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The Effects of Human Disturbance on Colonial Nesting Waterbirds with Recommendations for their Management at Last Mountain Lake

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THE EFFECTS OF HUMAN DISTURBANCE ON COLONIAL NESTING

WATERBIRDS WITH RECOMMENDATIONS FOR

THEIR MANAGEMENT AT LAST MOUNTAIN LAKE

HABITAT MANAGEMENT SECTION

Technical Report No. WNR 85-4

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ABSTRACT

Last Mountain Lake (LML), historically important to birds, is a critical area for breeding, feeding and staging of colonial waterbirds. Of 13 colonial species recorded breeding at LML, ten presently nest there. Fewer breeding species and reduced frequency of breeding of colonial birds there since the 1950s have been attributed, in part, to human disturbance. Recreational activities have steadily increased particularly since the establishment of the Regional Park in 1961. White Pelicans, which did not breed at LML from 1973 to 1983, successfully nested there in 1984 when low water levels resulted in increased nesting space on the islands and decreased boating activity. A literature review revealed that human disturbance of colonial nesting waterbirds results in overall reduced productivity and abandonment of traditional nesting sites, and that restrictive measures and public education can help protect colonial nesting waterbirds. Recommendations for protecting colonial waterbirds at LML include an inventory of important breeding, feeding and loafing areas; studies on toxic chemical residues in breeding colonial waterbirds at LML: restricted access to known sensitive breeding sites; and public education.

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TABLE OF CONTENTS

	· · · · ·	age
ABSTRACT		i
ACKNOWLE	DGEMENTS	11
LIST OF	TABLES	iv
LISIOF	FIGURES	+V
1.	INTRODUCTION EFEECTE OF HUMAN DISTUDBANCE ON	1
2.	COLONIAL NESTING WATERBIDDS	2
	2 1 Pelicans	2
	2.2 Cormorants	- Ĩ
	2.3 Gulls	6
	2.4 Terns	8
	2.5 Herons	10
	2.6 Grebes	12
2	TECHNIQUES FOR MANAGEMENT	13
J.	3.1 Restrictive Measures	13
	3.2 Education/Interpretation	14
1.	CRECIES SENSITIVITY TO DISTURBANCE EACTORS	4 /.
4.	SPECIES SENSITIVITY TO DISTORDANCE FACTORS	14
5.	DATA GAPS	15
6.	LAST MOUNTAIN LAKE COLONIAL NESTING WATERBIRDS	16
	6.1 Historical Use by Colonial Nesting Waterbirds	16
	6.2 Sensitive Areas for Colonial Nesting Waterbirds	19
	6.3 Human Activity and Seasonal Use	19
	6.4 Vulnerability of Last Mountain Lake	• •
	Colonial Nesting Waterbirds	20
	6.4.1 Pelicans and Cormorants	20
	6 4 3 Herons	27
	6.4.4 Grebes	22
	6.5 Pesticide Contamination	23
	6.6 Current CWS Information/Interpretation Program	23
7.	RECOMMENDATIONS	24
8.	LITERATURE CITED	29
J.		- /
9.	APPENDIX: SELECTED ANNOTATED BIBLIOGRAPHY	36

L	I	S	Т	0	F	T	A	В	L	Е	S	

Table		Page
1.	Relative sensitivity of colonial nesting waterbirds to human disturbance factors	26
	LIST OF FIGURES	
Figure		
1.	Breeding chronologies for selected colonial nesting waterbirds in Saskatchewan	27
2.	Sensitive breeding areas for colonial waterbirds	28
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1. INTRODUCTION

Last Mountain Lake (LML), a major staging area for migrating waterfowl and Sandhill Cranes, is also important as a breeding, feeding and staging area for colonial waterbirds. Of 13 species of colonial waterbirds recorded breeding at LML, ten presently breed there. They are the threatened White Pelican (<u>Pelecanus erythrorhynchos</u>), Double-crested Cormorant (<u>Phalacrocorax auritus</u>), Western Grebe (<u>Aechmophorus</u> <u>occidentalis</u>), Eared Grebe (<u>Podiceps nigricollis</u>), Ring-billed Gull (<u>Larus delawarensis</u>), California Gull (<u>L</u>. <u>californicus</u>), Franklin's Gull (<u>L. pipixcan</u>), Common Tern (<u>Sterna hirundo</u>), Black Tern (<u>Chlidonias niger</u>), and the rare Caspian Tern (<u>S. caspia</u>), (P. Taylor, pers. comm.).

During the past three decades, there has been a decline in colonial waterbird nesting at LML (Houston 1962; Vermeer 1970a; Allison 1978; P. Taylor, pers. comm.). This decline consists of fewer species breeding, reduced frequency of breeding (some species do not breed every year), and likely reduced success for breeders. The problem is most evident and best documented for the White Pelican and the Double-crested Cormorant. While these two species are not protected by the Migratory Birds Convention Act (1917), both have been protected by provincial wildlife legislation since the early 1950s (C. Scheelhaase, pers. comm.).

The north end of LML and surrounding uplands make up the 15,600-ha LML Wildlife Management Unit which includes the 4,600-

ha LML Migratory Bird Sanctuary. Located within the Sanctuary is a portion of the Last Mountain Regional Park which regularly attracts summer recreationists. Common activities occurring in the Sanctuary are fishing, boating and swimming.

Is recreational use of the LML Migratory Bird Sanctuary detrimental to colonial nesting birds? Did boating and other disturbance prevent pelicans from breeding there during 1973 to 1983? Will increased disturbance jeopardize recent (1984) breeding activity by pelicans, cause cormorants to cease nesting and result in reduced nesting by other colonial birds? To answer these questions and better understand this problem, the Canadian Wildlife service conducted this literature review to document the impact of human disturbance on colonial nesting birds in general, and to examine management techniques for protecting colonial birds. Recommendations developed for colonial bird management at LML could be applied to other migratory bird sanctuaries in Saskatchewan having colonial nesting species - - Basin and Middle lakes, Lenore Lake, Redberry Lake and Old Wives Lake.

2. EFFECTS OF HUMAN DISTURBANCE ON COLONIAL NESTING WATERBIRDS

Various human disturbance factors were considered in this review including fishing, boating, camping, off-road vehicles, low-flying aircraft, human intrusion and vandalism. The effect of the disturbance depends on the nature, frequency and duration of the disturbance and also on the stage of the birds' breeding

cycle. Human disturbance can lead to abandonment of nests; destruction of eggs, nests and young; reduced incubation and chick attendance; territorial displacement of adults and young; increased interspecific and intraspecific predation; and abandonment of breeding colony sites (Buckley and Buckley 1976; Anderson and Keith 1980; Burger 1981a, Conover and Miller 1978; Anderson et al. 1976).

2.1 Pelicans

Human intrusion into White Pelican colonies has been shown to contribute to nest abandonment, destruction of eggs and young, increased predation by gulls and abandonment of breeding colony sites (Houston 1962; Vermeer 1969a, 1970a; Johnson and Sloan 1976). Pelicans are particularly sensitive to disturbance during courtship and nest-site selection and therefore are most likely to abandon a breeding colony site during these early stages of the breeding season (R. Evans, pers. comm.). In the prairie provinces, courtship and nest-site selection usually occur in mid-April to early May. Pelicans forced to abandon their nests may not renest that year (Schaller 1964), although Sanderson (1966) reported renesting of White Pelicans after commercial fishermen had destroyed initial nests and young (Carson 1966). Roney (1980) reported that pelicans renested at Middle Quill Lake in Saskatchewan after human disturbance was eliminated. Bunnell et al. (1981) found that low-flying aircraft (one aircraft overflight) during the incubation period reduced the mean productivity of White Pelicans (0.22 young/nest

compared to 0.74 young/nest when disturbance occurred later in the season). Roney and Hlady (1984) reported that White Pelicans in Saskatchewan colonies left their nests when censused at an altitude of 150 m. When pelicans are flushed from their nests, eggs may be broken and exposed eggs and naked young are subjected to overheating, chilling and/or predation by gulls. When young pelicans (four to five weeks of age) are frightened, they leave the nest and huddle together which may result in trampling of eggs and weak and younger individuals (Houston 1962; Johnson and Sloan 1976).

Investigator and tourist disturbance of Brown Pelicans (<u>Pelecanus occidentalis californicus</u>) early in the nesting season severely reduced productivity. Young fledged per nest ranged from 0.62 to 0 (Schreiber and Risebrough 1972; Anderson and Keith 1980). This was attributed to accidental breakage of eggs, gull predation, heat stress of unguarded eggs and young, and related causes. Sustained human disturbance from tourists was the primary reason for Brown Pelicans abandoning established breeding colony sites in Mexico (Jehl 1973).

2.2 Cormorants

Human intrusion at colonies of Double-crested Cormorants nesting near gulls resulted in reduced productivity due to predator losses (Kury and Gochfeld 1975; Ellison and Cleary 1978; Vermeer 1969a, 1970a, 1970b; Houston 1962). When disturbed by humans, incubating and brooding cormorants may also crush eggs

and young as they flush from their nests. Frequent human intrusion has caused nest abandonment and discouraged late-nesting cormorants from using disturbed sites (Kury and Gochfeld 1975; Ellison and Cleary 1978). Thompson (1981) observed that tree-nesting Double-crested Cormorants flushed from their nests when approached within 200 m, but did not indicate whether the cormorants were laying or incubating. Lock and Ross (1973) reported that Double-crested and Greater cormorants tolerated fishing boats close to their colonies, but flushed from their nests if fishermen set foot on the islands. Repeated human disturbance has resulted in complete abandonment of cormorant breeding colonies in prairie Canada and the United States (Vermeer 1969a, 1970b; Mitchell 1975; Markham 1978b).

The European Cormorant nested in large numbers on Lake Baikal in Russia until about 20 years ago. A combination of human disturbance factors (collecting eggs and chicks, killing adults and increased motorboat traffic) was considered the primary reason for cormorants ceasing to nest there (Anderson 1981 citing Gusev 1980). Human intrusion at King Shag (<u>Phalacrocorax</u> <u>albiventer</u>) colonies in Argentina resulted in increased Dolphin Gull (<u>Leucophaeus scoresbii</u>) predation (Kury and Gochfeld 1975). Adults with incomplete clutches were more readily displaced than those with complete clutches or young.

Dunnet (1977) reported that fixed-wing aircraft and helicopters flying at 100 m above cliff tops on the coast of

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Scotland had no apparent effect on a mixed seabird colony including nesting shags and Herring Gulls (<u>Larus argentatus</u>), however data were incomplete.

In recent years, Double-crested Cormorant numbers have increased in parts of Canada even where human activity is high. Despite greater recreational use of the Lake Newell Irrigation Reservoir in Alberta, cormorant nesting pairs increased from 31 in 1957 to 665 in 1977 (Weseloh <u>et al</u>. 1977). On the Isle aux Pommes in the St. Lawrence Estuary, the number of nesting pairs tripled in the past 20 years following two attempts at reducing the population (DesGranges and Reed 1981).

2.3 Gulls

Investigator disturbance has been shown to reduce the reproductive success of Herring Gulls (Kadlec and Drury 1968; Fetterolf 1978), Western Gulls (Larus occidentalis) (Robert and Ralph 1975; Hand 1980), Glaucous-winged Gulls (L. glaucescens) (Gillet et al. 1975), and Ring-billed Gulls (Conover and Miller 1978). Human disturbance usually resulted in egg loss by exposure and predation by other gulls, although notable differences occurred among species. For example, Gillet et al. (1975) noted that Glaucous-winged Gulls did not steal or damage eggs, as Herring Gulls do, and that adults returned to their nests more quickly following disturbance.

Conover and Miller (1978) concluded that Ring-billed

Gulls' reaction to human disturbance or predation depends on the timing, intensity, duration and localization of the disturbance, the number of gulls present and whether adults or only young are threatened. During the pre-laying, laying, and early incubation periods, the gulls often deserted the colony for the day when disturbed. Incubating adults with eggs and young showed the greatest site tenacity permitting an intruder to approach within a few meters before flushing. During the post-hatch period, adults were less tolerant of intruders and flushed more easily. Territorially displaced chicks were subject to attack by other Repeated or prolonged disturbance resulted in adults adults. leading their chicks to other parts of the colony. If adults were killed by intruders or mammalian predators, or the disturbance was widespread, the gulls were more likely to desert the breeding colony.

Few studies have considered the impact of recreational activity on gulls. Hunt (1972) found that frequent disturbance by picnickers at two Herring Gull colonies resulted in egg loss by exposure and predation. Hand (1980) noted that campers, tour groups and egg collectors reduced the reproductive success of Western Gulls. Thirty to 69 percent of the nests were empty compared to 8 percent in an undisturbed colony. Anderson and Keith (1980) concluded that tourist disturbance of Heermann's Gulls (Larus heermanni) is particularly devastating because of the intense territoriality of the gulls. Territorial displacement of adults and young results in destruction of eggs

and young of conspecifics as well as those of Elegant (<u>Sterna</u> elegans) and Royal terns (<u>S. maxima</u>).

2.4 Terns

Caspian Terns are sensitive to human disturbance. particularly during the early stages of nesting. During this stage, motorboats can cause desertion of the colony (Martin 1978 citing Bergman in Vaisanen 1973). During egg-laying and incubation, adults will flush when a motorboat is still several hundred m from the colony. Adults will flush when a human intruder is within 100 to 200 m of the breeding colony (Soikkeli 1973). If disturbance is prolonged during early incubation, nests and eggs are abandoned (Shugart et al. 1978). As hatching nears, there is greater nest-site attachment and lesser chance of abandonment. Attempts by researchers using cannon nests to capture adults on nests resulted in egg loss (Blokpoel 1981) and egg abandonment (Shugart et al. 1978). Nestling mortality resulting from one hour of banding activities in a large colony of Caspian Terns was estimated at 35 percent for all 6 to 10-day-old chicks, which ran out of their parents' territory and were killed by returning adults. Younger chicks were less prone to flee and older chicks showed submissive behavior which terminated adult aggression (Penland 1981). Small colonies of Caspian Terns subjected to human disturbance were affected more by egg predation by gulls (Penland 1982).

When nesting Common Terns are disturbed by human

activities, adults leave their nests subjecting both eggs and chicks to gull predation (Gochfeld 1978). If repeatedly disturbed by humans, Common Terns may abandon an established breeding site and renest elsewhere including marginal habitats such as salt marshes where productivity is usually much reduced (Erwin 1980; Buckley and Buckley 1976).

McNicholl (1971) reported aggressive behavior by nesting Forster's Terns in response to researcher intrusion. During the period from near hatching to several days post-hatching, flushed birds' dive-bombing of the intruder was most frequent and intense. Displaced adults returned to their nests after the intruder moved a few m away from the nests. Chicks, which are able to swim soon after hatching, tended to leave their nests and hide when disturbed. Day-old chicks crouched in the nest at the approach of an intruder.

Terns may become habituated to human activity in certain situations. Morris and Hunter (1976) reported that their frequent visits to a Common Tern colony did not result in reduced breeding success or colony desertion. Blokpoel and Fetterolf (1978) reported that Common Terns nested 15 to 24 m from a road used intensively by dump trucks during the construction of the headland at Toronto Outer Harbour. Gochfeld (1978) found that some tern colonies have habituated to human activities: at a state park in New York, Common Terns nested near roadways and parking lots and became aggressive when disturbed. Similarly, Brubeck et al.

(1981) noted that a colony of Least Terns (<u>Sterna antillarum</u>) which were habituated to extensive daily pedestrian and recreational vehicle traffic were tolerant of additional disturbance by trapping, banding and patagial tagging. Altman and Gano (1984) reported Least Terns nesting alongside a Harrier jet pad at a naval air station.

2.5 Herons

Great Blue (Ardea herodias) and Black-crowned Night herons (Nycticorax nycticorax) are easily disturbed during courtship displays and nest-site selection, but are more tolerant of disturbance when nesting begins (Palmer 1976). Thompson (1981) reported a flushing distance of 70 m for tree-nesting Great Blue Herons compared to 200 m for Double-crested Cormorants nesting in the same colony. Tremblay and Ellison (1979) found that investigator disturbance just before and during egg-laying caused abandonment of nests and eggs, caused increased predation by crows and discouraged late nesters from settling in disturbed sites. Drapeau et al. (1984) reported reduced breeding success of Great Blue Herons in a mixed colony of herons and Double-crested Cormorants as a result of human disturbance. On average, 0.88 and 2.5 young herons respectively were produced per active and successful nest in 1979 when human disturbance was frequent, compared to 2.86 and 3.07 in 1980 when disturbance was minimal.

Several authors have reported abandonment of heronries because of human disturbance or a combination of factors. Ryder

et al. (1979) found that recreational activities (boating, water-skiing and fishing) and highway construction caused abandonment of smaller colonies (1 to 15 nests) of Great Blue Herons more frequently than larger ones. Heronries in Alberta were abandoned because of vandalism, decaying trees or other but were often relocated within 10 miles of the factors. original site (Vermeer 1973). Of 20 Great Blue Heron colonies that were abandoned in Saskatchewan over the years, human disturbance (shooting and tree-cutting) was the primary reason for abandonment of some colonies (Vermeer and Anweiler 1970). Kristensen (1981) suggested that increased human development and disturbance in more settled areas may be partly responsible for the existence of an active Great Blue Heron colony in the Wood Buffalo Park section of the Peace-Athabasca Delta, the most northerly known breeding site of the species.

A number of studies have considered habituation to repeated disturbance. Meyeriecks (1960) cited by Grubb (1978) reported that Great Blue Herons habituated to motor boat traffic. Anderson (1978) reported that a colony of Great Blue Herons became established beside a service road used regularly by a pick-up truck. Although the herons flushed as the truck passed, they always settled again. A colony of Great Blue Herons has nested in coniferous trees at Stanley Park, Vancouver, since 1921 despite high human activity (Kelsall and Simpson 1980). In 1981, Great Blue Herons began nesting in western red cedars bordering a parking lot on Sea Island near Vancouver International Airport

(Webb and Forbes 1982). It is speculated that the herons selected this site because of its proximity to heavily used feeding areas nearby. Grubb (1978) concluded that a large rookery containing Great Blue Herons, Black-crowned Night Herons and Great Egrets (<u>Casmerodius albus</u>) on the outskirts of St. Paul, Minnesota was expanding despite disturbance from nearby water, land and air traffic. Nesting herons in the colony showed no visible response to aircraft that were intentionally flown over the rookery at elevations as low as 50 m; this lack of response by the herons was attributed to possible habituation resulting from the urbanized environment (Grubb 1978). Parsons and Burger (1982) found that frequently disturbed Black-crowned Night Heron nestlings became habituated to human intrusion.

2.6 Grebes

Human disturbance of Western Grebe colonies during the reproductive season caused increased predation of eggs by American coots (<u>Fulica americana</u>) and California and Ring-billed gulls. Disturbed grebes left their eggs uncovered thus making them more visible to predators (Lindvall and Low 1982). In response to nest checks of Western Grebe colonies at Delta Marsh, Manitoba, adult birds immediately left their nests and formed a ring around the nesting island. The displaced birds remained at a distance of 30 to 100 m, depending on the stage of incubation. High nest desertion (22 of 42 nests) at one colony, located in a narrow channel used as a canoe route, was attributed to high human disturbance which included attempts to place an observation tower

at the site (Nuechterlein 1975).

During courtship and nesting, Eared Grebes responded to human disturbance by assuming the alarm posture and then escaping by diving or flapping across the water (McAllister 1958). De Vogel (1984) noted that disturbed nesting Eared Grebes left their nests all at the same time, but remained nearby.

3. TECHNIQUES FOR MANAGEMENT

Management techniques for protecting colonial nesting waterbirds from human disturbance are primarily restrictive measures or public education (Buckley and Buckley 1976). Manipulation of habitat, eggs and birds has been attempted to protect colonial birds from population declines attributed to a combination of factors, including human disturbance, but success has been minimal (Morris <u>et al</u>. 1980; Pullin and Hammer 1981). Buckley and Buckley (1976) contend that this technique, when used for protection against human disturbance, is usually detrimental to the species it is supposed to benefit.

3.1 Restrictive Measures

Restrictive measures include:

(a) Isolating sensitive areas by excluding human activity during the reproductive season (Markham and Brechtel 1978; Anderson and Keith 1980; Koonz and Rakowski 1985).

(b) Limiting access on a seasonal basis. This includes limiting the number of visitors and the frequency and duration of their visits (Anderson and Keith 1980; Kury and Gochfeld 1975;

Koonz and Rakowski 1985).

(c) Restricting harmful activities during the reproductive season. These include prohibiting the use of boats and off-road vehicles during the early part of the reproductive season, and requiring that aircraft not be flown below established ceilings over colonies (Roney 1980).

3.2 Education/Interpretation

Brochures, press releases, exhibits, signs, lectures and tours have been used in public education and interpretation programs to inform the public of the effects of human disturbance on colonial nesting birds (Buckley and Buckley 1976). Exhibits and signs at visitor centers and other entry points assist in controlling access. Lectures and tours, at entry points or locations where colonies are in sight but distant enough to avoid disturbance, help the public understand the needs of colonial nesting birds.

4. SPECIES SENSITIVITY TO DISTURBANCE FACTORS

The relative sensitivity of colonial nesting bird groups is shown in Table 1. Sensitivity is interpreted in terms of tolerance to disturbance: the less tolerant a species is to disturbance, the more sensitive it is considered to be. Each entry rates sensitivity to disturbance during the entire reproductive season, although sensitivity is generally highest during courtship and nest-site selection. Tolerance to disturbance increases as incubation progresses and desertion is least likely to occur when young are present (Buckley and Buckley 1976). Figure 1 shows breeding chronologies for selected colonial nesting waterbirds in Saskatchewan.

5. DATA GAPS

Most published material on human disturbance to colonial nesting birds in North America deals with researcher and tourist impact. Studies that have considered other kinds of human disturbance during the reproductive season are limited. Quantitative studies on the effects of human activities on birds emphasize non-breeding waterbirds in highly urbanized situations (Batten 1977; Burger 1981b). Data gaps which need to be addressed include:

(1) Sensitivity of cormorants to disturbance during courtship display and nest site selection.

(2) Behavioral response of pelicans and cormorants to commercial fishing activities.

(3) Minimum distance on land that pelicans and cormorants can be approached on foot without disturbance during egg-laying and incubation periods.

(4) Minumum distance on water that pelicans and cormorants can be approached by boat without disturbance during egg-laying and incubation periods.

(5) Minimum altitudes for aircraft (fixed-wing and helicopter) over pelican and cormorant colonies without disturbance to the birds.

(6) Effectiveness of access restrictions and public awareness efforts.

Answers to the above questions should help provide more effective control of human activities to minimize disturbance of breeding colonial waterbirds at LML.

6. LAST MOUNTAIN LAKE COLONIAL NESTING WATERBIRDS

6.1 Historical Use by Colonial Nesting Waterbirds Houston (1962) stated, "Last Mountain Lake was traditionally one of the best known nesting sites of colonial birds" in Saskatchewan. Thirteen species of colonial waterbirds have been recorded breeding at the north end of Last Mountain Lake (Anweiler 1970; P. Taylor, pers. comm.). Double-crested Cormorants and White Pelicans regularly nested there during years of favorable water levels. In 1954, Houston (1962) found 28 breeding pairs of White Pelicans. Hatfield (1973) reported 18 young were found at the north end of the lake in 1972. Although pelicans stopped at LML during spring and fall migrations and foraged there in summer, they did not nest there from 1973 to 1983. In 1984, 13 active nests and 9 young were found on the island off Perry's Point. Three nests found on a second island were destroyed by predators (C. Jorgenson, pers. comm.). Double-crested Cormorants ceased nesting at LML in 1958 (Houston 1962), but nested there again in 1969 (Vermeer 1970a) and periodically from 1969 to 1976 in reduced numbers (Allison 1978). In recent years, the number of breeding cormorants within the LML Migratory Bird Sanctuary has increased - 337, 789 and 1202 cormorant nests were found in 1978, 1980 and 1982 respectively

(Roney 1980, 1982; Roney and Hlady 1984; P. Taylor, pers. comm.).

Common Terns, traditional nesters at LML, continue to nest on small islands. In 1984, known numbers of active nests and young were 102 and 107 respectively. Caspian Terns, presently uncommon visitors and previously unknown to breed at LML, have recently been observed nesting there. One nest was found in 1979 and a breeding pair was seen in 1980 (P. Taylor, pers. comm.). Forster's Terns (<u>Sterna forsteri</u>) are uncommon summer residents, but are known to have nested there (Anweiler 1970; Canadian Wildlife Service 1977). However, Forster's Terns prefer marshes bordering lakes for nesting habitat (Godfrey 1966). Black Terns, commonly seen at LML, nest there in unknown numbers (Anweiler 1970).

Of six species of gulls observed at LML, only Ring-billed, California and Franklin's gulls have been recorded nesting there (Anweiler 1970; P. Taylor, pers. comm.). Ring-billed Gulls regularly breed on several islands (C. Jorgenson, pers. comm.). California Gulls nest with the Ring-billed Gulls rather than in their own colonies. Bonaparte's Gull (<u>Larus philadelphia</u>), which usually nests in coniferous woodlands near lakes or ponds (Godfrey 1966), is not known to have nested at LML, but is sometimes seen in the summer. Franklin's Gull, a common summer visitor at LML, was first recorded breeding in 1982 (P. Taylor, pers. comm.). Herring Gulls, which are seen at LML during migration and in the summer (Anweiler 1970; Canadian Wildlife

Service 1977), nested there for the first time in 1984. Transient Glaucous gulls have also recently been recorded in the fall at LML (P. Taylor, pers. comm.).

Great Blue and Black-crowned Night herons are recorded as breeding species for Last Mountain Lake (Canadian Wildlife Service 1977). No active heron colonies are known at present. Vermeer and Anweiler (1970) reported that the last active colony of Great Blue Herons at LML was in 1932. However, both species are regular, often common, summer visitors to the area. Other species of heron and egret which occur as vagrants and irregular summer visitors are Little Blue Heron (Egretta caerulea), Great and Snowy egrets (E. thula), and White-faced Ibis (Plegadis chihi) (P. Taylor, pers. comm.).

Western Grebes nest in the inlet behind Perry's Point, Sailor's Bay, and are suspected of breeding in the northern basins where they are regularly seen. Breeding colonies of Eared Grebes are found in Sailor's Bay and the northern basins. In 1984, known Western Grebe breeding consisted of 62 active, 45 inactive and 277 empty nests compared to 14 active and 17 empty nests for Eared Grebes. Low water levels in 1984 resulted in decreased <u>Scirpus</u> habitat for both species of grebe (P. Taylor, pers. comm.) which are intolerant of water level fluctuations (McAllister 1958; Nuechterlein 1975).

6.2 <u>Sensitive Areas for Colonial Nesting Waterbirds</u> Four areas within the LML Wildlife Management Unit are considered sensitive breeding areas (P. Taylor, pers. comm.). They are Basin A, the northern arms of the lake and islands, the Perry's Point area including the nearby island near the Point and the bay behind the peninsula, and Sailor's Bay (Figure 2). Specific locations of all the important breeding sites within the Wildlife Management Unit have not been identified. Limited information exists on the locations of important foraging and loafing sites.

6.3 Human Activity and Seasonal Use

Commercial and recreational activity at the LML Wildlife Management Unit has increased during the past 10 years (C. Jorgenson, pers. comm.). Many of these activities occur during the breeding season of colonial nesting birds. As the muskrat trapping season terminates in late April, sport fishing begins and continues through the summer. Naturalists, school groups and other visitors also use the area in the spring and summer. Large numbers of recreationists are attracted to the area in the summer. The Last Mountain Regional Park, which extends into the Wildlife Management Unit and the Migratory Bird Sanctuary, was established in 1961 and recreational use has been steadily growing ever since. Park attendance figures in recent years indicate more than 25,000 visitor days of annual use. Boating is a primary activity of Park visitors. Commercial fishing also occurs during the summer in the shallow parts of the lake where trap nests are set for buffalofish and carp. Hunting on the Wildlife Management Unit begins in September (Allison 1978).

6.4 <u>Vulnerability of Last Mountain Lake Colonial</u> <u>Nesting Waterbirds</u>

6.4.1 Pelicans and Cormorants

It is possible that a combination of unfavorable natural factors and increased human activities caused White Pelicans to abandon breeding at LML from 1973 to 1983. Pelicans that breed on inland lakes require (a) low-lying, untreed island breeding habitat that is relatively inaccessible to mammalian predation and human disturbance, (b) a good food supply within a reasonable distance of the colony, and (c) relatively stable water levels (Markham 1978a; Roney 1980).

Migrating pelicans start to arrive at LML in mid-April and the majority arrive by the third week of May (P. Taylor, pers. comm.). During this time, human visitors consist largely of sport fishermen and other recreationists, however, the first major influx of recreationists occurs during the third week of May, the first long weekend after winter (P. Taylor, pers. comm.). These activities may have prevented pelicans from nesting as they are sensitive to disturbance during courtship and nest-site selection (R. Evans, pers. comm.). The 1984 breeding was probably a combination of two factors -- more nesting space on the island and decreased boating as a result of the lower water level (P. Taylor, pers. comm.).

Double-crested Cormorants that breed on inland lakes have habitat requirements similar to those of White Pelicans (Markham 1978b). That greater numbers of cormorants are again nesting at LML suggests that they may be more tolerant of human activities than pelicans during the early stages of the nesting season.

In 1980, two cormorant colonies consisting of 39 and 40 nests respectively, were on the island off Perry's Point and a third colony of 710 nests was opposite Rowan's Ravine Provincial Park located outside the Wildlife Management Unit. In 1981, an estimated 25 pairs of cormorants began setting up territories on a small island near Watertown, but it is not known whether any breeding pairs nested or whether human activities inhibited the reproductive effort at this location. Up to 50 active nests and 120 young were found there in 1984 (P. Taylor, pers. comm.).

6.4.2 Gulls and Terns

Increasing numbers of nesting Ring-billed Gulls at LML suggests that they are the least vulnerable to human disturbance there. Because trends in numbers of breeding pairs of Common Terns over the past several years is unknown, it is difficult to say whether human disturbance may be limiting their productivity. Human disturbance during the early part of the reproductive season must not have been a limiting factor for the Common Tern colony on the island near Perry's Point in 1979 and 1980, as one pair of Caspian Terns nested among the Common Terns. However, it is not known if the Caspian Terns were successful. Two probable reasons for the nesting attempt by Caspian Terns in 1979 and 1980 are low water levels which discouraged boat travel in the area and the nesting site was inaccessible to people on foot (P. Taylor, pers. comm.).

6.4.3 Herons

It is not known if inadequate nesting and foraging sites, predation and/or human disturbance are preventing herons from establishing a breeding colony at LML. Marshes with an abundance of emergent vegetation (<u>Typha</u>, <u>Scirpus</u> and <u>Phragmites</u> spp.) are commonly used by Great Blue (Bray 1984; McCrimmon 1982) and Black-crowned Night herons (Greenwood 1981; Wolford and Boag 1971). A critical vegetation requirement, however, is the availability of sufficient densely concentrated dead stems (from previous years) for nest construction (Bray 1984). Only one known foraging site (opposite the Wildlife Management Unit Headquarters) is presently used by both species of heron as well as Great and Snowy egrets (C. Jorgenson, pers. comm.).

Predation, exacerbated by human disturbance, may also be responsible for discouraging herons from breeding in LML marsh habitat. That Black-crowned Night Herons are nesting at nearby Stalwart Marsh could be attributed to considerably less disturbance there.

6.4.4 Grebes

Both Western and Eared grebes prefer windsheltered nesting areas where open water is interspersed with dense clumps of emergents (Nuechterlein 1975; Faaborg 1976). A number of these sites at LML are located where commercial fishing may jeopardize grebe colonies (P. Taylor, pers. comm.). Fishermen prefer to set their nets across the mouth of Sailor's Bay and between the islands and other bays in the northern portion of the lake. As well, sport fishing also occurs in some of the areas where grebes nest. Disturbance by both commercial fishermen and anglers would be expected to cause increased egg predation by American coots (<u>Fulica americana</u>) and Ring-billed and California gulls.

6.5 Pesticide Contamination

Pesticide residues including mercury, DDE, PCB, chlordane, dieldrin, lindane and others may be affecting colonial waterbird productivity (and behavior) at LML (G. Adams and P. Taylor, pers. comm.). Pesticide residues found in eggs of colonial waterbirds in the prairie provinces in 1968 and 1969 were not considered serious (Vermeer and Reynolds 1970), however, increased use of pesticides (and herbicides) since then warrants further investigation. Riske (1976) concluded that high pesticide levels contributed to the deaths of recently-hatched grebe chicks in central Alberta. Low organochlorine levels were found in the eggs of 11 Great Blue Heron colonies in Quebec in 1979, but high concentrations (15.04 ppm DDE) were found in one heronry which had the lowest reproductive success (1.0 young/nest) that year and was deserted in 1980 (DesGranges and Laporte 1981; Laporte 1982).

6.6 Current CWS Information/Interpretation Program

Several brochures, including a bird check-list, highlight the importance of the LML Wildlife Management Unit for migratory

birds and list some of the programs for the protection and improvement of the area for wildlife. One brochure identifies a self-guiding auto tape (cassette) tour which helps visitors appreciate the area's diverse flora and fauna. Guided tours for school groups are provided on request. Resource kits, designed particularly for teachers, contain information on wildlife management and include suggestions for other activities (C. Jorgenson, pers. comm.).

Displays in the Regional Park consist of a variety of photographs and other illustrations to help convey the printed messages -- the importance of the area for migratory birds, management techniques and their benefits, and where additional information can be obtained. A display at the boat ramp encourages boaters to stay away from the nesting islands where breeding colonial waterbirds are easily disturbed.

7. RECOMMENDATIONS

 Important breeding, feeding and loafing areas for colonial waterbirds at LML should be inventoried as soon as possible.

2. Studies should be undertaken to determine (a) toxic chemical residues in the eggs of breeding colonial waterbirds at LML, and (b) the behavioral effect of the toxic chemical loads carried by the birds.

3. Known sensitive breeding areas should be protected by buffer zones of 1 km between April 15 and September 15.

4. No air traffic lower than 230 m should be permitted between April 15 and September 15. LML should be included in NOTAM (Notice to Airmen) regulations requesting pilots to avoid flying below 600 m over LML.

5. The entire Regional Park should be fenced (a) to prevent boat launching access to the long bay behind Perry's Point, and (b) to restrict recreational vehicle egress onto adjacent lands within the Wildlife Management Unit.

6. CWS should develop and implement an enforcement program in cooperation with the Saskatchewan Department of Parks and Renewable Resources (DPRR) to ensure compliance with regulations.

7. The current CWS public information program should be expanded and improved by (a) having on the area each year a trained seasonal naturalist for increased interpretation, (b) including in the package of brochures one specifically dealing with the importance of not disturbing colonial nesting waterbirds, and (c) encouraging the cooperation of DPRR and the Saskatchewan Museum of Natural History to inform the public of the sensitivity of colonial waterbirds to human disturbance.

		•				
	Low flying	Boats near	Foot	travel ^a	<u></u>	
	aircraft	colony	near colony	in colony	Source	
White Pelican	+++	+++	::::	+++	Houston 1962; Bunnell <u>et al</u> . 1981; Johnson and Sloan 1976; R. Evans, pers. comm.	
Double-crested Cormorant	+++	+++	+++	+++	Ellison and Cleary 1978; Kury and Gochfeld 1975; Markham 1978; R. Evans, pers. comm.	
California and Ring-billed gulls	++	0	+ +	++ 、	Conover and Miller 1978; Hunt 1972; R. Evans, pers. comm.	
Common Tern	++	++	++	+++	Gochfeld 1978; Morris and Hunter 1976; R. Evans, pers. comm.	
Great Blue and Black-crowned Night herons	++	++	+	++ ^C	Grubb 1978; Tremblay and Ellison 1979; Thompson 1981; Anderson 1978	

Table 1. Relative sensitivity of colonial nesting waterbirds to human disturbance factors. (+++ = very sensitive, ++ = moderately sensitive, + = slightly sensitive, 0 = not sensitive)

^a Includes researchers, photographers and naturalists. ^bCaspian Terns are very sensitive to all disturbance categories shown (Martin 1978; Soikkeli 1973; Shugart et al. 1978).

Ground-nesting herons are very sensitive.

Figure 1. Breeding chronologies for selected colonial nesting waterbirds in Saskatchewan (A = Arrival, E = egg-laying, I = Incubation, H = Hatching, B = Brooding, F = Fledging, M = Migration).

а



Information Sources: Canadian Wildlife Service 1977; Lindvall and Low 1982; McLeod and Bondar 1953; Mitchell 1977; Nuechterlein 1975; Quinney 1983; Schaller 1964; Thompson and Tabor 1981; Vermeer 1970b, 1970d, 1970e; Savage 1985; P. Taylor, pers. comm.



Figure 2. Sensitive breeding areas for colonial waterbirds.

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9. APPENDIX: SELECTED ANNOTATED BIBLIOGRAPHY

Allison, L. 1978. A 5-year management plan for the Last Mountain Lake Wildlife Management Unit. Unpubl. report. Can. Wildl. Serv., Saskatoon, Sask. 175 pp.

> Major objectives of the proposed 5-year management plan are to protect, manage and manipulate habitat for wildlife using the area without detriment to privately owned lands outside the unit; to conduct management oriented research, with particular emphasis on the effects of agricultural activities on wildlife habitat; and to increase the public awareness and understanding about the Wildlife Management Unit. Management program activities discussed include administration, public use, public information and interpretation, prevention of crop depredation, haying and grazing, revenues, habitat manipulation and research, operations, land acquisition and fire protection.

Anderson, E.C. 1981. The European Cormorant on Lake Baikal. J. Field Ornithol. 52(2): 163.

> The European Cormorant, one of the most numerous birds of the Lake Baikal fauna, ceased nesting there about 20 years ago and the last individual was recorded in 1971. Reasons given for its complete disappearance are collecting of eggs and chicks, killing of adults, increased predation of eggs by gulls, increased motorboat traffic and reduced fish resources.

Anderson, J.M. 1978. Protection and management of wading birds. Pages 99-103 in Wading Birds (A. Sprunt IV, J.C. Ogden and S. Winckler, Eds.). National Audubon Soc. Res. Report No. 7.

> Harvest of waders for their plumage or food value is considered minimal. Human disturbance during the nesting season is a critical factor, especially along the Texas Coast. Most state wildlife enforcement agencies are reluctant to get involved in wading bird protection - a situation which is improving only gradually. At present, private conservation agencies are unable to adequately protect wading birds along the Texas coast but usually can cope with the situation elsewhere. Wading bird protectors must know the life histories of the species involved and be experienced boatmen, with equipment costing an average of \$10,000 per person.

> Islands are extremely important to coastal heronries. When man-made, they should be built as large as possible, land-erosion and flood-control measures should be provided if feasible. Nesting platforms have been used successfully at Avery Island, Louisiana, but nowhere else along the Gulf Coast. The efforts of E.A. McIlhenny at

Avery Island represent the most outstanding wading bird management program in North America.

The filling of marshes and the continued use of persistent pesticides constitute a very serious threat to wading birds. Cooperation on the part of oil exploration and production companies results in good protection and occasional enhancement of habitat. At the Corkscrew Swamp Wildlife Sanctuary in Immokalee, Florida, a supplemental feeding program for Wood Storks offers considerable promise.

Sanctuaries in both freshwater and saltwater are the best means of preserving habitat. They may be operated by state or federal agencies or by private conservation organizations such as the National Audubon Society. (a.s.)*

Anderson, D.W. and J.O. Keith. 1980. The human influence on seabird nesting success: conservation implications. Biol. Conserv. 18(1): 65-80.

> Based on studies of brown pelicans (Pelecanus occidentalis californicus) and Heermann's gulls (Larus heermanni), disturbances by recreationists, educational groups, local fishermen and scientists alike can be seriously disruptive and damaging to breeding seabirds in the Gulf of California and along the west coast of Baja California. Similar instances have been identified throughout the world - the problem is not difficult to document, but it is difficult to eliminate. The increasing human-seabird contacts on islands in the Gulf of California and along the west coast of Baja and immediate California raise serious questions concern about the continued preservation of nesting colonies of marine birds in those areas. Conservation measures must consider the extreme sensitivity of many seabirds to the inter- and intraspecific behavioural imbalances created by human disturbances. In some cases, total exclusion of humans may be required; in others, limited access might be possible under closely managed conditions at certain times of the year. A symbiotic relationship between seabird conservation, legitimate research and tourism should be the desired goal. (a.a.)**

* author's summary
** author's abstract

Anderson, D.W., J.E. Mendoza and J.O. Keith. 1976. Seabirds in the Gulf of California: A vulnerable, international resource. Nat. Resour. J. 16(3): 483-505.

> The Gulf of California contains the most spectacular concentrations of southern seabirds on the West Coast of North America. Most of these seabirds nest in concentrated island colonies and are therefore particularly vulnerable to outside disturbances, pollution and unnatural environmental changes. Disturbance-induced reductions in productivity are usually caused by death of young birds due to heat exhaustion and injury, nest desertion by uneasy adults and egg losses to heat and abnormal predation by gulls. Water contamination by insecticides, industrial pollutants and oil, introduced predators and interactions with commercial fisheries are discussed. Conservation strategies must engage the cooperative efforts of federal and state governments supported by private organizations.

Anweiler, G.G. 1970. The birds of the Last Mountain Lake Wildlife Area, Sasktchewan. Blue Jay 28(2): 74-83.

> This is an annotated list of birds observed in the Last Mountain Lake area between April and October 1969 supplemented by information from other observers. Included for each species listed are extreme dates of occurrence, peak migration dates (if known), whether or not the species breeds in the area or is only a visitor.

Batten, L.A. 1977. Sailing on reservoirs and its effects on water birds. Biol. Conserv. 11: 49-58.

There is increasing pressure to develop many existing water spaces in Britain for recreational activities. This trend will increase disturbance to water bird populations. This paper considers these problems and suggests the sorts of information which are needed for formulating multi-purpose amenity plans for water spaces, where a conservation interest exists. The study at the Brent Reservoir in north-west London has shown that few species of wildfowl, e.g. Anas platyrhynchos, Aythya fuligula, Aythya ferina, still use the reservoir in autumn and winter despite an intensification of sailing activities. This use and the successful breeding of Podiceps cristatus and other species of water birds depends on the existence of a large enough part of the reservoir which is shallow and marshy and not accessible to boats. As there is some suggestion that larger flocks are more sensitive to disturbance than smaller ones, refuges may be made more effective by proper screening. (a.a.)

Blockpoel, H. 1981. An attempt to evaluate the impact of cannon-

netting in Caspian Tern colonies. Colonial Waterbirds 4: 61-67.

Five Caspian Tern colonies in Canadian Lake Huron were visited before, during and after cannon-net operations. After pre-netting visits, 7 percent of 212 nests checked had reduced nest contents. After netting operations, 28 percent of 457 nests checked inside the netted areas had reduced nest contents compared to 16 percent of 149 nests checked outside the netted areas. Limitations of the data and difficulties of interpreting the results are discussed.

Blokpoel, H. and P.M. Fetterolf. 1978. Colonization by gulls and terns of the Eastern Headland, Toronto Outer Harbour. Bird-Banding 49(1): 59-65.

> Ring-billed Gulls, Herring Gulls, Common Terns and Caspian Terns readily colonized the man-made Eastern Headland of Toronto Outer Harbour during its development from 1972 to 1976. Common Terns nested 15 to 25 m away from a road used intensively by dump trucks. Attractive features of the headland were immediate vicinity of water, ample food supply, low levels of disturbance by pedestrians or mammalian predators, suitable nesting substrates, sparse and low vegetation, and an unobstructed view in most or all directions.

Brubeck, M.V., B.C. Thompson and R.D. Slack. 1981. The effects of trapping, banding and patagial tagging on the parental behavior of Least Terns in Texas. Colonial Waterbirds 4: 54-60.

> Adult Least Terns that were nest-trapped and marked with patagial tags deserted nests at a greater rate than did terns that were handled less extensively. However, at one colony which was exposed to extensive recreational disturbance, adult terns showed lower desertion rates than birds from more isolated colonies. Brooding terns that were nest-trapped and tagged accepted significantly more fish from their foraging mates than did birds that were subjected to lesser degrees of handling. No differences occurred in food delivery rates to chicks or in chick survival rates among experimental groups or controls.

Buckley, P.A. and F.G. Buckley. 1976. Guidelines for the protection and management of colonially nesting waterbirds. North Atlantic Regional Office, National Park Service, Boston, Mass. 55 pp.

> Topics considered include critical biological features of colonially nesting waterbirds, assessment of colonial waterbird resources, kinds and effects of disturbance, protection measures against disturbance, predation, habitat, management techniques and pollution control.

Specific restrictive protective measures discussed are seasonal or areal closure to off-road vehicles and pedestrians, signs and posting, various types of fencing, ceilings for aircraft, special-use permits for bird-banders and scientists, boardwalks and towers and enforcement. Non-restrictive measures considered are lectures and tours, leaflets, exhibits, signs and press releases.

Bunnell, F.L., D. Dunbar, L. Koza and G. Ryder. 1981. Effects of disturbance on the productivity and numbers of White Pelicans in British Columbia - Observations and models. Colonial Waterbirds 4:2-11.

> During the past 20 years, the single breeding colony of White pelicans in British Columbia has declined at a mean rate of 2 breeding pairs per year. Human disturbance (low-flying aircraft) and coyote predation are the major factors causing the decline. Early disturbance was the most critical. Human disturbance early in the season reduced mean productivity to 0.22 young per nest, compared to 0.74 later in the nesting cycle. Coyote predation early in the season reduced mean productivity to 0.58 young per nest compared to 0.09 later in the nesting cycle. In years without human disturbance or predation, mean productivity was 0.74.

Burger, J. 1981a. Effects of human disturbance on colonial species, particularly gulls. Colonial Waterbirds 4: 28-36.

People affect nesting colonies of birds in diverse ways. They can destroy the nests, eggs, or chicks or force birds to abandon their nest sites and colonies. They can keep adults off their chicks and eggs, thus exposing them to temperature stress or predation. The above effects can be lethal to eggs or chicks, and result in immediate and obvious decreases in reproductive Many other effects of human disturbance are success. less obvious, but nonetheless contribute to lowered overall breeding success. Such effects include; decreased incubation and chick attendance, shifts in the mate incubating, earlier and distant movements of chicks, entanglement of chicks in vegetation, increased brood sizes (when several chicks enter the same nest), more frequent aggressive encounters, greater energy expenditures for territorial defense, and attraction of predators to nest sites. (a.s.)

Burger, J. 1981b. The effect of human activity on birds at a coastal bay. Biol. Conserv. 21(3): 231-241.

I examined the direct and indirect effects of human activity on birds at a coastal bay refuge along the Atlantic Coast. Over the year, human activity varied at different sample sites on the refuge, but people were present on part of the refuge every day, although activity was concentrated on designated paths around a freshwater pond and at a fishing pier. On the refuge (exclusive of the ponds) people were present at the sample sites 17 percent of the time, birds were present 42 percent of the time when people were present, but birds were present 72 percent of the time when people were absent. Human activities, such as jogging or grass mowing, which involved rapid movement or close proximity to roosting birds, usually caused them to flush. Slow-walking bird watchers and clammers did not usually cause birds to flush. Gulls and terns were least affected as they usually relanded where they had been, ducks usually flushed and flew to the centre of the pond, and herons, egrets and shorebirds were most disturbed and flushed to distant marshes. These results suggest tht if management objectives include providing roosting areas for migrating shorebirds then some areas must be protected from close and fast-moving human activities. (a.a.)

Canadian Wildlife Service. 1977. Bird Check List for Last Mountain Lake Wildlife Management Area and vicinity. Canadian Wildlife Service, Saskatoon, Sask.

This is a preliminary list of 217 species showing seasonal distribution of birds in the vicinity of Last Mountain Lake. The listing indicates for each species whether it is common, uncommon, rare or breeds in the area.

Carson, D. 1966. Destruction of colonial birds on an island on Suggi Lake. Blue Jay 24(2): 96-97.

> Commercial fishermen camped on an island where White Pelicans and Double-crested Cormorants were nesting and destroyed their nests.

Conover, M.R. and D.E. Miller. 1978. Reaction of Ring-billed Gulls to predators and human disturbances at their breeding colonies. Proc. Colonial Waterbird Group 2: 41-47.

> Ring-billed Gulls have unstable and transient breeding colonies. When faced with a disturbance or predation in some area of the colony, the gulls in that area may react by deserting either the particular area or the entire breeding colony. Such areas are usually devoid of gulls in subsequent years. The gull's reaction to a predator or disturbance is dependent upon a number of factors which include how severe, prolonged and localized the problem is, when it occurs during the day or during the breeding season, the number of gulls present, and if the adults or only the young are threatened. The unstable and impermanent colonies may be an adaptation to predation pressure that fluctuates yearly and is unpredictable. (a.s.)

DesGranges, J.L. and A. Reed. 1981. Disturbance and control of selected colonies of Double-crested Cormorants in Quebec. Colonial Waterbirds 4: 12-19.

> Double-crested Cormorants (<u>Phalacroxorax auritus</u>), nesting in mixed colonies with gulls (<u>Larus spp.</u>) in the St. Lawrence estuary were subjected to various levels of disturbance and population control. On 26 June 1978, the lle aux Pommes colony was disturbed four times by investigators. These visits resulted in the loss of 37 percent of the eggs and 13 percent of the young (N = 25 nests). Nests near the periphery of sub-colonies and those containing only eggs suffered most from predation by gulls. The proximity of a gull nest or perch did not seem to increase the risks of predation.

> During the last quarter century, two attempts at reducing the colony of cormorants on lle aux Pommes failed. In 1954-55 and 1978-80, most eggs and young cormorants were destroyed. Almost every year since 1963, biological surveys were conducted on the island, inevitably causing disturbance. Despite those disturbances the number of pairs nesting on lle aux Pommes has more than doubled (2.5x) since 1963, a rate of increase greater than that of the entire population of the St. Lawrence estuary (1.7x). In recent years, the colonies of Double-crested Cormorants on lle Rasade du Sud Ouest and in the llot le Pilier de Bois were submitted to partial and regular controls. These attempts failed, as indicated by population increases at both sites.

> We conclude that population control could only be achieved by extensive, sustained, and massive destruction of nests and their contents. (a.s.)

Dunnet, G.M. 1977. Observations on the effects of low-flying aircraft at seabird colonies on the coast of Aberdeenshire, Scotland. Biol. Conserv. 12(1): 55-63.

> The greatly increased use of helicopters and fixed-wing aircraft to support the exploration and exploitation of oilfields in the North Sea gives rise to concern about possible disturbance to seabirds breeding in the flight paths. The observations reported in this paper were made at a mixed colony of fulmars (Fulmarus glacialis), shags (Phalacrocorax aristotelis), herring gulls (Larus argentatus), kittiwakes (Rissa tridactyla), guillemots (Uria aalge), razorbills (Alca torda), and puffins (Fratercula arctica), breeding on the Buchan cliffs about 40 km north of Aberdeen, on two days during egg-laying and early nestling stages of the breeding season.

The number of birds in attendance at nests or nesting ledges were counted before and after the passage of aircraft, and general observations were made when the planes were overhead. The number of identifiable nests with 0, 1 or 2 adults was noted since disturbance might be most sensitively detected by the departure of non-incubating/brooding adults.

No evidence was found to suggest that aircraft flying at heights of about 100 m above the cliff-top affected the attendance of incubating and brooding birds, and there was only a slight indication that a few of the 'second adults' at kittwake nests may have flown off. Groups of kittiwakes nesting on nearby cliffs or on the sea did take to the air in response to the planes, but they also did so frequently in the course of the day with no obvious cause. It is stressed that these findings cannot be extrapolated to other species of seabirds or to different conditions. (a.a.)

Ellison, L.N. and L. Cleary. 1978. Effects of human disturbance of Double-crested Cormorants. Auk 95(3): 510-517.

> In 1975 and 1976, studies of the Double-crested Cormorant were conducted in the St. Lawrence Estuary to assess the influence of investigators visiting colonies during the breeding season. Frequent visits caused nest abandonment, gull predation, and discouraged late-nesting birds from settling in disturbed experimental colonies. Late clutch commencement was more prevalent in the relatively undisturbed controls. Birds were less susceptible to disturbance in the second year of study, but for some reason other than habituation. (a.a.)

Erwin, R.M. 1980. Breeding habitat use by colonially nesting waterbirds in two mid-Atlantic U.S. regions under different regimes of human disturbance. Biol. Conserv. 18(1): 39-52.

> More than 80% of the beach-nesting seabirds (common tern, least tern, black skimmer, and herring gull) in coastal Virginia nest on natural barrier island beaches, while in New Jersey the vast majority nest on dredge deposition material or natural marsh islands. This contrast probably results from the differences in human disturbance in the two regions. Although 75% of all oceanfront in New Jersey allows unrestricted recreation, about 85% of the Virginia beaches are "protected" under the ownership of several conservation agencies. Attendant with changes in habitat utilization in New Jersey, competitive interactions have apparently intensified with herring gulls usurping tern and laughing gull nest sites. Other implications are discussed. (a.a.)

Fetterolf, P.M. 1978. The human artifactor: gull behavior in response to the scientist. Proc. Colonial Waterbird Group

2: 48. Abstract.

The study quantified the behavioral responses of adult and chick herring gulls (Larus argentatus) to an "ecologist". Experiments were designed to answer 3 questions: How do the gulls behave before, during and after human intrusion? How much effect do behavioral changes, if any, have on the breeding success of the gulls? If human disturbance causes egg and/or chick loss, are these losses randomly distributed across all breeding pairs?

Observations were conducted from a blind which was situated outside the study plots and which was entered on the day before disturbance and data collection. Behavior was monitored for one hour before disturbance, during disturbance and for one hour after disturbance. Ecological information was collected by an assistant who caused all known human disturbance in the two adjacent study plots. One plot was visited rarely and briefly during egg-laying and hatching. The second plot was visited every second day for much longer periods over the entire study.

Human disturbance had profound effects on gull behavior and was the major cause of egg and chick loss. The biased nature of the mortality suggests that much previous work on gull breeding success may be seriously confounded.

Gillet, W.H., J.L. Hayward and J.F. Stout. 1975. Effects of human activity on egg and chick mortality in a Glaucouswinged Gull colony. Condor 77: 492-495.

> In summary, our presence on Colville Island increased chick mortality in areas where we worked. However, our presence had no effect on egg mortality. There is no overall population decline on Colville. Instead the population is on the increase. Compared with other gull colonies the mortality is small. The observed chick mortality on Colville is near the range of chick mortality (8-13%) on totally undisturbed colonies in the same area. Fifty-five percent of the mortality occurred during the first week after hatching. The increase in mortality resulted largely from chicks moving into adjacent territories and being attacked by neighboring adults as the result of our entering the chicks' home territory. (a.s.)

Gochfeld, M. 1978. Terns in traffic. Nat. Hist. 87(6): 54-61.

A large colony of Common Terns continues to nest near a heavily used public beach area. The main contact between

the terns and people is automobile traffic on a road through the colony. Other disturbance consists of pedestrian traffic and some vandalism. The failure of the colony to grow appreciably in recent years is attributed in part to the high number of fledglings killed on the road through the colony.

Grubb, M. 1978. Effects of increased noise levels on nesting herons and egrets. Proc. Colonial Waterbird Group 2: 49-54.

> It is known herons often breed in secluded locations and may abandon nesting efforts if disturbed. However, little information exists in the literature concerning the general subject of effects of increased noise levels on nesting herons and little is known on decibel levels which nesting herons will tolerate. This paper reviews the existing literature and presents the results of a field study conducted to address the above problem.

> Existing noise levels were measured in a large mixed species heron rookery in St. Paul, Minnesota. A small plane then flew over the rookery at elevations ranging from 150 ft. to 800 ft. above the ground. Calculated maximum noise levels from this plane were 9 dBA greater than calculated existing maximum noise levels from aircraft and 20 dBA greater than measured existing maximum noise levels. There was no response from the nesting birds to either the increased noise levels or the presence of the aircraft. The fact that these birds are currently residing in an urbanized environment may have resulted in their habituation to noise disturbances. (a.s.)

Hand, J.L. 1980. Human disturbance in Western gull (Larus occidentalis livens) colonies and possible amplification by intraspecific predation. Biol. Conserv. 18: 59-63.

> Indirect evidence is presented that human disturbances are having a profound effect on reproductive efforts of Larus occidentalis livens at several colonies in the Gulf of California. Breeding adults that lose their eggs or chicks apparently practise conspecific predation whether or not humans are present, thus increasing effects of human intrusions. These combined effects could lead to a severe decline in numbers or even pose a threat to the survival of this endemic population, if human disturbance is widespread. Attemps to assess breeding success throughout the Gulf seem warranted and, if necessary, some action to regulate human contact may be essential. (a.a.)

Hatfield, J.P. 1973. Pelicans return to Last Mountain Lake.

Blue Jay 31(2): 98.

In the summer of 1972, several hundred White Pelicans remained at the north end of Last Mountain Lake. Eighteen young pelicans were found on one of the smaller islands.

Houston, C.S. 1962. Hazards faced by colonial birds. Blue Jay 20(2): 74-77.

The changing status of some of the Saskatchewan colonies of pelicans, cormorants and gulls is reviewed. Specific locations considered are Last Mountain Lake, Crana Lake, Quill Lake, Manito Lake, Dore Lake and Redberry Lake. Fluctuating water levels and human disturbance are believed to be the major hazards faced by colonial birds.

Hunt, G.L. 1972. Influence of food distribution and human disturbance on the reproductive success of Herring Gulls. Ecology 53: 1051-1061.

> A three year study of Herring Gull (Larus argentatus) reproductive success on four islands in Maine indicated that production of young was controlled by different factors operating on the eggs and chicks. Hatching success was inversely related to the disturbance of colonies by picnickers, which apparently caused the adults to leave their eggs exposed to sufficient solar radiation to addle the eggs. The survival of chicks was lower on islands distant from sources of edible refuse (outer islands) than on islands close to sources of waste (inner islands), regardless of visits by picnickers. The nutrition and growth rates of chicks on inner and outer islands were similar. The attendance of parents on the territories was found to be less on an outer island than on an inner island. It is concluded that differences in parental behavior associated with greater foraging effort were responsible for a higher loss of chicks to predation on the outer islands. (a.a.)

Jehl, Jr., J.R. 1973. Studies of a declining population of Brown Pelicans in northwestern Baja California. Condor 75: 69-79.

> The reproductive success of Brown Pelicans was studied at three islands in northwestern Baja California from 1969 through 1971. Large-scale reproductive failure was found in all colonies. The major factor limiting productivity was thin-shelled eggs caused by chlorinated hydrocarbons. Egg collectors and recreationists were considered the major factor affecting productivity at San Martin Island.

Johnson, R. F. and N. F. Sloan. 1976. The effects of human disturbance on the White Pelican colony at Chase Lake National wildlife Refuge, North Dakota. Inland Bird

Banding News 48: 163-170.

Research activities at nesting colonies of White Pelicans can result in lowered reproductive success because of increased gull predation of eggs and young pelicans, temperature stress of young and trampling of young. Recommended techniques for reducing these harmful effects are (1) the number of researchers that enter a colony at any given time should be as small as possible, (2) research activities should be confined to the early and later hours of the day when temperatures are less extreme, and (3) researchers should take advantage of topographic and vegetative variations within the colony to conceal themselves.

Kadlec, J.A. and W.H. Drury. 1968. Structure of the New England Herring Gull population. Ecology 49: 644-676.

> Sixty-one productivity measurements on 43 islands from 1963 through 1966, involving almost 13,000 nests showed. that from 0.8 to 1.4 young per breeding pair per year is the usual range of rate of production. Of the 622,000 gulls observed, 68 percent were adults, 17 percent were second and third-year birds and 15 percent were first-year The age structure and rate of population increase birds. indicated a mortality rate of 4 to 9 percent for gulls two years old or older compared with 25 to 30 percent indicated by band recoveries. Data suggested that visits to the colonies lowered reproductive success according to frequency and duration of visits, types of weather in which they occurred (rain and high temperatures intensified the effect) and density of colony (more adults were kept alarmed and off their nests in dense colonies).

Kristensen, J. 1981. Great Blue Heron (<u>Ardea herodias</u>) colony in the Peace-Athabasca Delta, Alberta. Can. Field-Nat. 95(1): 95-96.

> The most northerly colony of Great Blue Herons was recorded in the Peace-Athabasca Delta, Alberta in 1977. Increasing human development and disturbance in more settled areas coupled with ideal feeding habitat in the Peace-Athabasca Delta are possible reasons for the northern nesting of the herons.

Kury, C.R. and M. Gochfeld. 1975. Human interference and gull predation in cormorant colonies. Biol. Conserv. 8(1): 23-34.

> The vulnerability of cormorant eggs and nestlings to gull predation is greatly increased by human intrusion into breeding colonies. Observations of the behaviour of double-crested cormorants (Phalacrocorax auritus) and

king shag (P. albiventer) vis-a-vis the behaviour of great black-backed and herring gulls (Larus marinus and L. argentatus) on the one hand and dolphin gulls (Leucophaeus scoresbii) on the other indicate that certain predictable offensive and defensive interactions occur when breeding birds are disturbed. Knowledge of these behavioural patterns suggests that interference with normal breeding activities and the resulting reduction in productivity of cormorants can be minimized in colonies where human access is carefully regulated. (a.a.)

Lock, A.R. and R.K. Ross. 1973. The nesting of the Great Cormorant (Phalacrocorax carbo) and the Double-crested Cormorant (Phalacrocorax auritus) in Nova Scotia in 1971. Can. Field-Nat. 87: 43-49.

> Thirty colonies, containing some 4150 pairs, of the Double-crested Cormorant (Phalacrocorax auritus) were censused. Only ten of these had been censused previously and increases in size were noted in five. Twenty-three colonies, containing some 2050 pairs, of the Great Cormorant (Phalacrocorax carbo) were censused. Of the seven which had been previously censused, three had increased in size. Great Cormorants were found breeding on four islands south of their previously known breeding range and the populations of both species appear to be increasing. The Great Cormorants nest on cliffs or on the ground on rocky islets while the Double-crested Cormorants always nest on islands, usually in spruce trees. (a.a.)

Markham, B.J. 1978a. Status report on the White Pelican (Pelicanus erythrorhynchos) in Canada. Unpubl. report prepared for The Committee on the Status of Endangered Wildlife in Canada. Canadian Nature Federation, Ottawa. 28 pp.

> The White Pelican (<u>Pelecanus erythrorhynchos</u>) is distributed over central and western North America. In Canada it breeds in five provinces: Ontario, Manitoba, Saskatchewan, Alberta and British Columbia with the three prairie provinces supporting the majority of the populations. While the species is not protected under the Migratory Birds Convention Act, it does receive full protection under the Wildlife Acts of the five provinces within which it breeds.

> Pelicans do not breed successfully before three years of age. While the reproductive rate is relatively low - less than one young successfully fledged per nest - recruitment appears to replace mortality. The most recent information available on 29 breeding colonies reported as active in the last ten year records a total of 15,560 nests. This suggests a total breeding population of approximately 31,000 individuals. This total nest figure is somewhat

larger than the 14,103 reported for the late sixties. However, over half of this latest figure is made up of Manitoba data which are seven years old. In the other four provinces recent surveys indicate an increased population in Ontario, a decrease in Saskatchewan and stable populations in Alberta and British Columbia.

In the long term the Canadian White Pelican population appears to be declining. Twenty-six colonies have been reported to have been abandoned since the turn of the century. The greatest threat to the species is increased human activity and disturbance at breeding colonies. Compared to human disturbance, other limiting factors like habitat destruction, predation and pesticide contamination, seem insignificant. While the majority of all colony sites are located on Crown land, inadequate protection of these critical areas exists.

The White Pelican generates considerable public interest because of its unique appearance and interesting breeding behaviour. Management recommendations suggest protection of the species under federal legislation and protection of its habitat through provincial regulations. Regular monitoring of the population on a provincial basis is also recommended. (a.a.)

Markham, B.J. 1978b. Status report on the Double-crested Cormorant (Phalacrocorax auritus) in Canada. Unpubl. report prepared for the Committee on the Status of Endangered Wildlife in Canada. Canadian Nature Federation, Ottawa. 28 pp.

> The Double-crested Cormorant (Phalacrcorax auritus) is widely distributed throughout North America. In Canada it breeds in all ten provinces. For this report, four "subpopulations" are discussed: East Coast, Great Lakes, Prairie and West Coast. The East Coast and Prairie "subpopulations" make up the majority of the Canadian population. While the species is not protected under the Migratory Birds Convention Act it does receive full protections under the Wildlife Acts of the provinces.

> Cormorants usually first breed at three years of age but some do so at two. Recruitment appears to replace mortality with the possible exception of the "Great Lakes Subpopulation". The most recent information available on 150 breeding colonies reported as active in the last ten years records a total of approximately 21,000 nests. This suggests a total breeding population of approximately 42,000 individuals of which approximately 40,000 occur on the East Coast and Prairies.

> The total Canadian Double-crested Cormorant population appears to be increasing. An exception to this is the

"Great Lakes Subpopulation" which has declined to a very low level. A similar trend appears to exist in Newfoundland. Dramatic population increases in recent years have occurred in Saskatchewan, Alberta and to a lesser degree in British Columbia. Recent information on Manitoba's cormorant population status is lacking.

While the Canadian Double-crested Cormorant population is not declining overall, local declines have occurred due to human disturbance. This continues to be the greatest potential limiting factor. While pesticide contamination has been a significant problem in the past, it is probably not serious today except possibly in the Great Lakes. While the majority of colony sites are located on Crown land, except specifically in Prince Edward Island, inadequate protection exists for these critical areas.

The major recommendations involve protection of breeding colony sites through provincial legislation or acquisition and routine monitoring of the populations on a provincial basis. (a.a.)

Markham, B.J. and S.H. Brechtel. 1978. Status and management of three colonial waterbird species in Alberta. Proc. Colonial Waterbird Group 2: 55-64.

> The paper presents a species management plan for three 'high demand' colonial waterbird species in Alberta: White Pelican (Pelecanus erythrorhynchos); Double-crested Cormorant (Phalacrocorax auritus); and Great Blue Heron (Ardea herodias).

> A total of 7 pelican colonies, 17 cormorant colonies and 64 heron colonies were active in 1978. Estimated 1978 breeding populations are 500, 1900, and 1200 to 1300 pairs, respectively. While the population of Double-crested Cormorants has increased dramatically in recent years, those of the other two species appear to be presently stable but declining in the long term.

> The management goal established for these three species is: To ensure long term stable populations to adequately meet demands related to recreational and aesthetic values, scientific investigations and publc education. Major objectives within the management plan are population monitoring, colony protection and public education.

> Four major management problems have been addressed: disturbance at the breeding colony; habitat loss; pollution; and incomplete management data. Strategies to overcome these problems include education, legislation and enforcement, land acquisition, population nonitoring and research. The plan will be reviewed at five year

intervals and strategies adjusted as required. (a.s.)

Martin, M. 1978. Status report on Caspian Tern (<u>Sterna</u> <u>caspia</u>) in Canada. Unpubl. report prepared for the Committee on the Status of Endangered Wildlife in Canada. Canadian Nature Federation, Ottawa. 43 pp.

> The caspian tern (<u>Sterna caspia</u>) has a worldwide but highly disintegrated breeding distribution. In Canada there are colonies in six provinces and in the Northwest Territories. Caspian terns are under the jurisdiction of the Federal Government. Based on the data available there does not appear to have been a reduction in the breeding range of the caspian tern but there is insufficient data available to establish a population trend in most areas. The majority of birds nest in tightly packed colonies of 50 to 1000 pairs.

> They nest on small islands with little or no vegetation that in most cases are in relatively undisturbed regions. They are plunge-divers and feed exclusively on fish. The most important threats to their populations are various forms of human disturbance and toxic chemical pollutants in the waters in which they feed. The effects of these can be drastic in a population that is in a few tightly packed colonies. (a.a.)

Mitchell, R.M. 1975. The current status of the Double-crested Cormorant in Utah: a plea for protection. Am. Birds 29: 927-930.

> The population of Double-crested Cormorants in Utah has been steadily decreasing for the past 50 years because of natural conditions and human disturbance. Of the 13 colonies that have existed at one time or another within the state, only five are still in use. A proposed diking' and drainage project at Provo Bay, Lake Utah, would eliminate the nesting area of two of the remaining five colonies in Utah.

Morris, R.D. and R.A. Hunter. 1976. Factors influencing desertion of colony sites by Common Terns (<u>Sterna</u> hirundo). Can. Field-Nat. 90: 137-143.

> During the years 1972 to 1974, factors affecting the breeding biology of Common Terns (<u>Sterna hirundo</u>) were studied at five colony locations in the lower Canadian Great Lakes. At three of these colonies, no terns returned to breed in 1974, but at two other locations numbers remained stable or increased. We consider availability of nesting substrate, reproductive failure, food supply, human disturbance, predation, and exploitation competition by Ring-billed Gulls as explanation for these observations. We conclude that

whereas the most probable cause of desertion can be suggested for specific colonies, experimental work is required to identify the actual cause(s), which may be multiple. (a.a.)

Morris, R.D., I.R. Kirkham and J.W. Chardine. 1980. Management of a declining Common Tern colony. J. Wildl. Manage. 44(1): 241-245.

> In an attempt to enhance Common Tern productivity on Gull Island on Lake Ontario, vegetation growth was controlled and nests of Ring-billed Gulls were destroyed. Lack of synchrony between hatching of artificially incubated eggs (obtained from another tern colony) and the Gull Island tern nests prevented the intended replacement of eggs lost at the study site. Reproductive success was higher in the management year. Virtually complete failure of late nesting terns was attributed mainly to predation by Black-crowned Night Herons.

Parsons, K.C. and J. Burger. 1982. Human disturbance and nestling behavior in Black-crowned Night Herons. Condor 84: 184-187.

> The effects of human disturbance on Black-crowned Night Heron (Nycticorax nycticorax) nestling behavior were studied at the Dead Neck Island (Barnstable Co., Massachusetts) heronry in June and July, 1980. Nestling response to disturbance was compared between three-week old chicks that had been regularly handled since hatching, and control nestlings. Every control nestling moved some distance from the nest during the observation period, whereas all experimental chicks remained in the nest. Mean distance travelled by control birds was 1.0 m (range 0.2 to 3.6 m). Experimental chicks became habituated to frequent handling, whereas a single, intense disturbance elicited escape behavior in control nestlings. Weights of three-week old control and experimetal nestlings were not significantly different. Repercussions of altered chick behavior in experimental animals are discussed and results compared to other studies. (a.a.)

Pullin, B.P. and D.A. Hammer. 1981. A management alternative? Relocating threatened heronries to protected areas. Colonial Waterbirds 4: 200. Abstract.

> Dramatic declines in wading bird populations in the Tennessee Valley Region have spurred research into the development of positive management programs to reverse the disconcerting trend. In 1977, the Tennessee Valley Authority in cooperation with the Tennessee Wildlife Resources Agency and the U.S. Fish and Wildlife Service, initiated a project to develop management procedures to:

(1) select and manipulate suitable sites for nesting colonies of Black-crowned Night Herons, and (2) attract and/or relocate threatened colonies to selected, secure nesting areas. In 1979, an attempt was made to relocate a nesting colony of Black-crowned Night Herons from private property in Grainger County, Tennessee to public land in Hamblen County. Analysis of 1977 and 1978 nesting habitat characteristics provided guidelines for selection of a suitable site for relocation of the German Creek Colony. Relocation procedures were designed to: (1) attract adult herons to the proposed relocation area, and (2) discourage nesting attempts at the German Creek Adult herons occupied the proposed site four site. consecutive days following initiation of relocation However, interference by campers at the procedures. public site caused desertion by the attracted herons. ln. 1980 adult herons were attracted to a different relocation site, but nesting activities did not ensue. Investigations are continuing.

Robert, H.C. and C.J. Ralph. 1975. Effects of human disturbance on the breeding success of gulls. Condor 77: 495-499.

> This study suggests that under defined conditions, the presence of an investigator can be strikingly detrimental to breeding success. Hatching failure was found to be directly proportional to the amount of disturbance in a However, mortality of young was inversely plot. proportional to the amount of disturbance. The later mortality was apparently the result of occasionally disturbed chicks reacting to the presence of the investigator by running into other territories and being attached by adults. Young gulls that were more frequently disturbed were less frightened, and less subject to attack Overall mortality of young, comparing the by adults. completely undisturbed plot with a disturbed plot, was higher on the disturbed plot. Future studies of the effects of the environment upon breeding success in gulls might well take account of this source of mortality. (a.s.)

Roney, K. 1980. Managment recommendations for White Pelican and Double-crested Cormorant colonies. Unpubl. report Nat. Hist. Research Mus. of Nat. Hist. Regina, Sask. 14 pp.

> Specific and unique habitat requirements of White Pelicans and Double-crested Cormorants are identified. Factors threatening colonies of these two species include human disturbance, predation, pesticide contamination, water level fluctuations, shortage of food, inclement weather and parasitism. Human disturbance is considered the greatest threat and is considered the main reason for pelicans and cormorants abandoning several nesting sites

in Saskatchewan. Thirteen recommendations for the management of these two species are given.

Ryder, R.A., W.D. Graul and G.C. Miller. 1979. Status distributrion, and movements of ciconiiforms in Colorado. Proc. Colonial Waterbird Group 3: 49-57.

> Herons and ibises have been studied in Colorado since 1929, primarily by banding nestlings. Statewide surveys in 1965 and 1973 (mainly by questionnaires) and again in 1978 and 1979 (questionnaires with follow-up searches) revealed changes in colony locations and numbers. Most Great Blue Heron colonies were small (1-15 nests) and more subject to abandonment than larger colonies. Great Blue and black-crowned Night Herons were the most abundant and widespread nesters. Most wintered in Mexico, although some overwintered in Colorado. Thin eggshells and pesticides have been detected in eggs of 2 Black-crowned Night Heron colonies. Snowy Egrets and White-faced Ibises were more restricted in distribution and wintered in Mexico. American and Least Bitterns nested in Colorado, but movement data were lacking. Great Egrets and Green Herons occasionally nested in northeastern and southeastern Colorado, respectively, and Cattle Egrets have nested in at least 2 locations since Little Blue Herons, Louisiana Herons, and 1977. Yellow-crowned Night Herons have been rather regular accidental visitors, mainly on the eastern plains. A Reddish Egret, Wood Storks and roseate Spoonbills have been collected in the state but reports of Glossy, White and Scarlet Ibises are believed to be mistakes in identification. (a.s.)

Sanderson, R.M. 1966. The colonial birds at Suggi Lake, Saskatchewan, in 1966. Blue Jay 24: 121-123.

> Commercial fishing operations were considered the major factor causing nest dersertion by White Pelicans and Double-crested Cormorants. Some pelicans renested at the north end of the island after a failure at the middle of the island. Colonies of Common Terns, Ring-billed Gulls and Herring Gulls continued to nest on the island.

Schaller, G.B. 1964. Breeding behavior of the White pelican at Yellowstone Lake, Wyoming. Condor 66(1): 3-23.

> Aspects of the breeding behavior of White Pelicans at a rookery containing eight colonies included courtship displays, nests and nest building, egg laying, incubating and brooding adults, behavior of young, feeding of young and differences in breeding schedules between colonies of the rookery. Observations of nine nests in which the eggs or young had been destroyed showed that the adults remained at the site for at least one day, but then

abandoned the nest and left the rookery.

Schreiber, R.W. and R.W. Risebrough. 1972. Studies of the Brown Pelican. Wilson Bull. 84: 119-135.

> This paper summarizes the historical status of the Brown Pelican in the United States through 1970 and presents data on the effects of human disturbance and the effects of chlorinated hydrocarbon residues on Florida colonies. Human disturbance resulted in egg breakage by flushing adult pelicans, temperature stress on eggs and young and predation of eggs and young by predators.

Shugart, G.W., W.C. Scharf and F.J. Cuthbert. 1978. Status and reproductive success of the Caspian Tern (<u>Sterna</u> <u>caspia</u>) in the U.S. Great Lakes. Proc. Colonial Waterbird Group 2: 146-156.

> During 1976 to 1978, about 1600 Caspian Tern pairs nested at 5 sites in the U.S. Great Lakes. All colonies were in Lake Michigan. There were about 11 percent more pairs in the U.S. Great Lakes than were nesting in 1967. The rate of increase in this region has changed from 15 percent per year during 1965 to 1967 to a stable state during 1976 to 1978.

> Clutch size for initial nesting attempts prior to hatching was 2.5 eggs/nest in 2170 clutches sampled during 1975 to 1978. Chick survival from these nests was 39 percent as a proportion of the total eggs present, and averaged 1.0 chick/pair living to flying. Renesting did not recoup all losses resulting from initial failures.

> Compared to other studies, the success of Lake Michigan colonies was low because storms washed eggs from nests; and eggs were abandoned after disturbance. Egg loss due to wave action indicates that a proportion of the terns nested on suboptimal sites. Terns apparently nested on suboptimum sites because earlier nesting gulls usurped many higher safe sites. Earlier nesting terns nested on the remaining sites and group adherence resulted in later arriving terns nesting on low areas next to established Nest and egg abandonments occurred in a large groups. asynchronous colony that was subjected to prolonged disturbance when many pairs had not incubated long enough to develop strong nest site attachment.

> In the future, it appears that the tern population in Lake Michigan will continue to be affected by earlier nesting Herring Gulls, fluctuating water levels, and human disturbance. Because of the small number of nesting pairs concentrated at a few colonies, we recommend continued monitoring of Caspian Terns nesting in the U.S. Great Lakes to guard against population declines. (a.s.)

Soikkeli, M. 1973. Breeding success of the Caspian Tern in Finland. Bird Banding 44: 196-204.

> In a three-year Study of the Caspian Tern, laying started in early May and ceased in late June or early July. Mean clutch size decreased from 2.70 before 21 May to 1.61 in clutches laid after 10 June. Hatching success averaged 1.78-1.86 chicks per pair. About 1.5 young fledged per pair. Usually in the middle of the breeding season, nesting adults flush when an approaching boat is still hundreds of meters from the colony. Most adults are on the wing when a human appears at a distance of 100-200 m from the breeding grounds.

Thompson, L.S. 1981. Nest-tree sharing by herons and cormorants in Montana. Can. Field-Nat. 95(3): 257-260

> Great Blue Herons arrived about three weeks earlier than Double-crested cormorants and selected sites in healthy trees near the center of the colony. Cormorants often used vacant nests or recently abandoned herons nests. Cormorants flushed from nests when the investigator was within 200 m compared to 70 m for herons.

Tremblay, J. and L.N. Ellison. 1979. Effects of human disturbance on breeding of Black-crowned Night Herons. Auk 96(2): 364-369.

Visits to Black-crowned Night Heron (<u>Nycticorax</u> <u>nycticorax</u>) colonies just before or during laying provoked abandonment of newly constructed nests and either predation of eggs or abandonment of eggs followed by predation. Investigator disturbance caused mortality of young in some situations. Frequent disturbance also discouraged the settlement of late-nesting night herons, late clutches being more likely in colonies visited only twice than in colonies visited 10-15 times. Clutch size and fledging success of successful early nests were the same in frequently and infrequently disturbed colonies. (a.a.)

Vermeer, K. 1969a. Colonies of Double-crested Cormorants and White Pelicans in Alberta. Can. Field-Nat. 83(1): 36-39.

> A survey of Double-crested Cormorants and White Pelican colonies was made in Alberta in 1967. Nesting colonies of both species are endangered in Alberta because of human disturbance. The average clutch sizes for Double-crested Cormorants were 2.30 and 2.31 and that for White Pelicans was 2.44. The average fledging success in 148 nests of the Double-crested Cormorants consisted of 1.9 fledglings per nest. (a.s.)

Vermeer, K. 1969b. The present status of Double-crested Cormorant colonies in Manitoba. Blue Jay 27(4): 217-220.

> On the basis of a count of 4772 nests, the total breeding population of Double-crested Cormorants in Manitoba in 1969 was estimated to consist of 10,000 birds. Lake Winnipegosis, with 1403 nests, had the largest breeding colony. The population at that lake has declined to less than one-third over the past 18 years. In all colonies in Manitoba, except four, cormorants nested on the ground of mostly small, treeless islands and reefs. (a.s.)

Vermeer, K. 1970a. Colonies of Double-crested Cormorants and and White Pelicans in Saskatchewan. Can. Field-Nat. 84(1): 39-42.

> A survey of Double-crested Cormorants and White Pelican colonies was made in Saskatchewan in 1968. Nine colonies of Double-crested Cormorants with a total of 1078 nests and eight colonies of White Pelicans with a total of 6558 nests were observed. One new location with the largest nesting population of White Pelicans in Canada has been described. Because of a decline of breeding colonies of both species, protection of their nesting habitat has been urged. (a.a.).

Vermeer, K. 1970b. Some aspects of the nesting of Double-crested Cormorants at Cypress Lake, Saskatchewan, in 1969; a plea for protection. Blue Jay 28: 11-13.

> The number of breeding Double-crested Cormorants at Cypress Lake made up more than one-third of the total breeding population of cormorants in Saskatchewan. The colony consisted of four nesting nuclei of 42, 144,166 and 82 nests. Other colonial nesters included Ring-billed Gulls, California Gulls and White Pelicans, but all 12 clutches of pelicans were deserted later on.

Vermeer, K. 1973. Great Blue Heron and Double-crested Cormorant colonies in the prairie provinces. Can. Field-Nat. 87: 427-432.

> Breeding populations of Great Blue Herons and Doublecrested Cormorants were estimated to consist of 4,000 and 6,500 pairs respectively, on the basis of surveys in the Canadian prairie provinces during 1967-72. Highest nesting densities were found in the Lake Manitoba -Lake Winnipegosis region where there is an abundant food supply. Cormorants were considered more vulnerable to human disturbance because they nested predominantly on the ground on lake islands.

Vermeer, K. and G. Anweiler. 1970. Great Blue Heron colonies

in Saskatchewan in 1970. Blue Jay 28(4): 158-161.

Thirty-one active Great Blue Heron colonies were located in Saskatchewan in 1970. Most nests were in poplar trees over 20 feet in height. Of nine colonies that ceased to exist in the 1960's, five appear to have disappeared because of human disturbance, hail and flooding.

Weseloh, D.V., S. Brechtel and R.D. Burns. 1977. Recent population changes in Double-crested Cormorants and California and Ring-billed gulls in Alberta, Canada, with a note on White Pelicans. Proc. Colonial Waterbird Group 1: 10-18.

> Alberta colonies of Double-crested Cormorants and California and Ring-billed Gulls censused prior to 1970 and 1975 were recensused in 1976-77. Cormorant populations throughout the province and gull populations in the Aspen Parkland have increased considerably; gull populations in the Short-grass Prairie have remained relatively stable. White Pelicans have unsuccessfully attempted to establish three new colonies in recent years. (a.s.)

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