfowl use of Houghton Lake, Michigan. Masters of Science Thesis, University Michigan, Ann Arbor. 105 pp.

Disturbances from occupied hunting blinds and boats caused birds to seek open waters for refuge during the day. These factors were more significant in preventing ducks from using the Middle Grounds than for any other location on the lake. In pre-season counts, ducks using the Middle Grounds made up 20.7% of duck-use days; after hunting started only 7.4% of the duck-use days were in the Middle Grounds. [See the following two papers, which seem to be based on this thesis.]

69. Evenson, D. E., and C. X. Hopkins, Jr. 1973. Waterfowl at Houghton Lake: including an analysis of the influence of food resources and disturbances on waterfowl use. Technical Bulletin No. 73-3, Michigan Department of Natural Resources, Lansing. 69 pp.

The largest-sized disturbances in 1972 (averaging 1,502 birds) were caused by hunters having a blind built directly onto the boat. The second largest disturbance factor on average was the authors' observation study. The value of 372 birds per disturbance is probably out of proportion to the actual disturbance effect on the lake because all disturbances the authors created were tallied. Hunters utilizing floating blinds, who were the most numerous type of hunters on the lake, caused an average disturbance of 232 birds. Non-hunting disturbance factors caused fewer and smaller disturbances than hunters did during the hunting season. However, in pre-season observations, fishermen created five disturbances averaging 537 birds per disturbance.

70. Evenson, D., C. Hopkins, and G. Martz. 1974. Waterfowl and waterfowl hunting at Houghton Lake. Michigan Department of Natural Resources, Wildlife Division, Information Circular 171, Lansing. 7 pp.

Disturbances to waterfowl on Houghton Lake during early fall and hunting season of 1972 occurred from at least six different sources including boating, fishing, hunting, this study, aircraft, and a bald eagle (*Haliaeetus leucocephalus*). At least 85% of the disturbances involved boats and 53% of the disturbances directly involved hunting activities. The hunting season disturbances affect more ducks than pre-season disturbances primarily because there were more ducks on the lake during the hunting season than before it. During the hunting season of 1972, we estimated that 408,000 waterfowl were involved in disturbances that occurred on the lake. Obviously, individual birds were disturbed more than once per day. When the number of birds disturbed is compared with the duck-use days for the season (408,000/268,000), it can be seen that each duck and American coot (*Fulica americana*) was disturbed about 1½ times per day on the average. Weekend disturbance rates were about 1½ times greater than those during the week.

In spite of the disturbances which occurred, ducks were never seen to leave the lake in 1972 as a result of harassment.

71. Figley, W. K., and L. W. VanDruff. 1982. The ecology of urban mallards. Wildlife Monograph 81, The Wildlife Society, Washington, D.C. 40 pp.

During January-March, many mallards (*Anas platyrhynchos*) were wary of humans, often flying 60 m in advance of an approaching boat. They were reluctant to take food from people. During the rest of the year, lagoon ducks were much less apprehensive and paid little attention to moving boats. Increased wariness during winter may be due to an increased number of wild migrant birds in the Angelholm flock. One of seven factors contributing to severe brood losses in the lagoon was the capturing and scattering of broods by people. Lesser (pers. comm.) noted that the total hatch of 28 and 13 mallard ducklings during 1974 and 1975, respectively, on a small campus pond was destroyed by cats and dogs.

72. Fraser, M. W. 1987. Reactions of sea-ducks to windsurfers. British Birds 80:424.

The author on 22 June 1981 was watching a flock of 400 common eiders (*Somateria mollissima*) about 200 m close inshore and about 220 black scoters (*Melanitta nigra*) 400 m out to sea. Suddenly the common eiders took off eastward to the open sea; a few seconds later, the black scoter flock reacted similarly. The author then noticed that a windsurfer had come into view 500 m to the west and 250 m from the shore around a rocky headland. Some 10 minutes after he had disappeared, the common eiders made their way back, but the black scoters were not seen again. By contrast to the sail and engine-powered dinghies and small boats, the appearance of the windsurfer produced instant panic. Dr. C. H. Fry then inserted an editor's comment as follows: "Casual observations on the Ythan Estuary, Grampian, which I walked for an hour or two in most weeks up to 1986, suggested that none of the wildfowl was much disturbed by the activities of up to about 20 windsurfers who were often present. The ducks, mainly common eiders, long-tailed ducks (*Clangula hyemalis*), red-breasted mergansers (*Mergus serrator*), common goldeneyes (*Bucephala clangula*) and Eurasian wigeons (*Anas penelope*), simply moved a minimum distance, 100-300 m perhaps, out of the way. The wildfowl might, of course, initially have been scared; if so, they adapted rapidly."

73. Frederick, R. B., W. R. Clark, and E. E. Klaas. 1987. Behavior, energetics, and management of refuging waterfowl: a simulation model. Wildlife Monograph 96, The Wildlife Society, Washington, D.C. 35 pp.

A stochastic simulation model designed to test alternative management schemes on refuging waterfowl populations was constructed from data on fall-migrating snow geese (*Chen caerulescens*) at the DeSoto National Wildlife Refuge. Components of the model include population level, food density and distribution, food-searching flight characteristics, feeding rates, activity and energy budgets, migration rates, and effects of weather, hunting pressure, and land management practices on the system. Data were collected to test the model's validity. Refuge population level was not sensitive to shifts (±20%) in the input values of 25 selected parameters, but hunting mortality and daily foraging distances were sensitive to several combinations of parameter perturbations. Model outcome was most sensitive to changes in

digestive efficiency, mean food density, and the proportion of refuge fields in which food was available. In other model experiments, increased hunting pressure caused significant ($P < 0.05$) increases in hunting mortality and a reduction in the refuge population. The effect of hunting was less important in reducing waterfowl population size than the associated disturbance of feeding snow geese by hunters.

74. Fredrickson, L. H., and R. D. Drobney. 1979. Habitat utilization by postbreeding waterfowl. Pages 119-131 in T. A. Bookhout, ed. Waterfowl and wetlands--an integrated review. North Central Section, The Wildlife Society, La Crosse Printing Co., La Crosse, Wisconsin.

Reduced caloric intake can have a dramatic effect on the time needed for waterfowl to replenish fat reserves. Reducing the daily caloric intake by 19% (390 kcal/day) more than doubles the estimated time required for fat replenishment, but these estimates represent a simplified case and actual requirements may be different. Concentrating waterfowl creates two problems that could adversely affect their energy budgets. First, food supplies become depleted more rapidly. Decreased food availability necessitates increased foraging time and/or longer foraging flights for those species that field-feed. Secondly, hunting pressure tends to increase in areas where waterfowl concentrate. Harassment by hunters could increase movements and reduce time available for foraging.

75. Fredrickson, L. H., and F. A. Reid. 1988. Waterfowl use of wetland complexes. Pages 1-6 in Managing waterfowl habitats: breeding, migrating, wintering. Gaylord Memorial Laboratory, University of Missouri, Puxico, Missouri/U.S. Department of Interior, Fish and Wildlife Service, Office of Information Transfer, 1025 Pennock Place, Suite 212, Fort Collins, Colo. 80524.

Refuge management may require manipulation of soil and water to produce habitat structure or essential foods. Production of foods does not assure that waterfowl will use them. Foods only are accessible if appropriate water depths are maintained during critical time periods, habitats are protected from disturbance, and habitats that provide protein and energy are close together. Disturbance is particularly important, and recognition of the influence of disturbance on access to and acquisition of needs throughout the annual cycle is essential. Subtle effects caused by bird watchers, researchers, and refuge activities during critical biological events may be as detrimental to waterfowl populations as hunting or other water-related recreational activities such as boating. At certain locations, predators or activities associated with barge traffic, oil exploration, or other industrial or military operations are detrimental.

76. Fruzi ski, B. 1977. Feeding habits of pink-footed geese (*Anser fabalis brachyrhynchus*) in Denmark during the spring passage in April 1975. Danish Review of Game Biology 10:1-11.

Because of the very narrow isthmus between the North Sea and the Nissum fjord and the considerable disturbance there by man and vehicles the geese often fed outside the area during day-time. During the feeding period at the Fiilso area the pink-footed geese were very sensitive to disturbance, (e.g. by farmers and vehicles). The "tolerance distance" was generally about 300

m, and only exceptionally 200 m during windy and rainy days. Geese usually fed and rested in the middle of the fields, far from roads, where they were most secure. Often disturbed at midday, they moved to the edges of the area into grassland where no farm work was being done.

77. Gauthier, G., J. Bédard, and Y. Bédard. 1984. Comparison of daily energy expenditure of greater snow geese between two habitats. Canadian Journal of Zoology 62:1304-1307.

Snow geese (*Chen caerulescens*) flew mostly when disturbed or between the marsh and adjacent farmland, and these flights were of short duration.

78. Geis, M. B. 1956. Productivity of Canada geese in the Flathead Valley, Montana. Journal of Wildlife Management 20:409-419.

Disturbance by the investigators was not believed to be an important cause of desertion, since visits were short and the Canada geese (*Branta canadensis*) were not kept away from the nest long enough to cause chilling of the eggs. Human disturbance over extended periods apparently did increase the desertion rate. This was indicated on two islands in the lake where people were living during part of one nesting season. In one case six out of eight nests were deserted, and in the other six out of nine nests were deserted. In years of no human disturbance, nesting success was above average on these two islands.

79. Gilbert, B. 1977. Uncle Sam says SCRAM! Audubon 79:42-55.

The general objective was to make the Horicon National Wildlife Refuges less attractive to Canada geese (*Branta canadensis*). To accomplish this, acreage previously used for growing goose food was reduced, and a plan was devised to harass, haze, and frighten Canada geese away from Horicon as they arrived in late fall. In summer, an aircraft, an airboat, gas-powered exploders, assorted firecrackers, rockets, and scarecrow-type devices were assembled. In 1965 the peak Canada goose population at Horicon was estimated at 120,000 birds. In November 1966 after hazing, peak population was 150,000. The Fish and Wildlife Service later began making specific plans to again harass Horicon Canada geese to reduce the peak fall population of Canada geese at Horicon from 200,000 to 100,000 by 1980.

80. Girard, G. L. 1941. The mallard: its management in western Montana. Journal of Wildlife Management 5:233-259.

Before hunting season, it is not unusual to see mallards (*Anas platyrhynchos*) feeding at any time of the day in the wheat fields, but most of the field feeding takes place in the evening and at night. The largest flights return to the water between 7:30 and 8:30 a.m. During the hunting season, with legal shooting hours from 7:00 a.m. to 4:00 p.m., practically all mallards return to water areas between 6:30 a.m. and 7:l5 a.m., and leave in large flocks between 4:30 and 6:00 p.m. After hunting season, they again change their habits.

81. Glover, F. A. 1956. Nesting and production of the blue-winged teal (*Anas discors* Linnaeus) in northwest Iowa. Journal of Wildlife Management 20:28-46.

In 1948 one blue-winged teal nest was destroyed by bluegrass seed-stripping machinery. Another blue-winged teal nest was deserted by the female after curious workmen visited the nest several times in a day. A teal nest in Whitford's Slough in 1949 apparently was deserted by the female after being flushed by the investigator. This was unusual, for most of the females generally returned to their nests within a few hours. At Barringer's Slough in 1949, an incubating female was unintentionally stepped on by the investigator while searching dense nesting cover. Two of her eggs were broken. The female flew about 30 yd (28.2 meters) and landed in dense vegetation. Damaged eggs were carefully removed from the nest and the cover returned to its original appearance. A recheck on the nest a week later revealed that the female had successfully brought off a brood of ducklings. It is doubtful if flushing the ducks from nests had a detrimental effect on success. Often successful nests found in Dewey's Pasture in 1949, nine were located by flushing the female. At Whitford's Slough, two of the three successful nests were found by flushing the female.

82. Goss-Custard, J. D., and K. Charman. 1976. Predicting how many wintering waterfowl an area can support. Wildfowl 27:157-158.

There is often a need to predict whether or not wintering waterfowl displaced from their normal feeding grounds by man's activities could be accommodated elsewhere. This short paper discusses and contrasts methods for studies of brant (*Branta bernicla*) in southeast England (K.C.) and wading birds (Charadrii) and shelduck (*Tadorna* sp.) on the Wash. Only an Abstract appears.

83. Götmark, F., and M. Åhlund. 1984. Do field observers attract nest predators and influence nesting success of common eiders? Journal of Wildlife Management 48:381-387.

The authors tested whether avian predators are attracted to islands in southern Sweden where observers flush incubating common eiders (*Somateria mollissima*). The abundance of hooded crows (*Corvus cornix*) was slightly lower after disturbance than before, although many common eider nests were exposed after disturbance. Crows did not increase their foraging effort or success in finding nests on the islands following disturbance. Herring gulls (*Larus argentatus*) and great black-backed gulls (*L. marinus*) were slightly attracted to the disturbed islands and tended to increase their foraging effort and success. Although we observed more depredations after disturbance than before, clutch size and frequency of robbed nests did not differ ($P > 0.10$) on disturbed and undisturbed islands. All nests were covered by the observers, and this probably protected the nests; simulated nests with exposed eggs experienced much higher predation than those covered with down.

84. Greenwood, R. J., A. B. Sargeant, D. H. Johnson, L. M. Cowardin, and T. L. Shaffer. 1982. Mallard nest success and recruitment in prairie Canada. Transactions of the North American Wildlife Natural Resources Conference 52:298-309.

Nests of mallards (*Anas platyrhynchos*) that were abandoned within a few days after discovery were considered to be investigator-influenced and were not used to measure survival in this paper.

85. Grieb, J. R. 1970. The shortgrass prairie Canada goose population. Wildlife Monograph 22, The Wildlife Society, Washington, D.C. 49 pp.

Prior to 1960, before harassment of birds at the Waggoner Ranch, the ranch fulfilled needs for this segment of the population. Since that time, Canada geese (*Branta canadensis*) have been constantly shifted about in the general area and no adequate provision has been made for their protection. Admittedly, harvest has improved under such a situation, but harvest cannot be controlled and the long-range effect on the geese may be detrimental. It would be better to keep these birds spread over their general wintering area instead of concentrating them on a single refuge area that might promote firing lines.

86. Gunn, William W. H. 1973. Environmental stress on the whistling swan. Wildfowl 24:5-7.

Tundra swans (*Cygnus columbianus*) are relatively undisturbed on the Mackenzie Delta, but the Delta is now a center of exploration for underlying fossil fuels. A major oil spill will be a continuous threat for years to come, and perhaps more important, human and mechanical disturbance on an unprecedented scale is a virtual certainty. There is safety in the isolation of the Arctic Coast but for one new development--the skidoo or snowmobile. The sale of skidoos is being pushed hard and Eskimos have taken to them enthusiastically. Snowmobiles make it possible to cover long distances along the coast, and tundra swans make a large and tempting target for their users.

87. Hansen, H. A., P. E. K. Shepherd, J. G. King, and W. A. Troyer. 1971. The trumpeter swan in Alaska. Wildlife Monograph 26, The Wildlife Society, Washington, D.C. 83 pp.

The Copper River study led to the conclusion that disturbance by humans during the brood season should be kept at a minimum. Both commercial and sports fishermen were frequent visitors as well as many people who traveled the road for a casual drive, photography, hiking, picnicking, hunting, target shooting, and other recreational activities. Although trumpeter swans (*Cygnus buccinator*) on the Copper Delta may not have been molested intentionally by the public, the varied and more frequent level of human activity seems to have had a detrimental effect in comparison to more isolated areas. A forced and rapid movement of cygnets from one body of water to another less secure, induced by human intrusion, seemed to be the most important factor causing higher mortality rates. Trumpeter swan broods exited from natal ponds when these areas were disturbed.

88. Hanson, W. C., and L. L. Eberhardt. 1971. A Columbia River Canada goose population, 1950-1970. Wildlife Monograph 28, The Wildlife Society, Washington, D.C. 61 pp.

Humans occasionally removed eggs from nests of Canada geese (*Branta canadensis*), broke eggs, or destroyed nest markers on lower islands 18, 19, and 20 which were open to public access. The greatest damage from man, however, was through harassment caused by picnics, beach parties, photographing nests, etc. Originally the beginning of the goose nesting season was publicized with public appeals through the news media that asked people to stay off the islands

until mid-May; however, there was less destruction of nests when no publicity was used during later years of the study.

89. Hansson, L. 1966. Studies on the adaptation of the mallard (*Anas platyrhynchos*) to urban environments. Vår Fågelvärld Supplementum 4:95-140.

When ice forms on the river, mallards are concentrated in the holes in the ice, which in exceptionally cold weather may be reduced to two in number. Difficulties in counting do not appear until the number of mallards is approaching a thousand. The birds are exposed to some disturbances from wanderers along the river bank and also to the mallard counter. They react by disappearing only on particular occasions. During the summer there is quite a lot of traffic on the river. Especially the motor boats seem to have increased in number during recent years. Mallards living in town during summer seem to have adapted to this traffic and ignore it completely. The greatest disturbance factor consists of people wandering or skating on the ice in winter. When such a disturbance has occurred during a census, the count has been repeated later. Birds are in the habit of circling around above the river during a disturbance, and normally return soon after it is over.

90. Heitmeyer, M. E. 1985. Wintering strategies of female mallards related to dynamics of lowland hardwood wetlands in the Upper Mississippi Delta. Ph.D. Thesis, University Missouri, Columbia. 376 pp.

Mallards (*Anas platyrhynchos*) wintering in the Mingo Basin changed their habitat use, daily time budgets, and food habits in response to human-related disturbance. Hunting was the main disturbance, but vehicular and foot traffic were also involved. Refuge areas were especially important during hunting seasons as evidenced by concentrations of mallards on certain areas. Effects of hunting disturbance are not entirely known but potentials were outlined in an earlier study. Disturbance seems most detrimental to wintering mallards in late winter and spring.

91. Henry, W. G. 1980. Populations and behavior of black brant at Humboldt Bay, California. Masters of Science Thesis, Humboldt State University, Arcata. 111 pp.

Use of specific areas by brant (*Branta bernicla*) and daily flight activity were influenced by tidal level, food availability, time of day, and particularly by hunting disturbance. Areas affected by human activity were used at lower densities than areas without these disturbances. Brant reacted to open-water hunting by leaving the Bay and flying to the ocean where there was little food. Brant were particularly susceptible to disturbance by aircraft, especially helicopters. Flights below 300 m often caused flocks to move to the ocean. Denying the birds an undisturbed feeding place during the day could result in a loss of energy and a lowering of body weight at a time when they need to prepare for northward migration and breeding.

92. Heusmann, H. W., and R. G. Burrell. 1974. Park mallards. Pages 77-86 in A symposium on wildlife in an urbanizing environment. 27-29 Nov. 1973, Springfield, Mass. Massachusetts Cooperative Extension Service, Amherst, Mass. 182 pp.

The greatest source of nest and brood destruction may result from the human disturbance. During the spring of 1973, two youngsters were seen rowing around a lake collecting eggs from all the mallard (*Anas platyrhynchos*) nests they found. Another person reported that many times he has observed people in motorboats intentionally run down broods of ducklings and in one instance beat a number of ducklings to death with paddles. We also have received reports of ducks in parks being stoned or clubbed to death. Well-meaning people can also cause nest destruction. At Norumbega park, employees of a motel brought food daily to a nestling mallard but the nest was destroyed by a predator that may have been attracted by the scent of the food. Results of a questionnaire and interviews with people observing or feeding the ducks are included.

93. Heyland, J. D., and W. T. Munro. 1967. The use of helicopters in hunting waterfowl nests. Journal of Wildlife Management 31:200-201.

The helicopter rotor spread was 35 ft (10.7 m) but the area affected by the downdraft was 45-50 ft (13.7-15.3 m) in diameter. It was apparent that the agitation of the nesting cover caused by the downdraft, coupled with the noise of the engine, was sufficient to cause ducks to flush. In addition to being faster, cheaper, and more efficient, use of the helicopter has other advantages, such as a reduction in nest desertion due to nest hunting activities. When examined the day following the survey, none of the nests located by the helicopter crew had been abandoned. By kneeling on a pontoon to locate, examine, and mark nests without landing or leaving the hovering helicopter, no human scent is left, the vegetation does not appear disturbed, and no trails are left for predators.

94. Hochbaum, H. A. 1944. The canvasback on a prairie marsh. American Wildlife Institute, Washington, D.C. 201 pp.

When flushed from the nest during egg-laying and early-incubation periods, female canvasbacks (*Aythya valisineria*) invariably leave by way a lane, swimming to open water, and then flying if approached too closely. Some leave while the canoe is still a quarter mile (0.4 km) or more away. Towards the end of incubation the female sits closely, flushing directly from the nest when the intruder is a few yards away. After absences induced by disturbance, the hen may return to find her brood dispersed and may fail to retrieve them all.

95. Hochbaum, H. A., S. T. Dillon, and J. L. Howard. 1954. An experiment in the control of waterfowl depredations. Transactions of the North American Wildlife Conference 19:176-185.

The observations of the first 2 years of study at Delta, Manitoba indicate that (1) patrol of areas by a trained man helped reduce losses of unharvested grain in outlying fields, (2) a combination of gunfire and scaring devices was effective but gunfire had to persist for several evenings in wet fields and be repeated when the harvest was long delayed, (3) ducks need not be killed if scaring is to be effective.

96. Hume, R. A. 1976. Reactions of goldeneyes to boating. British Birds 69:178-179.

Other waters often have an increase in waterfowl in late winter and early spring but this was not evident at Chasewater, and in the winter of 1974-75 the totals from late January were much lower than in December, almost certainly because of the increased frequency of midweek boating. Repeated observations showed that common goldeneyes (*Bucephala clangula*) often fly when people on the shore approach closer than 100 or 200 m but invariably settle again elsewhere on the water. A single sailing dinghy, however, may be sufficient to cause over 60 common goldeneyes to take flight and most to leave entirely within a few minutes. Any remaining birds then fly up each time the boat approaches to within 300-400 m and generally leave within an hour. A powerboat causes virtually instantaneous flight as soon as it appears on the water, the majority of birds leaving, and, if it traverses the length of the reservoir, all the remaining birds leave within minutes.

97. Hummel, V. D. 1980. Durchzug und überwinterung der kurzschnabelgans (*Anser brachyrhynchus*) im bereich der Nordseeküste (1974-1977). [Migration and winter distribution of the pink-footed goose (*Anser brachyrhynchus*) in the coastal area of the North Sea (1974-1977)]. Die Vogelwelt 101:121-131.

Resting along the way does not last long, particularly at the time of duck hunting along the entire German coast. Hunting so disturbs the pink-footed geese that they are quickly on their way. [translated]

98. Hunt, E. G., and W. Anderson. 1966. Renesting of ducks at Mountain Meadows, Lassen County, California. California Fish and Game 52:17-27.

Desertion in the 1956 study, 29.5%, was about 10% higher than that recorded in 1954. This increase probably resulted from disturbance of normal nesting activities by nest-trapping. Nesting mallards (*Anas platyrhynchos*) were difficult to trap and deserted readily.

99. Jahn, L. R., and R. A. Hunt. 1964. Duck and coot ecology and management in Wisconsin. Wisconsin Conservation Department Technical Bulletin 33, Madison. 164 pp.

This bulletin reviews Zimmerman's (1953) paper where it was reported that some Wisconsin lakes bordered with homes were so heavily used for recreation in the early 1940's that breeding ducks were discouraged from utilizing otherwise suitable habitat. Human activities on and near permanent water have increased tremendously. Activities of shore residents, fishermen, and boaters seem to discourage breeding waterfowl from using otherwise adequate habitat. On aerial waterfowl censuses, many duckless lakes with excellent stands of submerged aquatic plants were seen. This is especially true on smaller (under 1,000 acres (405 ha)) lakes with numerous piers and boats. Dillon (1956:37) reported that, on the 180-acre (72.9 ha) University Bay waterfowl refuge, fall fishing influenced use of the area by waterfowl, and boats on the bay often caused considerable disturbance.

100. Jessen, R. L. 1981. Special problems with diving ducks. Paper presented to the Fourth International Waterfowl Symposium, New Orleans, Louisiana, January 31-February 1, 1981. Minnesota Department of Natural Resources, St. Paul. 8 pp.

Lesser scaup (*Aythya affinis*) availability for sport hunting, especially in the Upper Midwest, is influenced by wariness of the birds and their intolerance to disturbance. A largely unrecognized wariness of lesser scaup to all kinds of disturbances, especially sport hunting, reduces their use of many fall habitats in the lake region of the Upper Midwest. Development of appropriate harvest techniques could improve the take of these birds by sport hunting. Such techniques should emphasize availability of feeding and resting areas rather than enlarged seasons and bag limits.

101. Jessen, R. L., J. P. Lindmeier, and R. E. Farmes. 1964. A study of duck nesting and production as related to land use in Mahnomen County, Minnesota. Pages 26-85 in J. B. Moyle, ed. Ducks and land use in Minnesota. Minnesota Department of Conservation, Division of Game and Fish Technical Bulletin No. 8.

Mean flushing distance (feet/meters) of mallard (*Anas platyrhynchos*) and blue-winged teal (*Anas discors*) hens as related to stage of nesting and to repeated visits to the nest (adapted, sample sizes not shown).

		Stage of nesting		
		Laying	**Early incubation**	**Late**
Mallard	1st visit	20/6	6/2	5/2
	2nd visit	24/2	15/5	19/6
Teal	1st visit	7/2	2/1	No data
	2nd visit	4/1	6/2	No data

The authors believed that predation is not significantly increased when reasonable care is exercised by the observer in approaching nests. Nest losses from human intrusion were due primarily to desertion by hens. Increased predation loss because of human intrusion was unimportant.

102. Joensen, A. H., and J. Madsen. 1985. Waterfowl and raptors wintering in wetlands of western Greece, 1983-85. Natura Jutlandica 21:169-200.

In the Amvrakikos wetlands studies were conducted on distribution of ducks and Eurasian coot (*Fulica atra*) in relation to food resources and the impact of human disturbance, especially hunting. Observations on hunting modes were made elsewhere also. The number of hunters is large, and illegal practices are frequently observed, including killing of protected species. Disturbance by hunters often causes mass displacement of ducks from the most important feeding areas. Some species such as northern shoveler (*Anas clypeata*), northern pintail (*Anas acuta*), green-winged teal (*Anas crecca*), and common pochard (*Aythya ferina*) are very sensitive to disturbance. Northern shoveler and northern pintail cease to feed when shooting occurs near them, while Eurasian wigeon (*Anas penelope*) and Eurasian coot are less sensitive and continue foraging at lower intensity. Shooting from motor boats is extremely disturbing. Sportsmen in only 1 or 2 powered punts in Logarou Lagoon and equivalent numbers in Koronisia Bay can

disturb waterfowl so that they stop feeding and eventually abandon the area. Poled fishing punts move rather slowly and generally cause less disturbance. Motor boats generally flush waterfowl and interrupt feeding for a much longer time. In Koronisia Bay fishing boats regularly displace ducks from feeding areas.

103. Johnson, F. A., and F. Montalbano. 1984. Selection of plant communities by wintering waterfowl on Lake Okeechobee, Florida. Journal of Wildlife Management 48:174-178.

Biases associated with their method of collecting data include the possible differential visibility of ducks relative to vegetational cover. Although not quantifiable, it was believed that this bias was reduced because birds tended to flush before the aircraft.

104. Johnson, R. E. 1964. Fish and fowl. pages 453-458 in J. P. Linduska, ed. Waterfowl tomorrow. U.S. Department of Interior, Fish and Wildlife Service. U.S. Government Printing Office, Washington, D.C.

It was recognized that if waterfowl use heavily fished waters for breeding, resting, or feeding, they will be disturbed often by anglers who use boats or fish from the banks. It was suggested that this conflict can be resolved by zoning certain water areas for use by waterfowl or by anglers or by restricting fishing during the season when waterfowl are nesting and rearing their broods.

105. Jones, J. J. 1981. Potential effects of winter shipping on diving ducks wintering on the Detroit River. Masters of Natural Resources Thesis, University Michigan, Ann Arbor. 91 pp.

The author believes winter navigation, if initiated, could pose a serious threat to wintering waterfowl for three major reasons. One reason is that ice-breaking activities could cause ice to be diverted to areas that were previously ice-free during winter. Areas that are susceptible to being covered by diverted ice include important foraging sites for wintering waterfowl. This could decrease waterfowl food availability. Winter shipping may adversely affect food abundance by the resuspension of fine substrates. The coarser substrates left behind could limit important waterfowl foods. There is evidence that waterfowl wintering on the Detroit River were depleting their endogenous energy reserves even when critical shallow water depths were available for feeding. Loss of feeding habitat due to long periods of ice cover may force major portions of the population to either migrate with low lipid reserves, or starve to death.

106. Jones, R. D., Jr. 1964. Age group counts of black brant in Izembek Bay, Alaska. Wildfowl 15:147-148.

Observation points were chosen because of their being free of waterfowl hunters, hence brant (*Branta bernicla*) could approach the shore more closely.

107. Jones, R. D., Jr. 1973. A method for appraisal of annual reproductive success in the black brant population. Masters of Science Thesis, University Alaska, Fairbanks. 117 pp.

Brant (*Branta bernicla*) did not take alarm at an exposed observer, even though he moved a bit, so long as he did not stand upright. Bright yellow oilskins, regular apparel both in and out of boats in Izembek Lagoon, did not deter approaching birds. Disturbing factors, in addition to waterfowl hunters, included airplanes and avian predators.

108. Jones, R. D., Jr., and D. M. Jones. 1966. The process of family disintegration in black brant. Wildfowl 17:75-78.

Flocks of brant (*Branta bernicla*) family groups were easily excitable and quarrelsome. They scrambled into flight at the approach of an airplane as well as an avian predator. Later, following family group disintegration, only low flying aircraft disturbed the large amorphous flocks. In September there were no juveniles unattached to family groups. Between 23 September and 18 October, the degree of interaction in these flocks clearly increased, as did the disposition to fly at the approach of an airplane. When family breakup was complete, the population was composed of a relatively few very large flocks with all age groups represented; hostile encounters were rare and the flock was not disturbed by an approaching airplane.

109. Kalmbach, E. R. 1937. Crow-waterfowl relationships: based on preliminary studies on Canadian breeding grounds. U.S. Department of Agriculture Circular 433. 36 pp.

The author emphasized strongly that careless intrusion of humans into duck-nesting areas creates a serious hazard, for incubating ducks may then be flushed in the presence of American crows (*Corvus brachyrynchos*) and the suddenly uncovered eggs left exposed to view. This is the reason that breeding grounds should be carefully guarded against trespass during nesting.

110. Keith, L. B. 196l. A study of waterfowl ecology on small impoundments in southeastern Alberta. Wildlife Monograph 6, The Wildlife Society, Washington, D.C. 88 pp.

The author wrote that there has always been controversy over the effect of human intrusion on predation during nesting studies. Tracks and trails leading to nest, nest markers, disturbance of nest cover, and observation of nest-finding activity, etc., have been cited as evoking increased predation. Hammond and Forward (1956) thoroughly discussed this problem on the basis of extensive experience at the Lower Souris Refuge, and concluded that when reasonable care was exercised, these factors usually were of minor consequence. However, the author believes there is a much more serious threat to waterfowl in areas where sport fish occur, and that is the general disturbance caused by fishermen. Fishing is a popular recreation on the prairies, and available waters are heavily used. Breeding birds and their young seem to find this disruption intolerable waterfowl populations and production seem to be low under these circumstances. In Alberta this danger has recently grown as small impoundments that previously lacked fish are now being stocked with trout (*Salmo* spp.).

111. Knittle, C. E., and R. D. Porter. 1988. Waterfowl damage and control methods in ripening grain: an overview. Fish and Wildlife Technical Report 14, U.S. Department of Interior, Fish and Wildlife Service, Washington, D.C. 17 pp.

Many methods are available to reduce losses, but success varies. Hazing with exploders, shotguns, rifles, and pyrotechnic devices; scarecrows of many descriptions; and aircraft can all be used to haze and frighten waterfowl.

112. Korschgen, C. E., L. S. George, and W. L. Green. 1985. Disturbance of diving ducks by boaters on a migrational staging area. Wildlife Society Bulletin 13:290-296.

Disturbances of canvasbacks (*Aythya valisineria*) by recreational boaters were studied on the upper Mississippi River to determine frequency of disturbance and possible energetic implications. Twenty-nine random observation periods during morning (30 min before sunrise to 1200 hr) and afternoon (1200 hr to sunset) were used to determine numbers by species, their dominant activity, and distribution on the staging area. Recreational boating activity that resulted in disturbance was recorded as well as flock size and duration of response. An average of 17.2 boats/day resulted in 5.2 disturbances/day. Sport fishermen accounted for 42% of the disturbances. Mean flock size of disturbed canvasbacks was 12,474 with 4.43 minutes/disturbance. Diving ducks were estimated to have left the staging area 19 times during the fall because of human disturbance. Birds may be forced to fly up to 1 hour each day due to disturbance. Energetic costs of the disturbances are unknown, but they may be detrimental if canvasback numbers significantly increase and require more food, American wildcelery (*Vallisneria americana*) winter bud production significantly decreases, disturbances become more severe, or foods at other migration areas deteriorate.

113. Kramer, D. 1984. The effects of recreational activities on the winter wildfowl population at Priory Park Lake, Bedford, during the winter of 1982-83. Ardea 1983-84:34-46.

Counts of wintering wildfowl were made at a 25-ha gravel pit lake before and after sailing and sail-boarding activities; counts with and without disturbance were compared. Recreational activities on the lake were restricted to a particular zone between 1 November and 28 February 1983, leaving a disturbance-free zone; the effect of this on the behavior and distribution of waterfowl was noted. Before zoning, any sailing activities displaced nearly all waterfowl from the lake. During the first month of zoning, sailing activities still caused a significant reduction in number of birds and species present, but after this period nearly all species tolerated the presence of sail-boards and dinghies and remained on the lake in numbers similar to those present on undisturbed days. Species included Canada goose (*Branta canadensis*), Eurasian wigeon (*Anas penelope*), gadwall (*Anas strepera*), green-winged teal (*Anas crecca*), common pochard (*Aythya ferina*), tufted duck (*Aythya fuligula*), long-tailed duck (*Clangula hyemalis*), common goldeneye (*Bucephala clangula*), mallard (*Anas platyrhynchos*), northern shoveler (*Anas clypeata*), and mute swan (*Cygnus olor*). Results in this paper are relatively similar to those in the publication by the same author reviewed below.

114. Kramer, D. 1986. The effects of recreational activity on wintering wildfowl populations at Priory Park Lake, Bedford. Bedfordshire Naturalist 41:21-26.

A 25-ha lake was selected and a disturbance-free zone created. Two visits per day were made on 39 occasions between 18 September 1982 and 28 February 1983. Canada geese (*Branta*

canadensis) were present only once and the flock was obviously alarmed by the first boat launched and departed immediately. Eurasian wigeon (*Anas penelope*) did not seem to be disturbed by the sailing. Mallard (*Anas platyrhynchos*) were affected by the sailing and deserted the lake. People walking, jogging, fishing, or dog walking along the lakeshore had little effect, except when a dog-owner deliberately sent a dog into the water and when the sudden movement of a person breaking into a fast run caused a party of 10 common goldeneye (*Bucephala clangula*) to depart from the lake. During the period before sailing was zoned a low level of disturbance resulted in near total departure of all water birds. During the pre-zoning period, some species such as the green-winged teal (*Anas crecca*) took flight as soon as a single sailboard or dinghy was launched, while common pochard (*Aythya ferina*) and tufted duck (*Aythya fuligula*) followed as soon as the craft approached within about 80 m of the flocks. Common pochard and tufted duck continued to be disturbed by sailing for several weeks (5 weeks in the case of common pochard) after the refuge was zoned. Thus learning probably took place.

115. Kramer, G. W., L. R. Rauen, and S. W. Harris. 1979. Populations, hunting mortality and habitat use of black brant at San Quintin Bay, Baja California, Mexico. Pages 242-254 in R. L. Jarvis and J. C. Bartonek, eds. Proceedings of the Symposium on Management and Biology of Pacific Flyway Geese, Northwest Section, The Wildlife Society, Washington, D.C.

Use of specific areas of the bay by brant (*Branta bernicla*) and daily flight activities were influenced particularly by hunting disturbance. On days without hunting, brant left deep-water areas and flew to eelgrass beds. Brant normally did not fly at other times except when disturbed by aircraft, fishermen, or boaters. Disturbance by hunters resulted in flight activity five to six times greater than on corresponding non-hunt days. Flights were more frequent, occurred sooner after hunting began and involved more birds during the 16 January-28 February 1975 portion of the hunting season (spring migration) than earlier. The intensity of movement to the ocean was significantly related to the level of human disturbance. Aircraft always caused most brant to take flight and remain airborne until the aircraft passed, but only a small portion of the ducks and shorebirds reacted. The authors believe that brant might abandon San Quintin Bay as a migration area as they left Humboldt Bay. They recommended stricter law enforcement; making herding illegal; continuing rest days during the hunt on Monday, Tuesday, and Wednesday; reducing the bag limit; establishing a refuge area; and avoiding ecological changes which would affect eelgrass.

116. Krasowski, T. P., and T. D. Nudds. 1986. Microhabitat structure of nest sites and nesting success of diving ducks. Journal of Wildlife Management 50:203-208.

To minimize investigator-associated nest failure, nests were revisited once after hatch was expected. Nests believed to be influenced by investigator disturbance were excluded from analyses that compared habitat structure with nest success. Nest success was not independent of the time of nest location (= 4.08, df = 1). Nests found early in the laying stage failed more often than those found later. Thus, the nest visit may have contributed to nest failure.

117. Krohn, W. B., and E. G. Bizeau. 1980. The Rocky Mountain population of the western Canada goose: its distribution, habitats, and management. Special Science Report--Wildlife No. 229. U.S. Department of Interior, Fish and Wildlife Service. 57 pp.

Data are presented that show desertion and destruction, no matter what the underlying cause, account for most nest losses of Canada geese (*Branta canadensis*). This has important management implications, since desertion can be minimized in areas with much human activity by regulating fishing seasons and access during the nesting season. A net gain in goslings hatched was recorded from elevated structures and these biologists concluded that structures were a positive management technique, provided they were maintained annually and located in areas away from people. The authors recommended that to more closely control the harvest of Canada geese from individual breeding regions, managers should consider encouraging Canada geese to molt within the region where they hatched. This could be accomplished by restricting recreational use and banding on lakes and reservoirs used by molters during July and August. A lack of disturbance seems especially critical to molters that are just starting to use an area.

118. Laperle, M. 1974. Effects of water level fluctuation on duck breeding success. Pages 18-30 in H. Boyd, ed. Canadian Wildlife Service waterfowl studies in eastern Canada, 1969-73. Report Series No. 29. Canadian Wildlife Service.

Searching effort was reduced from 1968 to 1970, which meant a reduction of interference by observers, but the American black duck's (*Anas rubripes*) nesting success fell from 64% in 1968 to 53% in 1969 and 44% in 1970. There was no such trend for the mallard (*Anas platyrhynchos*) with nesting successes of 36%, 73%, and 61% for the same years. The low in 1968 was attributed to the intensive effort made that year to capture mallard hens on nests.

119. Lebeda, C. S., and J. T. Ratti. 1983. Reproductive biology of Vancouver Canada geese on Admiralty Island. Journal of Wildlife Management 47:297-306.

A molting flock of approximately 300 Canada geese (*Branta canadensis*) at Fools Inlet was monitored weekly. Flightless Canada geese on water or in the intertidal zone fled into the forest when approached by observers in a boat. Similar behavior by flightless Vancouver Canada geese was observed in Adams Inlet in 1973 by Ratti et al. (1977). The authors recommended that human disturbance on Admiralty Island should be monitored and limited in some areas. Tiedeman Island (an island in the Admiralty Island complex) has an important concentration of breeding Canada geese and should also be considered in any management plan that would deal with the impact of human recreation. Known molting sites, such as Fools Inlet and Adams Inlet should be protected from human disturbance during the molting period; elsewhere human disturbance resulted in desertion by molting Canada geese (Sterling and Dzubin 1967).

120. Lee, F. B., R. L. Jessen, N. J. Ordal, R. I. Benson, J. P. Lindmeier, R. E. Farmes, and M. M. Nelson. 1964. Ducks and land use in Minnesota. Minnesota Department of Conservation Technical Bulletin 8. 140 pp.

In the Mahnomen Area 9% of the nests found were deserted by hens. Similar figures for Otter Tail and Pope Areas are 8% and 12%. Some desertion can be attributed to rope-dragging of nesting areas and to nest visits by study personnel.

121. Liddle, M. J., and H. R. A. Scorgie. 1980. The effects of recreation on freshwater plants and animals: a review. Biological Conservation 17:183-206.

This paper reviews the impacts of recreation on freshwater plants and animals, making a distinction between water- and shore-based activities, and between physical and chemical effects. Impacts of water-based recreation resulting mainly from boating, are discussed in terms of wash, turbulence and turbidity, propeller action, direct contact, disturbance to animals, and pollution from outboard motors and sewage. Impacts resulting from shore-based activities, such as angling and swimming, include trampling and associated effects, as well as sewage and other chemical impacts. Management for recreation is also considered. There is relatively more information on the effect of recreational activities on plants than on animals, but the authors consider that further research is required in both fields. Some possible approaches are presented. This review is extensive in the whole, and so is the section on disturbance.

122. Loosjes, M. 1974. Over terreingebruik, verstoringen en voedsel van grauwe gansen Anser anser in een brak getijden-gebied (Habitat use, disturbances and food of greylag geese Anser anser in a brackish tidal area). Limosa 47:121-143.

Greylag geese sleep principally in a dry rush-area, however, often on mudflats because of disturbance. Voluntary dispersal within the Beninger Slikken generally did not have a fixed pattern. Greylag geese fled from disturbance to mudflats or adjoining water. In the event of a serious disturbance, they fled to mudflats. Hunting and planes are disturbing factors. During day-time greylag geese are disturbed an average of one-third of the time, and they have to flee four times a day. In stormy weather with high tide, greylag geese flee to grassland outside the dikes. Recent damming up of the estuary in autumn 1970 will be harmful because of fresh water, probably increased pollution, ceasing of tides, and increase of disturbance. Other threats are increase of recreation, industrialization and aerial traffic, and a decrease of refuge.

123. MacInnes, C. D. 1962. Nesting of small Canada geese near Eskimo Point, Northwest Territories. Journal of Wildlife Management 26:247-256.

On one occasion 16 parasitic jaegers (*Stercorarius parasiticus*) landed at a single snow goose (*Chen caerulescens*) nest within 30 seconds of the departure of the incubating female. The extent of parasitic jaeger predation was much increased by disturbance in the nesting area of Canada geese (*Branta canadensis*), particularly by the presence of a man. In 1959 it was not unusual to count 30 or 40 jaegers within 100 yd (91.4 m) of a man in the blue goose colony.

124. MacInnes, C. D. 1980. Comment: observer-induced predation is real. Journal of Wildlife Management 44:222-224.

This article is a response to Strang's questioning (see paper 182) of parasitic jaeger (*Stercorarius parasiticus*) predation induced by the observer. MacInnes defended his position and suggested

that predator density at Strang's study area may have been less, and he agreed that further work needed to be done to define observer-induced losses of waterfowl nests. See Strang in the same volume on the pages immediately preceding this article (Journal of Wildlife Management 44:220-222), which is referenced herein.

125. MacInnes, C. D., and R. K. Misra. 1972. Predation on Canada goose nests at McConnell River, Northwest Territories. Journal of Wildlife Management 36:414-422.

Predation losses from nests of small Canada geese (*Branta canadensis*) were observed from 1965 to 1969 on a 62-km² study area at the mouth of the McConnell River, Northwest Territories. The lack of significant regression of logarithm of clutch size at first observation on date caused the author to believe that partial loss of a clutch did not occur in the absence of disturbance by humans. Partial clutch losses comprised 55% of all eggs observed lost after repeated visits to individual nests. The proportion of nests completely destroyed did not vary among years, but the proportion losing some eggs did change significantly. The latter difference was due to changes in predator activity, or of their interaction with humans, and not due simply to changes in human activity. Number of eggs lost per visit was the same (0.65 egg per visit) for all clutch sizes except six, which lost 0.26 egg per visit. Greater total destruction of small clutches resulted, because the eggs lost represented a higher proportion of the initial clutch. In the absence of human disturbance, predation losses of eggs would have been approximately 10% and varied little from year to year despite demonstrated changes in predator activity. A major exception to this might occur because of a high arctic fox (*Alopex lagopus*) population, which did not occur during this study.

126. MacInnes, C. D., R. A. Davis, R. N. Jones, B. C. Lieff, and A. J. Pakulak. 1974. Reproductive efficiency of McConnell River small Canada geese. Journal of Wildlife Management 38:686-707.

It was evident by 1967 that widespread searching during the laying period was disturbing the Canada geese (*Branta canadensis*) and leading to increased predation (MacInnes and Misra 1972), so from 1968 onwards searches were made less frequently early in the season, and on less than a third of the study area. Nests were observed until the first young hatched, and broods were enumerated once families reached the feeding area. In the intervening period many goslings were lost, but we made no attempts to find broods at this time because we had learned that our disturbance caused heavy predation by herring gulls (*Larus argentatus*). In the abstract, the authors stated that about half the predation was due to human disturbance, resulting in the loss of 13-31% of eggs.

127. Madsen, J. 1984. Study of the possible impact of oil exploration on goose populations in Jameson Land, East Greenland. A progress report. Norsk Polarinstitutt Skrifter 181:141-151.

Geese are extremely shy and wary when molting and respond noise of helicopters many kilometers away. A significant interspecific difference exists in both the distance of reaction and in the intensity of response. In certain situations the pink-footed geese (*Anser brachyrhynchus*) react to helicopters 20 km away, in general swimming out on open water at 10 km distance, and

clumping in panic when the helicopter is 4 km away. Barnacle geese (*Branta leucopsis*) are less shy and react only moderately to helicopters even 1-2 km away; generally they do not react to helicopters at 4 km distance. Walking past a lake with molting geese often causes them to be driven off, (especially the pink-footed geese). When they are forced to cross the tundra there is a risk of predation by the arctic fox (*Alopex lagopus*). If the lake is connected with a river or a coast, geese may return later in the molting period, but remote lakes will not be recolonized. Twice just prior to moult we drove geese off a lake, and they only returned to one of the lakes later during moult.

128. Madsen, J. 1985. Habitat selection of farmland feeding geese in West Jutland, Denmark: an example of a niche shift. Ornis Scandinavica 16:140-144.

Apart from habitat type, disturbance level and tolerance of disturbance are important factors that segregate the two goose species. In autumn 1982 the majority of the Svalbard population had arrived on Filsö by 8 October, but most geese were scared off by the farmer who feared damage to his crops of winter wheat. The highest pink-footed goose (*Anser brachyrhynchus*) use was found on fields far away from sources of disturbance and with wide open views; these things were not so important for greylag geese (*Anser anser*). Greylag geese avoided the fields which were important to pink-footed, and sought out fields near roads, where the pink-footed were reluctant to go. Greylag geese tolerated a shorter flight distance towards humans and vehicles, 100-300 m vs 300-600 m for pink-footed geese (the distance increasing with flock size). The tolerance of disturbance level contributes to the niche segregation of the two species. The geese are concentrated in a relatively small area with high disturbance levels. Due to farming activities and traffic, geese are daily chased from one part of the farmland to another with a consequent concentration in large flocks.

129. Madsen, J. 1985. Impact of disturbance on field utilization of pink-footed geese in West Jutland, Denmark. Biological Conservation 33:53-63.

The impact of roads and landscape features on field use by pink-footed geese (*Anser brachyrhynchus*) in autumn and spring is reported. Flight distance of goose flocks increases with flock size and is longer in autumn compared to spring. The disturbance distance of roads with traffic volume of more than 20 cars per day is approximately 500 m in autumn and less in spring. Lanes with 0-10 cars per day also have a depressing effect on goose use. Such features as windbreaks and banks which hinder an open view have a disturbance distance of approximately 200-300 m. The width of an area (hindrances in more than one direction) must exceed 500 m in order to be accepted by flocks of pink-footed geese in autumn.

130. Madsen, J. 1985. Relations between change in spring habitat selection and daily energetics of pink-footed geese *Anser brachyrhynchus*. Ornis Scandinavica 16:222-228.

Pink-footed geese put to flight by disturbance must compensate for the lost feeding time (and the higher energy expenditure) by spending increased time feeding in the hours following the disturbance. Pink-footed geese feeding on newly sown fields doubled their daily net energy intake when compared with pasture-feeding pink-footed geese. Converted into net energy intake per peck, the pink-footed geese on the newly sown fields had 16 times more net intake per peck

as pink-footed geese on pastures. If pink-footed geese grazing on pastures in West Jutland spent the same daily amount of time flying as pink-footed geese feeding on newly sown fields (1 hour), they would not be able to compensate for their energy loss while flying, unless they increased pecking rates or the time spent feeding. The energy content of food and food availability is very important to migrant geese.

131. Madsen, J. 1988. Autumn feeding ecology of herbivorous wildfowl in the Danish Wadden Sea, and impact of food supplies and shooting on movements. Danish Review of Game Biology 13:1-32.

The southern part of the Danish Wadden Sea is an important autumn staging area for brant (*Branta bernicla*) (peak numbers 6,000), Eurasian wigeon (*Anas penelope*) (15,000) and green-winged teal (*Anas crecca*) (3,500). In 1985 duck shooting on the mud flats was moderate while in 1986 it was intensified, displacing ducks and brant to a non-shooting zone. This zone was soon depleted for resources, and most of the waterfowl left the area earlier than in 1985 even though food was still available in the shooting zone. Birds fed in the shooting zone at night. Waterfowl numbers were limited by food resources and switching between habitats was linked to depletion of food stocks. Shooting modified movements and caused birds to leave the area prematurely.

132. Maher, M. 1982. Response by waterfowl to hunting pressure: a preliminary study. Australian Wildlife Research 9:527-531.

The movements of ducks to refuges in response to hunting pressure were investigated during the opening of the 1981 duck season. Gray teal (*Anas gibberifrons*), Australian black duck (*Anas superciliosa*), Australian white-eye (*Aythya australis*), and Australasian shoveler (*Anas rhynchotis*) actively sought refuge while pink-eared duck (*Malacorhynchus membranaceus*) did not. Some implications for management are discussed.

133. Mathews, G. V. T. 1982. The control of recreational disturbance. Chap. 42, pages 325-330 in D. A. Scott, ed. Managing wetlands and their birds, a manual of wetland and waterfowl management. Proceedings 3rd Technical Meeting on Western Palearctic Migratory Bird Management, Biologische Station Rieselfelder Münster, Federal Republic of Germany, 12-15 October 1982.

Water-based recreationists increased sevenfold in the last 30 years. In Britain nearly 4 million anglers, half a million boaters, half a million bird-watchers, and other millions make some impact on wetlands. There must be some sort of rationing. Activities that cause disturbance to waterfowl in order of decreasing disturbance are: (1) those involving rapid movement and loud noise (power-boating, water skiing, cruising), (2) those involving movement but little noise (sailing, wind surfing, rowing, canoeing), (3) those involving little movement or noise (sub-aqua, swimming), and (4) those carried out largely from the banks (coarse fishing, game fishing, bird-watching, informal). Tuite et al. (1983) ranked species of winter waterfowl in increasing sensitivity: common pochard (*Aythya ferina*), tufted duck (*A. fuligula*), common merganser (*Mergus merganser*), mute swan (*Cygnus olor*), mallard (*Anas platyrhynchos*), Eurasian wigeon (*A. penelope*), northern shoveler (*A. clypeata*), and common goldeneye (*Bucephala clangula*).

Boats must be kept at least 300 m from a waterfowl area. Banks are more easily zoned than water itself, and bird areas must be strictly off limits to anglers. The paper also discusses how to accommodate bird-watchers and use of wetland display centers to educate the general public.

134. McKenzie, D. F. 1987. Utilization of rootstocks and browse by waterfowl on moist-soil impoundments in Missouri. Masters of Science Thesis, University Missouri, Columbia. 93 pp.

Human disturbance frequently prevented waterfowl from using habitat. Attempts to collect waterfowl eliminated most or all waterfowl use for a few days from a unit that had been supporting large concentrations of birds. This bias caused by research activities form the basis for the opportunistic nature of the censuses. Systematic walk-through counts would have caused additional human disturbance to waterfowl. Unpredictable disturbance resulting from the public is an unknown variable that undoubtedly biased the census data. No gross changes in study impoundment use in relation to duck hunting season were detected.

135. Meltofte, H. 1982. Jagtlige forstyrrelser af sv mme-og vadefugle (Shooting disturbances of waterfowl). Dansk Ornithologisk Forenings Tidsskrift 76:21-35.

During hunting season hunters were present during daytime at more than half the visits by bird censusers in about half of the most important shallow-water areas. At dusk and dawn hunting is even more intense. In western Jutland about 90% of the ducks are found in 20% of the shallow-water area protected against shooting. In autumn large changes in bird distribution occur in connection with the start and end of shooting. Although much information exists on displacement caused by hunting, little information is available concerning the ecological consequences of this for waterfowl. As autumn and winter proceed, feeding becomes progressively more difficult. In winter, disturbances probably have more severe consequences for waterfowl. Probably few individual waterfowl in Danish wetlands during autumn avoid being shot at, or being in a flock which is shot at. Even in the sedentary Danish mute swan (*Cygnus olor*) population, which has been fully protected for 50 years, about 25% carry shot in their tissue. Such extreme hunting intensity has led to great wariness in the birds, so that other innocuous human activities may cause serious disturbances.

136. Mendall, H. L. 1958. The ring-necked duck in the northeast. University of Maine Bulletin, Vol. LX, No. 16. University of Maine Studies, Second Series, No. 73. 317 pp.

Such factors as spring trapping, and unrestrained fishing, picnicking, and boating are usually associated with unsuccessful waterfowl breeding. With an objective to produce more ducks, areas must be selected where this priority can be maintained. Neither American black ducks (*Anas rubripes*) nor ring-necked ducks (*Aythya collaris*) will produce many young under conditions of excessive human disturbance. They will soon go elsewhere to nest. Sizes of Class II and Class III broods have averaged more than two birds higher at Portage Lake in northern Maine since the use of motorboats was prohibited by law in the marsh portion of that lake. Of great concern from the waterfowl standpoint is the increased amount of motor-boating, picnicking, and camping on inland waterways.

137. Mickelson, P. G. 1975. Breeding biology of cackling geese and associated species on the Yukon-Kuskokwim Delta, Alaska. Wildlife Monograph 45, The Wildlife Society, Washington, D.C. 35 pp.

Human activity near brood rearing areas undoubtedly adversely affected broods. When brood counts were made, parent Canada geese (*Branta canadensis minima*) would often outdistance and desert their young, leaving them susceptible to the ever-present glaucous gulls (*Larus hyperboreus*). When brood members became separated after being startled by humans or approaching boats, some young may have been lost. The sound of a boat would send Canada goose families fleeing. Disturbances at the time of onset of nesting caused some reduction in nesting density around the author's camp. Desertion was increased as a result of checking nests early in the laying period. Nest trapping of incubating hen Canada geese resulted in desertions. Predation loss may have doubled because of the presence of the author on the Onumtuk study area. A restriction of unnecessary human activity on the waterfowl nesting and brood rearing grounds is needed. Checking nests of cackling geese several times prior to hatch resulted in twice the normal loss of eggs to predators, and boating led to increased predation on young birds.

138. Mooij, J. H. 1979. Winterökologie der wildgänse in der kulturlandschaft des Niederrheins (Winter ecology of wild geese in the cultivated land of the lower Rhine). Charadrius 15:49-72.

In North-Rhine Westfalia (western Germany), in the area of the river Rhine, between the town of Duisburg and the Dutch-German border thousands of wild geese winter every year. Most of them are bean geese (*Anser fabalis*) but about 12-22% are greater white-fronted geese (*Anser albifrons*). Since the middle sixties goose numbers in this area increased rapidly. Presently there are 22,000-24,000 geese at winter maximum. At the same time the concentration of wintering geese is moving north because more feeding sites and roosts have been sacrificed for industry and recreation; as a result, complaints about goose damage have increased. In order to save a goose wintering area of great international importance, to stop constantly increasing disturbance and destruction of roosts and feeding sites by humans, and to make it easier to compensate for possible goose damage and solve the problems between farmers and geese, it is imperative to create a network of protected goose refuges along the Rhine.

139. Mooij, J. H. 1982. Die Auswirkungen von Strassen auf die Avifauna einer offenen Landschaft am Unteren Niederrhein (Nordrhein-Westfalen), untersuch am Verhalten von Wildgänsen (Inquiry into the effects of open-field roads on behavior of wild geese in the North Rhine, Westphalia, Germany). Charadrius 18:73-92.

In the Lower Rhine area a new highway is planned for an area that is yearly becoming more important for geese since the 1960s. Feeding places that are used by geese are at least 250 m from low traffic roads such as country lanes and at least 400 m from roads with heavy traffic such as highways. Buffer zones surrounding a central feeding area extend from a road or any other source of disturbance to 350 m into the field; the first 250 m is occasionally used by geese until they are disturbed. In the next zone, at a distance of 250-350 m from the source of disturbance, geese feed only irregularly. In the central feeding area two-thirds of the goose days are accounted for. At a distance of 350-450 m from a road or other source of disturbance, geese

are feeding frequently, and at a distance of 450-550 m they are found to feed regularly. The most central part, at least 550 m from every source of disturbance, geese are using very intensely. The construction of the proposed new highway (B 9 neu) through "die Düffel" would reduce the total area of the central feeding places in this region by at least 20%; thus it is not acceptable.

140. Mooij, J. H. 1982. The "Niederrhein" (Lower Rhine) area (North Rhine Westphalia, Federal Republic of Germany), a goose wintering area of increasing importance in the Dutch-German border region. Aquila 89:235-297.

This article discusses international problems at the Dutch-German border, one of which is the difference in hunting regulations between the governments. The result of the ban on hunting in North Rhine Westphalia is that geese wintering in the border region, though still roosting in the Netherlands, feed more on German territory. This leads to actions like those of Dutch hunters, who scare geese feeding in the German border region over the frontier, where their hunting colleagues, warned by walkie-talkie, try to shoot them.

141. Morgan, N. C. 1972. Problems of the conservation of freshwater ecosystems. Pages 135-154 in R. W. Edwards and D. J. Garrod, eds. Conservation and productivity of natural waters. Symposia of the Zoological Society of London 29.

Water-based recreation is increasing; this includes fishing, bird watching, swimming, canoeing, sailing, rowing, picnicking, and holiday boating of various kinds. Many of these activities are incompatible with each other and variably affect the ecosystem. Cottages on the shore and trailer sites can also have detrimental effects. Few quantitative studies have been done in the United Kingdom on effects of disturbance. I. Newton (pers. comm.) found that disturbance of nesting ducks caused a significant increase in predation on eggs. In a control area with 84 nests, which were not disturbed, 17% were predated and in the disturbed study area with 781 nests, 41% were predated. This difference occurred even though the disturbance amounted to only one or two visits to the nests each week. Conflicting activities can be segregated. Zones can be established as wildlife reserves into which no boats are allowed, and in which there is no bank fishing and picnicking. Blinds with screened walkways should be erected for the use of birdwatchers.

142. Morse, T. E., J. L. Jakabosky, and V. P. McCrow. 1969. Some aspects of the breeding biology of the hooded merganser. Journal of Wildlife Management 33:596-604.

The authors concluded that nest abandonment (18.2%), of hooded mergansers (*Lophodytes cucullatus*) was due primarily to nest disturbance by the investigators, and was the main cause of egg loss.

143. Newton, I., and C. R. G. Campbell. 1970. Goose studies at Loch Leven in 1967/68. Scottish Birds 6:5-18.

A boat on the lake, an airplane, or a short-eared owl (*Asio flammeus*) flying over caused the whole flock to fly; they circled once or twice before settling again. Otherwise the birds were initially rather tame towards people; but this changed as soon as they had been shot at, a few days after arriving. In 6 "shooting" weeks, between October and January, geese were much

disturbed, but fewer than 200 were killed as they flew on and off the lake. This was a negligible proportion of the total present. After some shoots goose numbers declined and after others they rose, so probably shooting had no important effect on the numbers of geese using the lake this winter. The same conclusion might not have held for smaller waters or where disturbance was greater. The pink-footed goose (*Anser brachyrhynchus*) is more wary, difficult to shoot, and more easily disturbed than the greylag goose (*Anser anser*).

144. Newton, I., V. M. Thom, and W. Brotherston. 1973. Behavior and distribution of wild geese in south-east Scotland. Wildfowl 24:111-121.

Shooting and other disturbance had less effect on geese using large waters than on those using small ones. On large lakes, goose numbers seemed unaffected after shoots, but small waters were frequently deserted for several days afterwards. Pink-footed geese (*Anser brachyrhynchus*) more often deserted a roost after shooting than did greylag geese (*Anser anser*). When heavily disturbed, both species delayed their arrival until well after dark and made maximum use of the moon for feeding. With limited disturbance on feeding areas, birds almost always found alternative places nearby. Several factors combined to make a site safe and acceptable for roosting; not only actual disturbance but also intrinsic features such as situation, area, openness, and distance from centers of human activity. Dupplin Lake, e. g., was unattractive because of its small size and woodland setting, but had such little disturbance that at times it held more geese than any other site in Britain. Disturbances were, in order of importance, low flying aircraft, shooting, human presence, and unfamiliar and prominent objects like oil drums and scarecrows.

145. Ogilvie, M. A. 1968. The numbers and distribution of the European white-fronted goose in Britain. Bird Study 15:2-15.

Two localities, the Taw/Torridge Estuary and the Towyn/Laugharne Marshes, remain suitable habitats for greater white-fronted geese (*Anser albifrons*) and might attract the birds once more if disturbance due to military airfields were to stop. This also applies to other declining haunts where disturbance is to blame, notably the Burry Inlet and in the Severn and Camlad valleys near Welshpool. Beyond knowing that protection from disturbance of both roost and feeding-grounds has been followed by an increase in numbers, as in the Avon valley, there is little practical knowledge of how to encourage the birds further by possible improvement of the habitat.

146. Ogilvie, M. A. 1981. The mute swan in Britain, 1978. Bird Study 28:87-106.

The increase in the numbers of flooded gravel pits is an obvious feature of many river valleys in the southern half of England. Mute swans (*Cygnus olor*) have colonized many of them, where water sports have not kept them away. Pleasure boating has shown tremendous growth on many river and canal systems in recent years, to the detriment of underwater weed growth and the security of many mute swan resting places. Lead poisoning has recently been found to be a major cause of mortality of mute swans on certain Midlands rivers, such as the Trent and the Avon, where almost every mute swan found dead has been shown to have ingested lead weights discarded by anglers.

147. Ogilvie, M. A., and G. V. T. Mathews. 1969. Brent geese, mudflats and man. Wildfowl 20:119-125.

This paper covers the decline of brant (*Branta bernicla*), control of hunting, habitat conservation, total world population, man's changing of the landscape, etc. Considerable discussion is focused on the adverse effects of disturbance caused by locating an airport amidst the brant. The authors believe the future of brant is in doubt because of the various changes wrought by man.

148. Oplinger, C. S. 1977. Waterfowl populations and water quality relationships in the Allentown park system. Pennsylvania Urban Observatory, City of Allentown. 221 pp.

Human disturbance of nests was not believed to be significant. However, the investigator's visits, although infrequent and conducted so as to cause as little disturbance as possible, may have caused some birds to abandon their nests. Possible predators in an urban setting are dogs and cats which might catch young birds straying too far from water. Park visitors were seen to handle ducklings and this might have separated young from the rest of the brood and caused abandonment.

149. Owen, M. 1972. Movements and feeding ecology of white-fronted geese at the New Grounds, Slimbridge. Journal of Applied Ecology 9:385-398.

Greater white-fronted geese (*Anser albifrons*) first used fields isolated from disturbance. Other fields were used roughly in relation to their size and distance from areas of human activity. Droppings in 40 quadrats, each of 3 m^2, along a single transect were used to analyze the effects of disturbance. Wild greater white-fronted geese will not normally use small fields with high hedges and will not graze under trees. For the purposes of discussion about such landscape form, Owen considers them a "disturbance" factor as well as active disturbance which puts greater white-fronted geese to flight. Owen also discusses directional disturbance, and disturbance such that is non-directional. Low-flying aircraft and hunting have a marked effect on the greater white-fronted geese. Owen believes the most effective forms of disturbance are "directional" and usually arise from human activity; noise is not as serious as visual sightings of moving objects, and fields which are screened from canals or roads by a belt of trees are not affected as much. Owen concludes that if all disturbance were removed from the New Grounds, the potential carrying capacity would more than double, and that disturbance appears to be the most important factor affecting wintering greater white-fronted geese.

150. Owen, M. 1972. Some factors affecting food intake and selection in white-fronted geese. Journal of Animal Ecology 41:79-92.

Many factors affect disturbance. It is well known that quarry species become less wary after the end of the shooting season. Food availability is another important factor, and greater white-fronted geese (*Anser albifrons*) tolerate much more disturbance when food is in short supply, although alertness then occupies more time. Wariness of a flock of greater white-fronted geese feeding in an area may depend on a tradition of disturbance in that area as well as actual disturbing influences at any particular time. On average, 3% of the day is spent being alert with parents spending more time alert than others, thus allowing young birds to feed or rest for longer.

Level of disturbance is important in limiting time available for feeding whether or not disturbance is actual and the birds are put to flight. During the short days of midwinter, grazing greater white-fronted geese spend more than 90% of their daytime feeding with the remainder spent in other essential activities such as drinking, preening, and flight from disturbance. Any enforced increase in these activities compels birds to feed at night, possibly lose weight, and desert the feeding area.

151. Owen, M. 1973. The management of grassland areas for wintering geese. Wildfowl 24:123-130.

Disturbance is the most important factor controlling the availability of food. Heavy shooting pressure keeps geese away from favorable habitat. Riders are less disturbing, and sometimes can approach geese within 46 m. Helicopters are extremely disturbing, and low-flying, small planes can cause geese to fly to roost or refuge areas. Barnacle geese (*Branta leucopsis*) at Caerlaverock were sometimes raised by small aircraft at a distance of 1.6-3.2 km. Even brant (*Branta bernicla*) can become indifferent to larger planes. Noise is less important than visual cues, but sudden sounds usually affect geese. Greater white-fronted geese (*Anser albifrons*) spend about 3% of their undisturbed time alert, but any forced increase of vigilance takes time away from feeding. Avoidance values" were calculated for 47 fields at Slimbridge by giving arbitrary points for distance from roost (0-2), size of field (0-20), extent of hedges or banks (0-5), shepherding frequency (0-15), distance from roads or canals (0-10), distance of bordering roads or canals from field center (0-30). The sum of the avoidance values for each field plotted against mean goose use for four seasons resulted in a correlation coefficient of -0.809 ($P = 0.1$). Greater white-fronted geese can spend more than 2% of their daytime drinking. If water is not freely available, birds have to fly to drink and bathe. Pink-footed geese (*Anser brachyrhynchus*) at Loch Leven travelled several miles to the roost at midday to drink. Geese relying on food of low nutritive value cannot afford such an expenditure of time and energy.

152. Owen, M. 1973. The winter feeding ecology of widgeon at Bridgwater Bay, Somerset. Ibis 115:227-243.

Eurasian wigeon (*Anas penelope*) are very wary and disturbance is extremely important to their feeding behavior. Owen used Fenning Island, a peninsula bounded on one side by the river Parrett estuary and on the seaward side by a shingle ridge, an observation tower and farm access on the third (landward) side to calculate an index to "disturbance" (see his 1973 paper immediately above). Disturbance is fairly heavy from the landward and seaward side, but light on the estuary bank, so the combined distance from the center of each plot to the shingle ridge and to the observation tower was used as a measure of the magnitude of the disturbing influence. Owen expected that differences between plots where droppings were counted would be correlated with distance from disturbance. The correlation coefficient between count of droppings and the summed distance for disturbance was +0.496 (n. s.) in 1968-69; +0.817 ($P < 0.01$) in 1969-70; and +0.325 (n. s.) in 1970-71. Dr. Owen included landscape factors in his calculations. Landscape factors, however, do not fit into our definition of human disturbance, but this is an interesting research approach to disturbance.

153. Owen, M. 1976. Factors affecting the distribution of geese in the British Isles. Wildfowl 27:143-147.

Habitat and food availability are believed to be the most important factors influencing the presence of geese (bean geese *Anser fabilis*, pink-footed geese, *Anser brachyrhynchus*, greater white-fronted geese *Anser albifrons*, greylag geese *Anser anser*, barnacle geese *Branta leucopsis*, brant *Branta bernicla*) as well as past distribution. Both will continue to be altered with changes in disturbance and agriculture, and with various forms of development. The creation by forest clearance of open areas in the past was undoubtedly to the benefit of geese. Other changes, such as increasing restrictions on shooting seasons, loss of interest in hunting and egg collecting because of improvements in human diets, and creation of refuges have more than doubled the numbers of four species of geese in the last 20 years.

154. Owen, M., and G. Williams. 1976. Winter distribution and habitat requirements of widgeon in Britain. Wildfowl 27:83-90.

Large sites afforded greater security from disturbance as well as more extensive feeding areas. On mudflats, feeding is controlled by the tide. Elsewhere wigeon feed by day in undisturbed areas, but when feeding grounds are subjected to daytime disturbance, birds spend the day on the roost. Drainage with its consequent disturbance and increases in recreational activities that result, particularly bird watching, has accelerated the decline of Eurasian wigeon. Bird counters, who were mailed a questionnaire, responded by listing factors they considered as being important threats to Eurasian wigeon (*Anas penelope*). Factors and the incidence of their responses (in parentheses) were: shooting (37), boating and sailing (28), fishing (18), bird watching (9), powerboating and water skiing (6), pleasure flying (2), other recreational activities (13). The preceding were listed under recreation, and the following were listed under commercial/development: industrial development (31), drainage (20), reclamation (12), military activities (4), bird scaring (2).

155. Owens, N. W. 1976. Responses of wintering brent geese to human disturbance. Wildfowl 27:152. (Summary only)

Effects of human disturbance on distribution and behavior of brant (*Branta bernicla bernicla*) wintering in Essex were assessed. Disturbed areas and places with poor visibility for the brant were avoided in early winter, but were used later when favored areas became depleted of food. Brant became partially habituated to the proximity of people and to some loud noises, but did not habituate to small, low-flying aircraft. Disturbance could be ameliorated or reduced by restricting access of people to the sea wall in certain areas around high tide, and by controlling low-flying aircraft in the area.

156. Owens, N. W. 1977. Responses of wintering brent geese to human disturbance. Wildfowl 28:5-14.

Large boats and yachts rarely disturbed brant (*Branta bernicla*), but small boats with noisy outboards caused them to fly. In 168 hours of observation, human disturbance caused some birds to fly an average of once every 81 min. Forty-eight percent of disturbances were by people, most

of whom were on shore; 39% by aircraft, chiefly small planes; 9% by loud noises; and 4% by small boats. Disturbances by aircraft caused about twice as many brant to fly as disturbances by people ($d = 5.3$; $P < 0.001$). Aircraft caused about 1.6 times as much disturbance as people. Without disturbance, brant spent an average of 1.1% of their time in flight. Total time spent flying was correlated with the amount of flying caused by disturbance ($r = 0.93$; $n = 11$; $P < 0.001$). Weekend disturbance stopped brant from feeding for as much as 11.7% of their time, and increased time spent flying as much as sevenfold. Overall, disturbance would probably have been unimportant if adequate food was available. However, food shortages probably prevented full compensation for disturbance.

157. Page, R. D., and J. F. Cassell. 1971. Waterfowl nesting on a railroad right-of-way in North Dakota. Journal of Wildlife Management 35:544-549.

Nest success was calculated on the basis of 80 of 85 nests. Of five nests not included, four were abandoned and one was destroyed by a search vehicle. These desertions were attributed to search operations.

158. Parr, D. 1974. The effect on wildfowl of sailing at Island Barn Reservoir. Surrey Bird Report 1973:74-78.

Sailing activity and waterfowl do not mix well. As sailing takes over the whole water surface, birds are constantly harassed. Birds leaving the reservoir fly off chiefly to Queen Elizabeth II Reservoir. Despite disturbance suffered by the waterfowl on sailing days, birds quickly return to the reservoir on non-sailing days as confirmed by Saturday and mid-week counts during 1972-73 and 1973-74. Sometimes the waterfowl return in smaller numbers than those chased off. Queen Elizabeth II Reservoir is less than a mile from Island Barn and clearly the maintenance of that reservoir as an undisturbed sanctuary is an important factor in maintaining duck numbers in the vicinity of Island Barn. Mallard (*Anas platyrhynchos*) appear to be generally tolerant to sailing. Green-winged teal (*Anas crecca*) numbers in the post-sailing period have been about half of what they were previously. The effect of sailing on tufted duck (*Aythya fuligula*) appears to have been largely on the numbers of molting birds which build up on some reservoirs in August. Numbers in mid-winter have not been appreciably affected. Disturbance of sailing is not to the liking of common goldeneye (*Bucephala clangula*) and they have now almost deserted the reservoir.

159. Parr, D. E., M. D. Scott, and D. D. Kennedy. 1979. Autumn movements and habitat use by wood ducks in southern Illinois. Journal of Wildlife Management 43:102-108.

The two roosts at Union County Refuge were not subjected to direct hunting, and the northern roost at the LaRue-Pine Hills Ecological Area was closed to hunting each noon. These roosts supported large populations of wood ducks (*Aix sponsa*) during hunting season. Wood ducks from the northern roost at LaRue-Pine Hills Ecological Area were harvested by hunters at Oakwood Bottoms Greentree Reservoir until the birds migrated from the area. The area surrounding Union County Refuge was not hunted as intensively for wood ducks, but birds moving from these roosts did provide sport for hunters. Thus, by establishing roosting site refuges, populations of wood ducks can be held during the hunting season to provide continuous,

legal hunting opportunities in surrounding areas. The opposite assumption is that wood ducks would be driven from an area by hunting.

160. Parry, M. L. 1987. Multi-purpose use of waters. Pages 66-71 in P. S. Maitland and A. K. Turner. Angling and wildlife in freshwaters. Proceedings of a symposium organized by the Scottish Freshwater Group and the British Ecological Society. University of Stirling, 30 October 1985. (ITE Symposium 19)

This is a general paper summarizing some of the human disturbances to waterfowl, with descriptions of the use and conflicts at several reservoirs as examples. Key words mentioned are roosting or feeding waterfowl, bird-watchers, water-based recreation, boating, time-zoning of use, space zoning, refuge, flight, energetic costs, fishermen, waterfowl counts, scare distance for mallards (*Anas platyrhynchos*), and "compensatory conservation."

161. Paulus, S. L. 1984. Activity budgets of nonbreeding gadwalls in Louisiana. Journal of Wildlife Management 48:371-380.

Gadwalls (*Anas strepera*) were rarely seen to leave feeding areas during day or night except when disturbed or during hunting season. Hunting pressure in marshes surrounding Rockefeller Refuge forced many gadwalls to leave these marshes during the day and use impounded marshes on the refuge.

162. Pedroli, J-C. 1983. Activity and time budget of tufted ducks on Swiss lakes during winter. Wildfowl 33:105-112.

When ice covered the bird sanctuary, tufted ducks (*Aythya fuligula*) sometimes rested on open water near Neuchâtel, the feeding ground of the Bas-lac region. Boat traffic for hunting, fishing, and sport was dense and produced major disturbances. For Vaumarcus and Yvonand, disturbances were similar but considerably greater than those of the bird sanctuary. Boat traffic was again the main sources of disturbance. Frequent storms forced fishermen to take in their nets at night, which greatly disturbed feeding ducks. These nocturnal disturbances were probably responsible for the decrease in the number of birds in the Bas-lac region. The duration of feeding activity was more or less constant throughout winter and the only increase was noted between the end of November and the end of December when boat traffic on the lake produced increased disturbance resulting in more flight activity that cost energy. On Lake Neuchâtel, the feeding area with the least disturbance was occupied first with the greatest number of wintering ducks. Movement of ducks towards other feeding areas was caused by disturbance at night.

163. Pfeifer, W. K., and S. D. Fairaizl. 1988. Should ducks be frightened? Pages 160-162 in D. W. Uresk, G. L. Schenbeck, and R. Cefkin, technical coordinators. Eighth Great Plains Wildlife Damage Control Workshop Proceedings, General Technical Report RM-154. U.S. Department of Agriculture, Forest Service.

Commonly waterfowl depredations to small grains are resolved by scaring ducks using mechanical scare devices or pyrotechnics. Such scaring can cause waterfowl to damage, by trampling, up to twice the amount of grain consumed. Conditions such as weather, harvest stage,

cultural techniques, farm equipment, length of damage season, availability of alternative feeding sites, and waterfowl population could combine to increase trampling losses. Thus, these conditions should be evaluated to determine if large-scale scaring projects may actually increase damages to small grains. A large number of scare devices were built, collected and distributed throughout the state, including propane exploders, black plastic flags, firearms, 15-mm flare pistols, racket bombs, whistle bombs, noise bombs, cracker shells, and M-80 type bird bombs.

164. Piest, L. A., and L. K. Sowls. 1985. Breeding duck use of a sewage marsh in Arizona. Journal of Wildlife Management 49:580-585.

Nests that were deserted (2.8%), apparently because of disturbance they caused, were excluded from their sample.

165. Prevett, J. P., and C. D. MacInnes. 1980. Family and other social groups in snow geese. Wildlife Monograph 71, The Wildlife Society, Washington, D.C. 46 pp.

When feeding or loafing geese were frightened suddenly, entire flocks of snow geese (*Chen caerulescens*) took off in near unison without normal preflight coordination of families. If flocks were large, birds rose in a confused, clamoring mass and social groups frequently were broken in the disorder. Flocks frightened by the same disturbance mixed together as snow geese circled about before landing again. Disturbances that caused flocks to flush occurred more frequently in Northern States than on the Gulf Coast. Major factors causing disturbances were eagles and aircraft flying overhead, and human activity nearby. Although northern observations were from protected areas, gunfire on refuge boundaries sometimes frightened snow geese inside the refuge while some geese that flew outside the refuge to feed came under heavy fire causing flocks to separate and scatter. Hunting was closed during most of the southern observation period. Disturbances at Squaw Creek in spring were intermediate between fall and winter rates (1.9/hr) and did not differ from either ($P > 0.10$).

166. Purdy, K. G., G. R. Goff, D. J. Decker, G. A. Pomerantz, and N. A. Connelly. 1987. A guide to managing human activity on National Wildlife Refuges. Human Dimensions Research Unit, Department of Natural Resources, Cornell University, Ithaca, New York/U.S. Department of Interior, Fish and Wildlife Service, Office of Information Transfer, 1025 Pennock Place, Suite 212, Fort Collins, Colo. 80524. 57 pp.

Wildlife impact situations were reported by managers of 16 wildlife refuges in Region 5. Shorebirds (61.5%), waterfowl (16.9%), great blue herons (*Ardea herodias*) (12.8%), deer (*Odocoileus* spp.) (5.4%), eastern bluebirds (*Sialia sialis*) (2.0%), loggerhead turtles (*Caretta caretta*) (1.4%), and herons (0.7%) were reported as being affected (20 species total). Wildlife groupings were variably affected from refuge to refuge, but lowered productivity was reported as an impact most often (41.3%), followed by aberrant behavior/stress (16.2%), reduced use of preferred refuge habitat (13.5%), reduced use of refuge (12.8%), direct mortality (11.5%), and indirect mortality (4.7) among 148 instances of impact. Refuge manager's perception of the importance of impacts by species grouping was shorebirds (73%), waterfowl (17%), birds of prey (16%), deer (5%), bluebirds and herons (no data), and loggerhead turtles (2%). Overall, managers considered impact of great importance 58.5% of the time, of moderate importance

22.1%, and of minor importance only 19.5% of the time. Exploring on foot was involved in 48.0% of the impact situations, and driving on beaches was involved 20.9% of the time. Chief causes of direct mortality were indicated as hunting (83%) and driving on roads (50%); for indirect mortality, feeding/petting wildlife; for lowered productivity, harassing wildlife, collecting eggs, and littering (each 100%); for reduced use of the refuge, hiking-bicycling-jogging, and sunbathing-swimming (each at 50%); for reduced use of preferred habitat, exploring on foot (18%) and hunting (17%); and for aberrant behavior-stress, feeding-petting (50%) and wildlife observation on foot (29%).

167. Raveling, D. G. 1979. Traditional use of migration and winter roost sites by Canada geese. Journal of Wildlife Management 43:229-235.

Temporary separation of family members of Canada geese (*Branta canadensis*) was common because of human disturbances, both at the roost lake and when they were of the lake feeding in fields. These separations may account for most of the differences between adults and immatures in their fidelity to roost locations. Young birds apparently did not return to their traditional roost sites as rapidly as did adults. Intentional harassment or hazing of Canada geese by wildlife agencies has resulted in accelerated kill by hunters in short periods of time and has not been successful in its objective of inducing migration. Flushing birds repeatedly prevents them from establishing or returning to traditional roost sites and insures that the family and social structure are continually disrupted. Canada geese are probably highly vulnerable to hunting as they seek to reestablish contact with their parents and siblings. The author believes that hazing is ineffective and inhumane means of inducing migration and that hazing calls into question wildlifer's use of the word refuge.

168. Reed, A. 1975. Reproductive output of black ducks in the St. Lawrence Estuary. Journal of Wildlife Management 39:243-255.

Of 98 nests of American black ducks (*Anas rubripes*) which were abandoned, 52 were judged to have been abandoned as a direct result of the author's interference. However, capturing and marking of nesting females performed only during late incubation did not seem to contribute appreciably to nest losses. On Ile-aux-Pommes, the losses were largely attributed to egg predators (gull, *Larus* sp.) and occasionally American crows (*Corvus brachyrhynchos*) or to nest-site competitors (common eiders, *Somateria mollissima*) which occasionally take over American black duck nests. On the mainland where the red fox (*Vulpes fulva*) and the American crow are the chief predators, human scent and disturbed vegetation may have resulted in a greater degree of observer-induced losses than on the island.

169. Reeves, H. M., H. H. Dill, and A. S. Hawkins. 1968. A case study in Canada goose management: the Mississippi Valley population. Pages 149-165 in R. L. Hine and C. Schoenfeld, eds. Canada goose management, current continental problems and programs, a symposium. Publisher, Dembar Educational Research Services, Inc., P. O. Box 1148, Madison, Wisconsin 53701.

Hazing at Horicon National Wildlife Refuge was pursued with vigor. At the peak of activity the week prior to the season's opening, this involved use of a helicopter, 2 fixed wing aircraft, 2

airboats, 2 marsh vehicles, 6 conventional boats, 15 floating platforms mounted with crop depredation exploders, 16 landbased exploders, and other frightening devices such as shot-shells and firecrackers. Thirty-nine individuals were directly involved in field work. Hazing was discontinued 24 hours before the season opened. Hazing efforts were successful in removing most of the Canada geese (*Branta canadensis*) from the refuge during daylight hours but they returned at dusk, there was no evidence that the hazing operations as conducted resulted directly in migration of Canada geese to areas farther south, and there was some evidence that hazing broke up family groups and made them more vulnerable to shooting.

170. Reichholf, J. 1970. Der einflu von störungen durch angler auf den entenbrutbestand auf den altwässern am Unteren Inn. (The influence of disturbance by anglers on duck reproduction in backwaters of the Lower River Inn) Die Vogelwelt 91:68-72.

The 85% decrease of breeding ducks since 1961 at two ponds 1 ha in area near the reservoir of Egglfing by the River Inn was presumably caused solely by disturbance from an increasing number of anglers during the breeding season. Numbers of mallard (*Anas platyrhynchos*), green-winged teal (*Anas crecca*), northern shoveler (*Anas clypeata*), common pochard (*Aythya ferina*), and tufted duck (*Aythya fuligula*) decreased from 26 pairs with 134 ducklings in 1961 to 4 pairs with 19 ducklings in 1969. Surface-feeding ducks have vanished completely from the area. Food plants have not changed in this period. A limitation on fishing is urgently needed to conserve breeding duck numbers.

171. Reichholf, J. 1976. The influence of recreation activities on waterfowl. Pages 364-369 in M. Smart, ed. Proceedings of the international conference on conservation of wetlands and waterfowl, Heiligenhafen, Federal Republic of Germany, 2-6 December, 1974. International Waterfowl Research Bureau, Slimbridge (Glos), England.

Angler activity during the waterfowl breeding period can cause a serious decline in breeding waterfowl, in one study a 90% decrease over 10 years. One angler may prevent duck territories or selecting nest sites when the area of open water is less than 1 ha, but disturbance is less of a problem on larger waters. Intensive angling resulted in only 20% of the expected number of waterfowl nests, and nests were restricted to areas inaccessible to anglers. Breeding success is also much lower in areas with anglers because of clutch losses to crows (*Corvus* sp.) and black-billed magpies (*Pica pica*); the same is true for boating. Also the motor boat's bow wave tips over exposed nests. Hunters who shoot out nests of crows and black-billed magpies in May to reduce predation of these birds on waterfowl nests have an effect opposite that intended, for flocks of non-breeding crows entering the empty territories. Instead of legislatively creating vitally needed reserves for molting birds, pressure from recreational activities increases in existent sanctuaries. Extensive hunting August-September) prevents an influx of ducks and greatly reduce ecological efficiency of waterfowl in wetland ecosystems to eat vegetation produced and prevent formation of anaerobic muds. The author suggests restrictions for angling and establishment of molting places, and that certain wetlands should be off-limits to duck shooting or boating until studies are made.

172. Riggert, T. L. 1977. The biology of the mountain duck on Rottnest Island, Western Australia. Wildlife Monograph 52, The Wildlife Society, Washington, D.C. 67 pp.

Both the silver gull (*Larus novaeholandiae*) and the Australian raven (*Corvus coronoides*) have been observed preying on mountain duck (*Tadorna tadornoides*) nests on Rottnest Island, but it is felt that those birds were drawn to nesting burrows by the presence of investigators. The author believes predators were searching for food scraps and inadvertently discovered duck nests.

173. Roberts, E. L. 1966. Movements and flock behavior of barnacle geese on the Solway Firth. Annual Report, The Wildfowl Trust 17:36-45.

Barnacle geese (*Branta leucopsis*) react most often to passing aircraft, moderately often to man, and least often to other birds and farm stock. Barnacle geese spend most of the day in feeding. Close observation of wintering flocks at Caerlaverock one complete winter season resulted in 203 witnessed disturbances of the flock: 33 by man on the ground (16.2%), 71 by aircraft (35%), 15 by other birds (7.3%), 3 by farm stock (1.5%), and 81 cause unknown (40%).

174. Ross, R. K. 1984. Migrant waterfowl use of the major shorelines of eastern Ontario. Pages 53-62 in S. G. Curtis, D. G. Dennis, and H. Boyd, eds. Waterfowl studies in Ontario, 1973-81. Occasional Paper No. 54, Canadian Wildlife Service.

Waterfowl distribution is related to agricultural practices, urbanization, hunting pressure, sanctuary areas, and artificial feeding. The Cessna Skymaster's fast speed undoubtedly reduces survey efficiency through missed birds, but a slower-moving, noisier aircraft (Beaver) gives waterfowl more warning and may cause birds to flush so far in advance that they will be missed or misidentified. Most waterfowl seen were diving ducks. Of these, the bay ducks (*Aythya* spp.), common goldeneye (*Bucephala clangula*), bufflehead (*Bucephala albeola*), and mergansers (*Mergus* spp.) were excellent subjects for aerial survey because of their tendency to form highly visible flocks, preference for shallow water, and relatively minor avoidance reactions to low-flying aircraft. Long-tailed ducks (*Clangula hyemalis*) often dove before the aircraft reached them, further lowering counts. Boat traffic will tend to disturb rafting birds and thus reduce feeding efficiency. Only in the case of winter traffic of freighters and ice breakers might any benefits accrue to ducks from boat traffic proposed for the Seaway.

175. Rusch, D. H., S. R. Craven, R. E. Trost, J. R. Cary, R. L. Drieslein, J. W. Ellis, and J. Wetzel. 1985. Evaluation of efforts to redistribute Canada geese. Transactions of the North American Wildlife Natural Resources Conference 50:506-524.

Fall Canada goose (*Branta canadensis*) counts at Horicon National Wildlife Refuge reached 100,000 in the early 1960s and were increasing annually. Management agencies dumped 467.5 tons (475,003 kg) of shelled corn to hold Canada geese on the refuge in 1965, but crop depredations were high nevertheless. In 1966, an effort was made to disperse Canada geese with aircraft, but the program failed due to lack of cooperation. In late October a helicopter operated only over the refuge flushed geese from adjacent private lands up to 2 km (1.24 mi) distant. Airboats were effective and versatile for hazing Canada geese because they could be operated after dark. While Canada geese were highly sensitive to helicopters flying low, they could not be used after dark. Although Canada geese loafed in uplands during the day, thousands returned during the 2-hours after sunset in 1966. Disruption of night roosting was achieved with airboats

in 1976-78. Propane exploders were largely ineffective, but frequent use of airboats for exploder maintenance provided a major disturbance.

176. Sherwood, G. A. 1965. Canada geese of the Seney National Wildlife Refuge. Completion Report for Wildlife Management Studies, No. 1 and No. 2., Seney National Wildlife Refuge, Seney, Michigan. U.S. Department of Interior, Fish and Wildlife Service, Region 3, Minneapolis, Minnesota. 222 pp.

Family ties are fragile the first 3 to 4 weeks of a gosling's life, and a brood unit could be easily broken up. Vehicles on dikes caught broods unaware, caused them to panic, and they dispersed in all directions. Parents usually headed for the pool, but some goslings were lost in dense vegetation. Parent Canada geese (*Branta canadensis*) usually swam off with whatever portion of the brood they had left. Occasionally the gander waited for a straggler if he heard it calling. Because of its disruptive nature, driving the refuge dikes was held to a minimum.

177. Sincock, J. R. 1966. Back Bay - Currituck Sound data report. Waterfowl studies, Volume 2. U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, Maryland. 62 pp.

Diving duck use was influenced more by disturbance than that by dabbling ducks. The primary factor limiting diving duck use of feeding areas was disturbance. Tables and graphs showed that diving duck use in the prehunting, hunting, and posthunting season was frequently highest in the posthunting period on areas with good food, high disturbance, and below average diving duck use during the hunting season. This differs from diving duck use where there was natural or established sanctuary and use was highest during hunting season but sharply reduced after the season. Thus diving ducks have low tolerance to disturbance. Only one area sustained above average Canada geese (*Branta canadensis*) use when there was above average disturbance, probably because of heavy baiting there. The only other areas with above average Canada geese use in either year during hunting season were areas which include the refuge, the sanctuary, and two areas where disturbance was low. Distribution of Canada geese on the Back Bay-Currituck Sound Area is definitely affected by disturbance. Use of the entire area by dabbling ducks and American coots (*Fulica americana*) apparently was about equally affected by food conditions and disturbance.

178. Smith, A. G. 1971. Ecological factors affecting waterfowl production in the Alberta parklands. U.S. Department of Interior, Fish and Wildlife Service Resource Publication 98. 49 pp.

Brood beat-outs were conducted in the same manner as breeding pair censuses. When disturbed, mallard (*Anas platyrhynchos*) and northern pintail (*Anas acuta*) young tended to run for upland cover. The overall effects of man's influence on duck nest success was probably somewhat greater than indicated by nest histories in this study. Not only were nests deserted early in the season because they were disturbed by nest-hunting observers, but others were destroyed by agricultural activities such as plowing, burning of stubble and pasture lands, fence building, and road construction. Man-induced disturbances were undoubtedly responsible for many unobserved losses which occurred before the crews began work in the spring or because

destruction was so complete that all evidence was hidden. At worst a brood beatout is a disturbing factor, and it may take a local population several days to return to normal following it. The disturbance resulting from the observer's activities is not fully understood, but causing females and their broods to go overland would add to losses by avian predators, mammalian predators, automobiles on highways, and physical exhaustion.

179. Steel, P. E., P. D. Dalke, and E. G. Bizeau. 1956. Duck production at Gray's Lake, Idaho, 1949-1951. Journal of Wildlife Management 20:279-285.

Over-water nests of diving-ducks were located by flushing the hens, which would leave the nests at the approach of a boat. A time-sampling method was used to measure nest production with the assumption that all but a small percentage of ducks nesting in emergent marsh vegetation will locate their nests within 20 yd (18.3 m) of open water. Markers were set at the start and finish of each sample and an outboard motorboat was operated at a set speed for a predetermined period immediately adjacent to the edge of vegetation. Forty 10-minute samples were randomly established in 1949, but these were changed to twenty 20-minute samples at a faster speed in 1950 and 1951, thus covering more nesting habitat. Twenty-eight of the 147 unsuccessful nests were deserted, but no mention was made of losses possibly caused by the investigators.

180. Sterling, T., and A. Dzubin. 1967. Canada goose molt migrations to the Northwest Territories. Transactions of the North American Wildlife and Natural Resources Conference 32:355-373.

Authors concluded that banding and boating activities caused some groups of molting Canada geese (*Branta canadensis*) to desert sites. They suggested that presently known molting grounds be given added protection against human intrusion by boat and airplane use from June 15 to August 1. These recommendations were made in view of increasing oil, mining, tourism, canoeing, and fishing activities in northern Canada.

181. Stieglitz, W. O., and C. T. Wilson. 1968. Breeding biology of the Florida duck. Journal of Wildlife Management 32:921-934.

Of 21 nests of mallard (Florida duck, *Anas platyrhynchos fulvigula*) known to have been broken up, 10 (47.6%) were lost to unknown causes. In most of these eggs had disappeared, but the nest was not disrupted and there were no egg shells in the vicinity. Such predation could logically be attributed to snakes, humans, or fish crows (*Corvus ossifragus*). Because some of the spoil islands are frequently visited by fishermen, boaters, and picnickers, and in light of the low snake population and the knowledge that humans will readily collect eggs, most of the unknown losses were attributed to humans.

182. Stotts, V. D., and D. E. Davis. 1960. The black duck in the Chesapeake Bay of Maryland: breeding behavior and biology. Chesapeake Science 1:127-154.

Males or pairs of American black ducks (*Anas rubripes*) disturbed by the observer usually flew a short distance offshore and returned soon after the observer withdrew. If disturbed just prior to nesting, the pair flew off with the female quacking loudly and never returned to nest at that exact

area. Nest-building females often flushed within 100 yd (91.4 m) and usually never returned. In 1956, 22 nesting females were trapped on their nests and marked and of those 6 deserted due to flooding or observer interference, 1 lost her nest to crows (*Corvus* sp.) , and 13 hatched clutches successfully. Nesting studies in 1954 resulted in the collection of many clutches by the observer and desertion of many nests by the female, and abnormal activity near nests may have caused predation by crows. In 1955, local persons collected numerous clutches of eggs from Bodkin Island. In 574 nesting attempts, 4 were abandoned because of humans, 12 were destroyed by humans, and 132 were abandoned because of the observer (a total of 3.3% of all nest losses).

183. Strang, C. A. 1980. Incidence of avian predators near people searching for waterfowl nests. Journal of Wildlife Management 44:220-222.

This paper raises questions about work by MacInnes and Misra (1972) and Mickelson (1975), with the author stating, "Waterfowl biologists collecting nest data in tundra regions often have the impression that they are being followed by avian predators, such as gulls and jaegers (MacInnes and Misra 1972)." He then reported his observations with glaucous gulls (*Larus hyperboreus*), parasitic jaegers (*Stercorarius parasiticus*), and long-tailed jaegers (*Stercorarius longicaudus*) within the Clarence Rhodes National Wildlife Range in Alaska. He ended with the statement, "I conclude that there is still a need for estimation of the undisturbed losses of waterfowl eggs to predators." MacInnes responded beginning on the same page of the Journal of Wildlife Management, and his response is included herein.

184. Sugden, L. G., W. J. Thurlow, R. D. Harris, and K. Vermeer. 1974. Investigations of mallards overwintering at Calgary, Alberta. Canadian Field-Naturalist 88:303-311.

Available food, open water, and protection from hunting were considered chief factors causing mallards (*Anas platyrhynchos*) to forego migration. Of the control methods tried (no supplementary feeding, removal by transfer, scaring with acetylene exploders, and winter shooting within the city), cessation of feeding was the most acceptable and efficient.

185. Takekawa, J. Y. 1987. Energetics of canvasbacks staging on an Upper Mississippi River pool during migration. Ph.D. Thesis, Iowa State University, Ames. 189 pp.

Canvasbacks (*Aythya valisineria*) reacted to human activity by alert posturing, swimming, diving, or usually by flying. The percentage of time that canvasbacks were disturbed varied weekly but most disturbances of canvasbacks occurred during the first 2 weeks of fall. Scan samples for time-activity budgets were based on observations of ducks sitting on the water, thus percentages reported for disturbance (0.6%) in this paper may be underestimated.

186. Tamisier, A. 1985. Hunting as a key environmental parameter for the Western palearctic duck populations. Wildfowl 36:95-103.

Western palearctic duck populations have to stand a very high hunting pressure in seasons running from mid-July to the end of May, having an annual kill of about 10 million ducks; this leaves a January population of about 15 million. A wide discrepancy occurs between the very few countries which are responsible for these high mean figures because of night shooting, long

hunting seasons, and heavy kill. Consequently the winter distribution of ducks is biased in favor of the lightly hunted countries where the overall population level. Lowering the hunting pressure must be achieved through international cooperation to restore western palearctic duck populations. Stopping night shooting and shortening the hunting season to run from September in the northern and eastern countries and October in the western and southern countries until the end of January would be helpful. Protection of wetlands is fruitless as long as hunting regulations are not changed. Considerable discussion is made over varying levels of hunting disturbances in various countries.

187. Thomas, G. 1976. Habitat usage of wintering ducks at the Ouse Washes, England. Wildfowl 27:148-152.

Table 4. Percentages of bird days (BD) and bird days per ha in refuges and non-refuges on the Ouse Washes, 1970-1971 (adapted).

		Refuges (490 ha)		Non-refuges (1424 ha)	
		%BD	BD/ha	%BD	BD/ha
Before 31st Jan					
Mallard	751,000	87	1,333	13	67
Wigeon	2,136,000	83	3,618	17	250
Common pochard	16,000	21	7	799	
Moorhen	45,000	47	43	53	16
After 31st Jan					
Mallard	368,000	32	240	68	173
Wigeon	1,963,000	40	1,602	60	812
Pochard	167,000	0	0	100	115
Moorhen	29,000	51	30	49	10

Up to January 31 includes the hunting season and after February 1 is post-hunt. Results for mallard (*Anas platyrhynchos*) and Eurasian wigeon (*Anas penelope*) are typical for dabbling ducks, with only 13% and 17% respectively of the bird days spent in non-refuge areas up to January 31. Post-hunt, about two-thirds of mallard and Eurasian wigeon use days are spent on land formerly hunted. Duck days per ha spent in refuges before January 31 are 19.6 times that of non-refuges for mallard and 14.5 times that for Eurasian wigeon. After January 31, proportions are reduced to 1.4 times and twice respectively. Common moorhen (*Gallinula chloropus*) distribution is similar with about 3 times as many moorhen days per ha being spent in refuges as in non-refuges. Common pochard (*Aythya ferina*) were equally distributed in the two areas before January 31, mainly using unshot boundary rivers; post-hunting they used non-refuge

areas. Surveys for these calculations were taken weekdays biweekly to avoid concentrations of waterfowl at refuges on weekends, thus use of refuges really is smaller than shown.

188. Thompson, D. 1973. Feeding ecology of diving ducks on Keokuk Pool, Mississippi River. Journal of Wildlife Management 37:367-381.

From 1966 through 1968, a study was conducted to investigate relationships between diving ducks and their food resources on the Keokuk Pool (Pool 19) of the Mississippi River. This information is useful as a baseline from which to measure the impacts of channelization on food resources of diving ducks. Nearly 20 million diving duck days were recorded during each year by aerial and ground census. Night dispersal and feeding were very important to diving ducks because disturbances caused the concentration of 90% of the waterfowl on 28% of the study area during daytime. (D. Thompson = J. D. Thompson in the thesis below.)

189. Thompson, J. D. 1969. Feeding behavior of diving ducks on Keokuk Pool, Mississippi River. Masters of Science Thesis, Iowa State University, Ames. 79 pp.

Most hunting on Keokuk Pool (Pool 19) was done on back-waters, but about 25 blinds were built over open water in 1967. In addition to disturbance from shooting, flocks of diving ducks were flushed when hunters moved between blinds and landing areas. The Keokuk Pool sustains a commercial fishery. Much fishing occurs during summer, but also occurs in late spring and throughout fall when trot-lines and trammel nets are fatal to diving waterfowl which become entangled in them. Fishing activities disturb large flocks of diving ducks and flush them from one section to another. The upper section of the pool had the highest disturbance ranking of all sections in fall, and the lowest numbers of birds occurred there. Many birds would feed until disturbed by hunters, fishermen, or barges. If disturbance continued throughout the day, waterfowl concentrated on the lower section of the pool where disturbance was the least. The lower section would become food-depleted if large flocks fed there, particularly the area which held the greatest percentage of diving ducks during day. The following table is constructed from Thompson's work.

Waterfowl days on sections of the Keokuk Pool for fall 1966 and 1967, average relative rankings of disturbance (1=little and 5=frequent), benthos (mean pounds/acre), and acres of emergent and submergent aquatic vegetation.

Pool sect.	Rel dist. rank	Benthos	Waterfowl days (000)	Aquatic veg.		Wtfwl. days per acre
				Emer.	Subm.	
Lower	2.8	1,026	12,273	38	26.8	10,383
Middle	4.0	675	6,569	100	18.6	2,508
Upper	4.2	1,841	1,853	13	26.7	2,155

190. Thornburg, D. D. 1973. Diving duck movements on Keokuk Pool, Mississippi River. Journal of Wildlife Management 37:382-389.

A study was initiated in 1969 to determine patterns and causes of local movements of diving ducks on the Keokuk Pool (Pool 19) of the Upper Mississippi River and to relate diurnal activity to hunter harvest and food availability. Within a week of arrival, diving ducks on the Keokuk Pool established a diurnal rhythm of movement with a morning flight at dawn from the highly disturbed middle and upper sections to the less disturbed lower section where birds loafed throughout the day. A return flight upstream to choice feeding areas in the middle and upper sections occurred at dusk. Over 60% of the population using the pool participated in this daily movement and human disturbance was the major factor inducing these mass movements. Hunting activity was most intense in the middle and upper sections and the initiation of mass movements to the lower segment was correlated with the opening of the hunting season. Minimal feeding occurred on the pool during the day and birds fed extensively at night in the middle and upper sections of the Pool. Middle and upper sections were more productive in bottom invertebrates than in the lower section. The distribution of diving ducks was generally correlated with the greatest abundance of benthic organisms.

191. Tuite, C. H., M. Owen, and D. Paynter. 1983. Interaction between wildfowl and recreation at Llangorse Lake and Talybont Reservoir, South Wales. Wildfowl 34:48-63.

Recreational intensity decreased during autumn and increased again in March. Boats were very dispersed among different parts of the lake; this was the worst distribution as far as the birds were concerned. The authors concluded that recreation was responsible for significantly limiting the carrying capacity of Llangorse for wintering waterfowl. Prohibiting recreation in certain key areas would probably increase wildfowl numbers and diversity but would require an overall decrease in summer recreation. In winter it would only be necessary to exclude boats from about a quarter of the lake area would to encourage birds. This should not substantially affect the quality of winter recreation. Birdwatching is the most widespread single form of recreation on British inland waters in summer and winter. Some compromise with birdwatchers should be reached at Llangorse Lake which is so important to both recreational and wildlife interests.

192. Tuite, C. H., P. R. Hanson, and M. Owen. 1984. Some ecological factors affecting winter wildfowl distribution on inland waters in England and Wales, and the influence of water-based recreation. Journal of Applied Ecology 21:41-62.

Multiple regression analyses were used to compare distributions of nine common waterfowl in Britain with six independent variables related to the ecology of inland waters. Large sites tended to hold more waterfowl than smaller ones and relationships with the crinkliness of the shore were probably due to the fact that many sites are primarily roosts and that large reservoirs have relatively simple perimeters. Chi-square analyses were used to test presence of different water-based recreation in relation to the observed number of birds as compared to the number predicted by regression models. Species most susceptible to disturbance from recreation were green-winged teal (*Anas crecca*), northern shoveler (*A. clypeata*), and common goldeneye (*Bucephala clangula*). Most tolerant were mute swan (*Cygnus olor*), tufted duck (*Aythya fuligula*), common pochard (*Aythya ferina*) and mallard (*Anas platyrhynchos*). The greatest deleterious impact on winter wildfowl numbers was associated with the presence of coarse fishing, sailing, and rowing. The presence of birdwatching was associated with higher-than-expected numbers of most species.

193. Tydeman, C. F. 1977. The importance of the close fishing season to breeding bird communities. Journal of Environmental Management 5:289-296.

A 2-year study was made of breeding bird populations of three gravel pits. Fishing during the close season is an important factor in determining the composition of bird communities and actual numbers of nesting pairs. Deleterious effects of close season fishing appear to be largely indirect--general disturbance and denudation of the bank vegetation. It is recommended that close fishing season be prohibited wherever possible and carefully controlled where complete prohibition is not practicable, chiefly for the sake of the birds.

194. U.S. Fish and Wildlife Service. 1976. Environmental impact assessment: effect of boating on management of Ruby Lake National Wildlife Refuge. (P.O. Box 3737, Portland, OR 97208). June, 1976.

Percent nest success of canvasbacks (*Aythya valisineria*) and redheads (*Aythya americana*) on Ruby Lake National Wildlife Refuge for nests hatching before and after opening on June 13 to power boats. Sample sizes of nests are in parentheses (adapted).

Species	Before boating	With boating
Boating Area		
Canvasback	91 (33)	57 (7)
Redhead	92 (13)	83 (12)
Control Area		
Canvasback	95 (21)	90 (10)
Redhead	100 (73)	92 (12)

195. U.S. Fish and Wildlife Service. 1987. Migratory nongame birds of management concern in the United States: the 1987 list. Office of Migratory Bird Management, Washington, D.C. 27 pp. + app.

From a section on Major Threats to Listed Species, human disturbance was viewed as the second greatest threat, being mentioned in 20% of the references and attributed as a problem for 13 species. Species most impacted by human disturbance are the marsh/wading birds, birds of prey, and marine/shore birds, and species associated with coastal and freshwater wetlands and beaches. Species most often mentioned as suffering from human disturbance were common loon (*Gavia immer*), trumpeter swan (*Cygnus buccinator*), snowy plover (*Charadrius alexandrinus*), and roseate tern (*Sterna dougallii*).

196. Vacca, M. M., and C. M. Handel. 1988. Factors influencing predation associated with visits to artificial nests. Journal of Field Ornithology 59:215-223.

Artificial goose nests were used to determine what factors might increase predation after visits to nests of Cackling Canada geese (*Branta canadensis minima*), such as whether leaving the nest uncovered, marking the nest location with a flag, or placing the nest on an island or peninsula

would increase the rate of predation. Predators destroyed more of the nests with eggs exposed to view (61%) than of the nests with eggs covered with goose down (35%) ($P < 0.05$). The rate of predation was only slightly higher among nests located on peninsulas than on islands and equal proportions of flagged and unflagged nests were destroyed. Investigators seemed to attract predators and caused an increase in predation at uncovered nests immediately after a visit to the nest. Covering the eggs with down seemed to negate the attraction of predators when visiting the nest. Among 46 nests destroyed, 78% were destroyed by birds and 22% by mammals. Islands seemed to provide refuge from mammalian predators. Investigators should minimize their impacts on nesting success and should measure the extent of their impact as part of their studies.

197. van der Zande, A. N., W. J. ter Keurs, and W. J. van der Weuden. 1980. The impact of roads on the densities of four bird species in an open field habitat--evidence of a long-distance effect. Biological Conservation 18:299-321.

We decided to include this paper although it does not deal with waterfowl because it may be of use to researchers of disturbance. On page 308 of this publication, two concepts, disturbance distance and disturbance intensity, are introduced. Roads may affect animal communities in various ways. One such way is "disturbance," i.e., emission of stimuli to which animals may respond by avoiding the vicinity of the road. The extent, intensity, and mechanism of this effect is almost entirely unknown.

198. Vander Zouwen, W. J. 1983. Waterfowl use and habitat changes of a refuge in southern Wisconsin: 1947-1980. M. S. Thesis, University Wisconsin, Madison.

Although human activity is not a normal component of habitat, it affects waterfowl use of the University Bay refuge. For example, on 6 and 9 November 1954, 2,200 and 950 ducks departed the Bay when a fisherman motored through the area used by waterfowl. Over the 5 years that disturbance was recorded, human activity resulted in departure of ducks in the following percentages of observation periods: 44% in 1953; 27% in 1957; 32% in 1960; 33% in 1964; and 43% in 1973. Shore activity increased substantially since the 1950's due to development of land adjacent to the Bay for a variety of uses. A dramatic increase in jogging in the early 1970's resulted in increased disturbance along the south and west shores and on the Picnic Point peninsula on the north shore. Fishermen and boaters were reported as major disturbance factors in the 1950's. Subsequent to the 1970's the University rowing team has been considered to be the major disturbance factor.

199. Ward, D. H., and R. A. Stehn. 1989. Response of brant and other geese to aircraft disturbance at Izembek Lagoon, Alaska. Final Report of U.S. Fish and Wildlife Service. Alaska Fish and Wildlife Research Center to the Minerals Management Service, Outer Continental Shelf Region, 949 E. 36th Avenue, Anchorage, Alaska 99501. 193 pp.

Brant (*Branta bernicla*), Canada geese (*Branta canadensis taverneri*), and emperor geese (*Chen canagica*) interrupted foraging and flew in response to helicopters. Disturbance caused by aircraft may be harmful to brant. In 1,912 hours of daylight observations, potential incidental disturbance events occurred at 1.07/hr. Aircraft (0.57/hr) and persons on foot (0.08/hr) were the most frequent human-related disturbances. Of all disturbances, bald eagles and boats elicited the

greatest responses with brant. Canada and emperor geese responded most to bald eagles (*Haliaeetus leucocephalus* Linn.) and persons on foot. Using data grouped by altitude and lateral distance to the flock, brant and emperor geese reacted similarly to different types of aircraft and were more responsive than Canada geese. Noise rather than visual cues could trigger behavioral responses. For each additional aircraft disturbance that occurred daily throughout a 54-day fall staging period, the predicted total weight gain would be reduced by 7.4 g, equivalent to energy expended in 53 minutes or 73 km of migratory flight. Ten daily disturbances reduced body weight by 4% from the expected departure weight at Izembek.

200. Weigand, J. P., M. J. Pollok, and G. A. Petrides. 1968. Some aspects of reproduction of captive Canada geese. Journal of Wildlife Management 32:894-905.

There was some disturbance of Canada geese (*Branta canadensis*) by the farm staff during daily feeding and egg collecting. Geese have become accustomed to this intrusion, and although they daily displayed against intruders, no nest desertion due to disturbance was recorded.

201. Wheeler, W. E., R. C. Gatti, and G. A. Bartelt. 1984. Duck breeding ecology and harvest characteristics on Grand River Marsh Wildlife Area. Wisconsin Department of Natural Resources Technical Bulletin No. 145. 49 pp.

A 9% abandonment rate was due to human disturbances resulting from nest trapping or the death of the hen.

202. White-Robinson, R. 1982. Inland and saltmarsh feeding of wintering brent geese in Essex. Wildfowl 33:113-118.

Disturbance for brant (*Branta bernicla*) can be measured by the number of times per hour that a flock is disturbed and the resultant amount of time spent flying. Disturbance levels on the saltmarsh may be biased because of the occasional testing of explosives at a nearby factory and no correction can be made for this. Disturbance flights were made more frequently on the saltmarsh, but they lasted for a shorter time than those on farmland. The provision of refuge areas on permanent pasture and saltmarsh combined with intensive scaring over sensitive crops will maximize the benefit to the birds and considerably reduce their energy expenditure. If the value of feeding in refuge areas is improved then the rate of energy intake will increase and further attract birds to these areas.

203. Williams, C. S., and W. H. Marshall. 1937. Goose nesting studies on Bear River Migratory Waterfowl Refuge. Journal of Wildlife Management 1:77-86.

Loss from desertion was 4%, and involved five Canada goose nests. In two instances some of the eggs in a nest were destroyed and the remainder were then deserted. Three complete clutches were abandoned. In one instance the cause of desertion was undetermined and it was possible that nest hunting was the cause. Activity by visiting photographers and the operation of a dragline caused the other two desertions.

204. Williams, G., and J. E. Forbes. 1980. The habitat and dietary preferences of dark-bellied brent geese and widgeon in relation to agricultural management. Wildfowl 31:151-157.

On weekdays a construction road was in regular use by traffic passing to and from an electricity sub-station being built. Farm vehicles used the road at irregular intervals every day. Brant (*Branta bernicla*) flocks soon became accustomed to passing traffic, frequently feeding to within 10 m of the road. They fed close to banks and they often allowed human approach to as close as 50 m before taking to the air. In contrast, Eurasian wigeon (*Anas penelope*) were usually feeding well away from the road and banks. Only on weekends when traffic on the road was at a minimum did they feed on the south slurry-treated grassland or winter barley near the road. Although Eurasian wigeon preferred feeding on the fertilized slurry-treated grassland, an intolerance of disturbance led them to feed on the less disturbed, but nutritionally poorer unimproved grassland. Disturbance thus can mask food preferences. Disturbance and the nutritional value of grassland can be identified as the two main factors controlling distribution and availability of grazing for brant and Eurasian wigeon.

205. Wiseley, A. N. 1974. Disturbance to snow geese and other large waterfowl species by gas-compressor sound simulation, Komakuk, Yukon Territory, August - September, 1973. Chapter III in W. W. H. Gunn, W. J. Richardson, R. E. Schweinburg, and T. D. Wright, eds. Studies on snow geese and waterfowl in the Northwest Territories, Yukon Territory and Alaska, 1973. Arctic Gas Biological Report Series, Vol. 27.

Responses of snow geese (*Chen caerulescens*) to the sound of gas compressor simulators were studied at Komakuk, Yukon Territory. The primary objective was to learn whether migratory snow geese along the Arctic coastal plain are affected by the sound and whether they eventually accommodate it. Although reduced from its maximum volume, the noise of the sound simulators caused snow geese and tundra swans (*Cygnus columbianus*) to break their flight formations, flare, increase altitude, increase calling behavior, change speed, and (or) land. Snow geese that were both vertically and horizontally nearer to the simulators reacted to sound more frequently; feeding flocks of geese approached no closer than 800 m (½ mi) to the simulator's side where the sound was most intense.

206. Woodall, P. F. 1983. A quantitative analysis of some winter habitats of the red-billed teal, *Anas erythrorhyncha,* in Zimbabwe. South African Journal of Wildlife Research 13:41-46.

Such variables as area of water, Ph, conductivity, turbidity, benthic and neustic organisms, plant cover, and disturbance index were recorded in winter from 19 dams. In univariate analysis, area of water, Ph, and a disturbance index differed between dams with and without red-billed teal. When red-billed teal were present, their numbers were correlated with chironomids and Polygonum sp. seeds. For Multivariate Discriminant Function Analyses area of water and disturbance were identified as important variables with turbidity, Ph, and conductivity being of lesser importance. Seven categories of disturbance (human presence, swimming, boating, fishing, shooting, irrigation, watering cattle) and two of attraction (artificial feeding, domestic or pinioned ducks) were established and ranked 0-3 (nil, slight, moderate, extensive). Past

disturbance was important and was determined based on experience with use of the dams and the signs of recent human or bovine presence. A disturbance index was calculated as:

Disturbance Index = (total present disturbance - total present attraction) + (total past disturbance - total past attraction).

207. Wooten, W. A. 1954. Waterfowl losses in the surf along the northern California coast. Journal of Wildlife Management 18:140-141.

"Sanding" is a natural phenomenon in which the surf becomes heavy with sand and ducks resting in rafts from 200 to 3,000 birds become fouled with sand. Ducks involved include American wigeon (*Anas americana*), northern pintail (*Anas acuta*), mallard (*Anas platyrhynchos*), green-winged teal (*Anas crecca*), lesser scaup (*Aythya affinis*), canvasback (*Aythya valisineria*), and redhead (*Aythya americana*). This phenomenon occurs when the surf at low tide roils steeply sloping sandy beaches. Excessive losses of birds usually occur in moderately rough seas immediately following storms and with heavy fog off shore. Loss of waterfowl in this manner usually occurs several times during the year but is prevalent mainly during the hunting season. At these times the birds seek sanctuary in the ocean as an escape from hunters who harass them regularly on inland feeding areas. During the 2-months of this study it is probable that 6,000-9,000 birds perished along 25 mi of beaches.

208. Yocom, C. F., C. L. Buechele, and S. W. Harris. 1956. Great Basin Canada goose nesting populations at the former Lake Lenore National Wildlife Refuge, Washington. Murrelet 37:14-17.

The general lack of success of Canada geese (*Branta canadensis*) on inner islands was attributed to nearby human activity on shore and (or) disturbance from curious fishermen who were allowed to use this portion of the lake during nesting season. If each pair brought off three to four young successfully, an increase of 150-200 birds per year would be added to the population. Everything necessary should be done to maintain goose nesting; fishing dates should be coordinated so that the Canada goose population would remain undisturbed during breeding season.

209. Ziegler, G. 1981. Zum Einflu von Störungen durch Angler auf Stockentenbestände an Kiesteichen im Wesertal (The influence on the mallard (*Anas platyrhynchos*) population on gravel pits of disturbances caused by anglers.) Charadrius 17:127-130.

The positive correlation of the adverse effects of the steady increase in the number of sport fishermen on the "biosphere" of fishing waters is now more often mentioned. While studies on the pressures caused by the presence of fisherman during the breeding period continue, up until now little is known of the effects of fishing pressure during the molting, resting (pause in migration), and over-wintering periods. The paper is concerned with the Häverner Marsh, made up of eight water-flooded gravel pits, which in the last 25 years, have been opened, enlarged, and because of technical advances, recultivated in recent years. One of the pits is still being quarried, and fishing is not allowed there because of safety concerns. Ziegler graphs the annual population of mallards and relates this to the presence of fishermen. From late summer in 1978, fishing has

been suspended on four government-owned gravel pits serving as wildlife preserves. The suspension continues except for the pond "Wilddiebereien." With the exception of the molting period, it is possible for the mallards to avoid the disturbances found on the "fished ponds." Without such restrictions on fishing, it is not possible to prevent disturbances of the waterfowl. This is not an accusation against fishermen, but a simple fact, verified by observations in England by Tanner (1979). The paper ends by citing the decision of the DS-IRV at the 20th symposium in Ratzburg (1972) that at least 20% of the gravel pits are required to be set aside as nature preserves. (Translated from German)

210. Ziegler, G. 1987. Zur Entstehung eines Mauserplatzes der Reiherente (*Aythya fuligula*) von überregionaler Bedeutung im nördlichen Westfalen (Development of a supra-regional molting-site of the tufted duck (*Aythya fuligula*) in northeastern Westfalia). Die Vogelwelt 108:67-70.

About 1980 the tufted duck began to use a gravel-pit reserve, Häverner Marsh, as a molting site. As many as 350 adult ducks are to be seen June-August during post-breeding and the start of pre-breeding molt. The reasons for use by ducks are probably high densities of zebra mussels (*Dreissena polymorpha*) and lack of human disturbance, but hunting in this marsh has a negative effect. With rules passed in 1979 concerning nature preserves, access to the banks and sport fishing was prohibited and this was enforced since 1981. Since March 1986, main entryways into the nature preserves have been closed with barriers during periods when there has been no mining activity in the gravel pits. These steps resulted in an increase in molting ducks seen. The greatest disturbance comes from hunting, which is allowed by nature preserve ordinances April 1-November 15. There are four hunting districts in the Häverner Marsh and hunting pressure is great. Continued mining of quarries keeps tufted ducks away, a voluntary alternating-week hunting plan was not effective in helping ducks, and a complete ban on hunting is believed to be necessary where ducks use gravel pits.

211. Ziegler, G., and W. Hanke. 1988. Entwicklung von Stockenten (*Anas platyrhynchos*)-Beständen in der Häverner Marsch unter dem Einflu der Jagd (Influence of hunting on mallard (*Anas platyrhynchos*) population numbers inside the "Häverner Marsh" reserve). Die Vogelwelt 109:118-124.

Inside the RAMSAR-reserve "Weserstaustufe Schlüsselberg" game tenants bound themselves voluntarily to alternate hunting weekly in the nature reserves "Staustufe Schlüsselburg" and "Häverner Marsch" September 1-November 15. Counts of mallard ducks were made 35 times in Häverner Marsch. Mallard numbers decreased sharply with the beginning of hunting and built up again only after a week had elapsed since the end of hunting. Hunting was not stopped each "hunting week" as promised. Comparing mallard numbers inside and outside, waters without voluntary restriction had more mallards than where duck hunting was alternated, but the intensity of hunting on other waters is not known. The author believes waterfowl hunting in Häverner Marsch and the whole RAMSAR-area is a severe interference which is out of line with conservation aims of the nature reserve decree and the international commitment taken by the federal government when it ratified the Ramsar Convention.