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COLONIZATION AND UTILIZATION OF A NEW HABITAT BY RING-BILLED GULLS AND HERRING GULLS

presented by

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has been accepted towards fulfillment of the requirements for

Masters degree in Wildlife Ecology

Harold H. Prince

Major professor

Date April 28, 1986

COLONIZATION AND UTILIZATION OF A NEW HABITAT BY RING-BILLED GULLS AND HERRING GULLS

By

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Fisheries and Wildlife

1986

ABSTRACT

COLONIZATION AND UTILIZATION OF A NEW HABITAT
BY RING-BILLED GULLS AND HERRING GULLS

By

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The colonization and utilization of a newly created industrial cooling pond in central Michigan by ring-billed gulls and herring gulls was examined over a 5-year period. A breeding colony of ring-billed gulls became established on the cooling pond the first year after construction. This is the only reported inland nesting site for ring-billed gulls within the Great Lakes region. Immigration of gulls from other colonies was the major factor leading to the expansion of the breeding colony. Reproductive success was low but did not affect the attractiveness of the site. Fledging success and reproductive success decreased as the number of nests increased. Herring gulls used the cooling pond in large numbers during fall. They were attracted to the site due to abundant gizzard shad in the Tittabawassee River. Seasonally abundant food sources, located near a common breeding/roosting site was the most important reason leading to the cooling pond's attractiveness.

ACKNOWLEDGEMENTS

Funding for this study was provided by Consumers Power Company. I am indebted to Dr. Gary Dawson, of Consumers Power Company's Environmental Department, for his valuable assistance and suggestions during the course of this study.

I am deeply indebted to Dr. Harold Prince, my research advisor, for his guidance and editing of the manuscript. I thank Dr. Daryl King and Dr. Carl Ramm for serving on my research committee. I am especially thankful to Patrick Rusz for his help in collecting the data and valuable comments concerning the manuscript. I thank Doug Reeves, and Earl Flegler for their assistance in collecting field data.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Utilization of nesting habitats in the Great Lakes region by colonial waterbirds has been well documented. The distribution and numbers of colonial birds have been inventoried and many important nesting habitats have been described (Blokpoel 1977, Blokpoel and McKeating 1978, Scharf et al. 1978). Common species found breeding are: herring gulls (Larus argentatus), ring-billed gulls (Larus delawarensis), common terns (Sterna hirundo), and Caspian terns (Sterna caspia). Herring gulls, common terns and Caspian terns appear to be sensitive to changing habitat conditions caused by high pesticide levels in the Great Lakes, competition with ring-billed gulls and fluctuating water levels (Scharf et al. 1979). Although herring gulls, common terns and Caspian terns are common species, they have not shown remarkable population increases like that of the ring-billed gull. Use of man-made habitats has resulted in increases in common terns (Shugart and Scharf 1983).

Expansion of ring-billed gulls began in the 1940's and 1950's. Ludwig (1974) reported on the rapid increase of breeding ring-billed gulls in the Great Lakes region during the 1960's. Blokpoel (1977) observed a continuing increase in the Canadian portion of Lake Ontario during a 1976 survey, and Scharf et al. (1979) described the recent invasion of

Lake Superior by ring-billed gulls. Ludwig (1974) hypothesized that the ring-billed gull is an irruptive species able to adjust to the changing habitat conditions which have occurred in the Great Lakes. A continuous shifting and exchange of individuals among colonies allows this species to colonize new habitats created by changing water levels or other disruptions.

During a 5 year study, I observed the rapid colonization of a newly created industrial cooling pond by ring-billed gulls. The study area is unique because it is located approximately 40 km inland from Lake Huron's Saginaw Bay. Although Vermeer (1970) discussed the inland nesting habit of ring-billed gulls, inland nesting sites in the Great Lakes region have not been identified for this species. In addition to serving as a nesting site, the cooling pond served as a post-breeding roosting site for both ring-billed gulls and herring gulls. The objectives of the study were to determine the rate of colonization and reproductive output of gulls on the area and to evaluate their seasonal population trends and activity patterns.

DESCRIPTION OF THE STUDY AREA

The study area is located in Midland County on the southern edge of the city of Midland, Michigan. It includes the Midland Energy Center cooling pond and the adjacent Tittabawassee River. The study area is approximately 40 km west of established gull colonies on Shelter and Channel Islands in Saginaw Bay (Scharf et al. 1978). Land use near the study area is industrial on the north, residential and commercial on the west and rural residential and agricultural on the south and east (Figure 1).

The 350 ha cooling pond was built to serve as a heat sink for Consumers Power Company's Midland Energy Center. Construction of the cooling pond was completed in 1978, and it was completely filled with water by the spring of 1979. Since the Midland Energy Center was not in operation during the study, the water chemistry and temperature were similar to that of many Michigan lakes of similar size. A dike with a travel road encircles the pond and a 15 m wide baffle dike extends into the pond from the north (Figure 2). All dike interfaces with water are rip-rap with large rocks. The entire pond is enclosed by fence, making the area nearly completely protected from human disturbance.

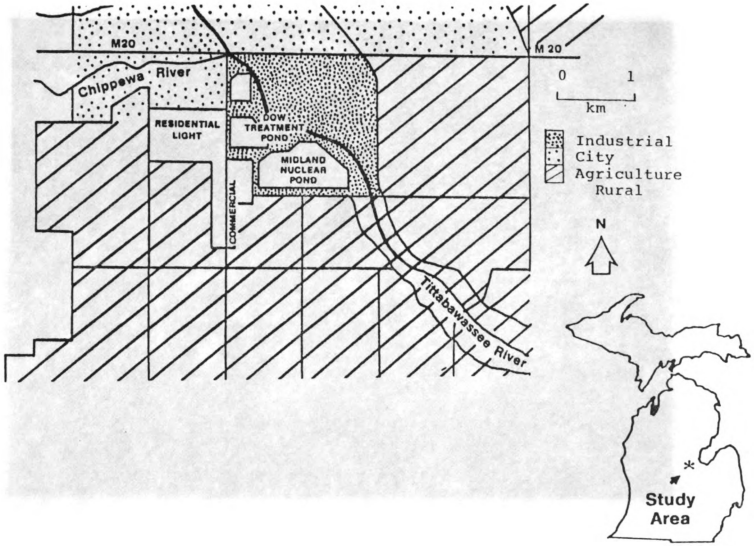

Figure 1. The Midland Energy Center and adjacent land use patterns.

Figure 2. The baffle dike on the cooling pond.

METHODS

Weekly counts of gulls on the cooling pond were made throughout the ice free period each year (1979-1983). Numbers were recorded at sunrise and sunset and during the following 3 time blocks: 0700-1000, 1000-1600, and 1600-1900. A Bushnell 15x-60x zoom spotting scope and 10x50 binoculars were used. Gull use-days were estimated by multiplying the average number of gulls per weekly census by the number of days between censuses. Evening counts were weighted by the number of night hours each week.

Gull activity was examined by observing up to 225 randomly selected birds for 3-second intervals within each of the 3 time blocks listed above. Activities were categorized as: feeding, locomotor, social (courtship and aggressive behaviors), resting, and comfort (preening). Gull flight patterns to and away from the cooling pond were determined in 1981 by counting flying gulls from 5 fixed points located on the perimeter of the pond. Counts were made within one to three 5 minute intervals, depending on the number of flights made over that area. These counts were made during the first hour and last hour of daylight. Based on the flight patterns and observations outside the study area, the major seasonal feeding areas utilized by gulls were determined.

The number of nests and clutch sizes of nesting gulls were recorded by location within 15 m intervals along the 15 m wide baffle dike. Censuses were conducted during mid-May each year. Additional estimates were made during late May and early June in 1982 and 1983. Fledging rates were determined by total counts of juvenile gulls in early July from 1979 to 1981 and during 1983. During 1982, six 15 x 7.5 m enclosures were built around three of the 15 m intervals. Individual nests were marked and the number of eggs recorded. The colony was visited every 2 days (weather permitting) until all chicks within the enclosures were banded. Weekly censuses were conducted for the remainder of the breeding season. Differences in clutch sizes between years were analyzed using Scheffe's interval (Gill 1978). Reproductive output was evaluated using fledging success (chicks fledged per egg laid), and reproductive success (chicks fledged per nest).

Gull use of the cooling pond was evaluated for each of the following 4 seasons: (1) Spring (ice-out through 2 May), (2) The breeding season (3 May to 18 July), (3) Summer (19 July to 19 September) and, (4) Fall (20 September until freeze-up). No data were collected druing the spring of 1979 due to the late start of the study. Daily and seasonal changes in gull numbers were evaluated using the Kruskal-Wallis analysis of ranks (Siegel 1956). The analysis excluded censuses made during the breeding season because of the difficulty in obtaining accurate counts. It was virtually impossible to approach the colony without major disturbances,

hence censuses were conducted from long range with a spotting scope. The gulls were often so dense that individual gulls could not be distinguished. The frequency of occurrence of each gull activity was calculated for each season, and daily activity patterns were analyzed using a X^2 contingency test (Siegel 1956).

RESULTS

Yearly Use

Ring-billed gulls were the most numerous species on the cooling pond during the 5 year study (Table 1). Yearly use ranged from 68% to 88% of the total use by all spceies. An estimated 217,400 use-days in 1979 expanded to a peak of 417,800 use-days in 1981. Total use decreased slightly in 1982 and dropped by 11% to 371,700 use-days in 1983.

Herring gulls did not use the study area in significant numbers during 1979 (Table 1). They accounted for 9,100 use-days in 1980. Yearly use increased to approximately 140,000 use-days in 1982 and 1983, making them the second most abundant species using the cooling pond.

Ring-billed Gulls

Seasonal Use

The pattern of use by ring-billed gulls remained similar throughout the study (Figure 3). They returned to the cooling pond as soon as there was open water and numbers increased rapidly during April. The total number of birds using the cooling pond peaked by early May and coincided with the initiation of breeding. Numbers remained high until the adult and fledged juvenile gulls dispersed from the colony in mid-July. Numbers for the remainder of the summer were low and

Table 1. Yearly use-day estimates of ring-billed gulls, herring gulls and other waterbirds on the cooling pond.

YEAR	RING-BILLED GULLS	HERRING GULLS	OTHER WATERBIRDS	TOTAL
1979	217,400	TRACE	28,300	245,700
1980	366,900	9,100	149,400	525,400
1981	414,800	98,800	34,500	548,100
1982	397,500	143,800	21,100	562,400
1983	371,700	138,800	38,200	548,700

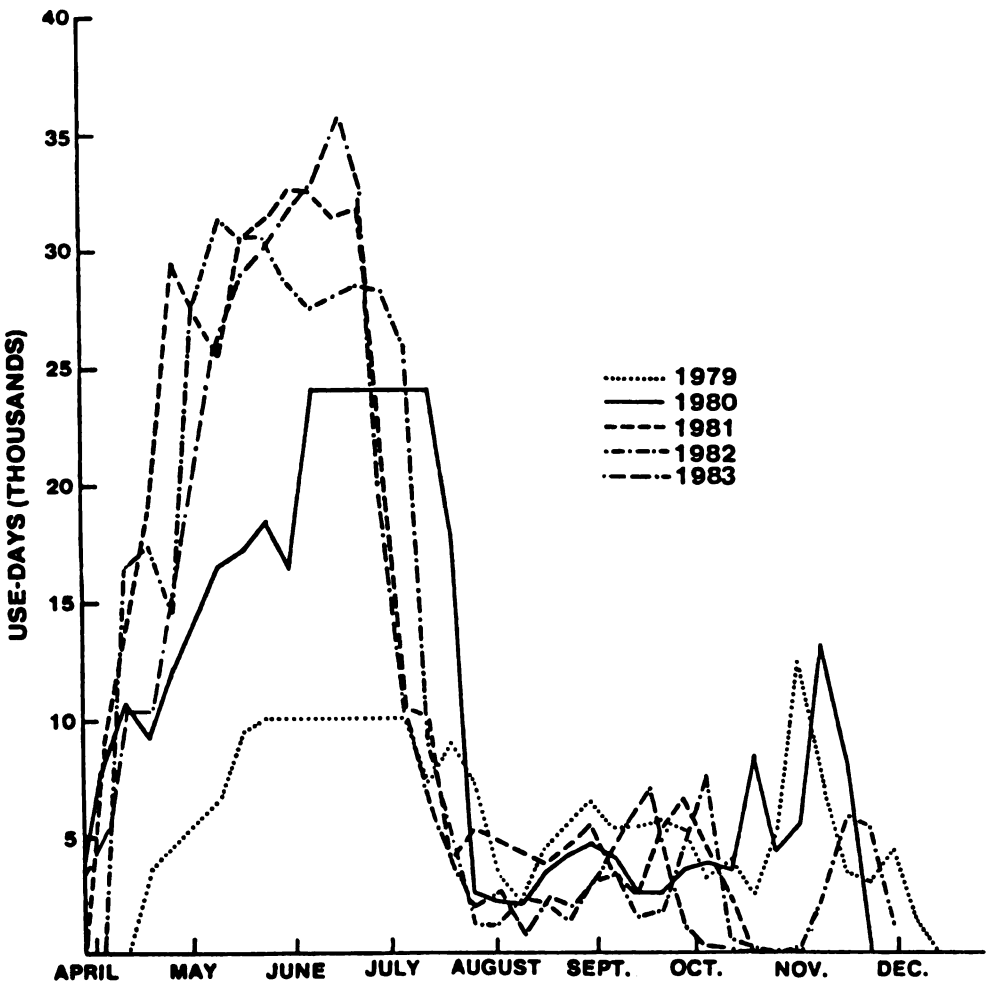

Figure 3. Chronology of use of ring-billed gulls on the cooling pond from 1979 to 1983.

stable. Fall use varied among years. During 1979 and 1980, use increased in October but in subsequent years it declined.

The arrival of ring-billed gulls from 1980 to 1982 occurred within a three week period in late March and early April (Table 2). During 1983, the winter was exceptionally mild and the cooling pond was free of ice by early March. The first gulls returned on 10 March.

During 1979 and 1980, ring-billed gulls remained on the cooling pond throughout the fall (Table 2). In 1981, ring-billed gulls were not observed on the cooling pond after 22 October. During 1982 and 1983 a significant drop is use also occurred during early fall. Large numbers of ring-billed gulls returned to the cooling pond in late November of 1982, but in 1983 they were seen only sporadically.

Spring populations of ring-billed gulls, based on the average number of gulls present during late afternoon censuses, varied between years ($P < 0.05$) (Figure 4). The mean count of 1,597 $\pm$ 282 gulls ($\bar{x} \pm$ s.e.) in 1980 was significantly less than the 3,014 $\pm$ 625 gulls and 2,522 $\pm$ 298 gulls counted in 1981 and 1982, respectively. The mean numbers in 1983 decreased to 1,191 $\pm$ 328 gulls.

The cooling pond was used by 500 to 1,200 ring-billed gulls as a night roost during summer. During 1979 and 1981, 1,167 $\pm$ 76 gulls and 897 $\pm$ 119 gulls were counted on the cooling pond, respectively (Figure 4). Numbers during the remaining three years of the study were significantly lower ($P < 0.05$).

Afternoon numbers of ring-billed gulls differed among

Table 2. Arrival and departure dates of ring-billed gulls on the cooling pond.

YEAR	SPRING ARRIVAL	FALL DEPARTURE
1979	No Data[1]	6 December
1980	29 March	15 November
1981	5 April	22 October
1982	12 April	29 November
1983	10 March	11 October

[1] Beginning of monitoring program.

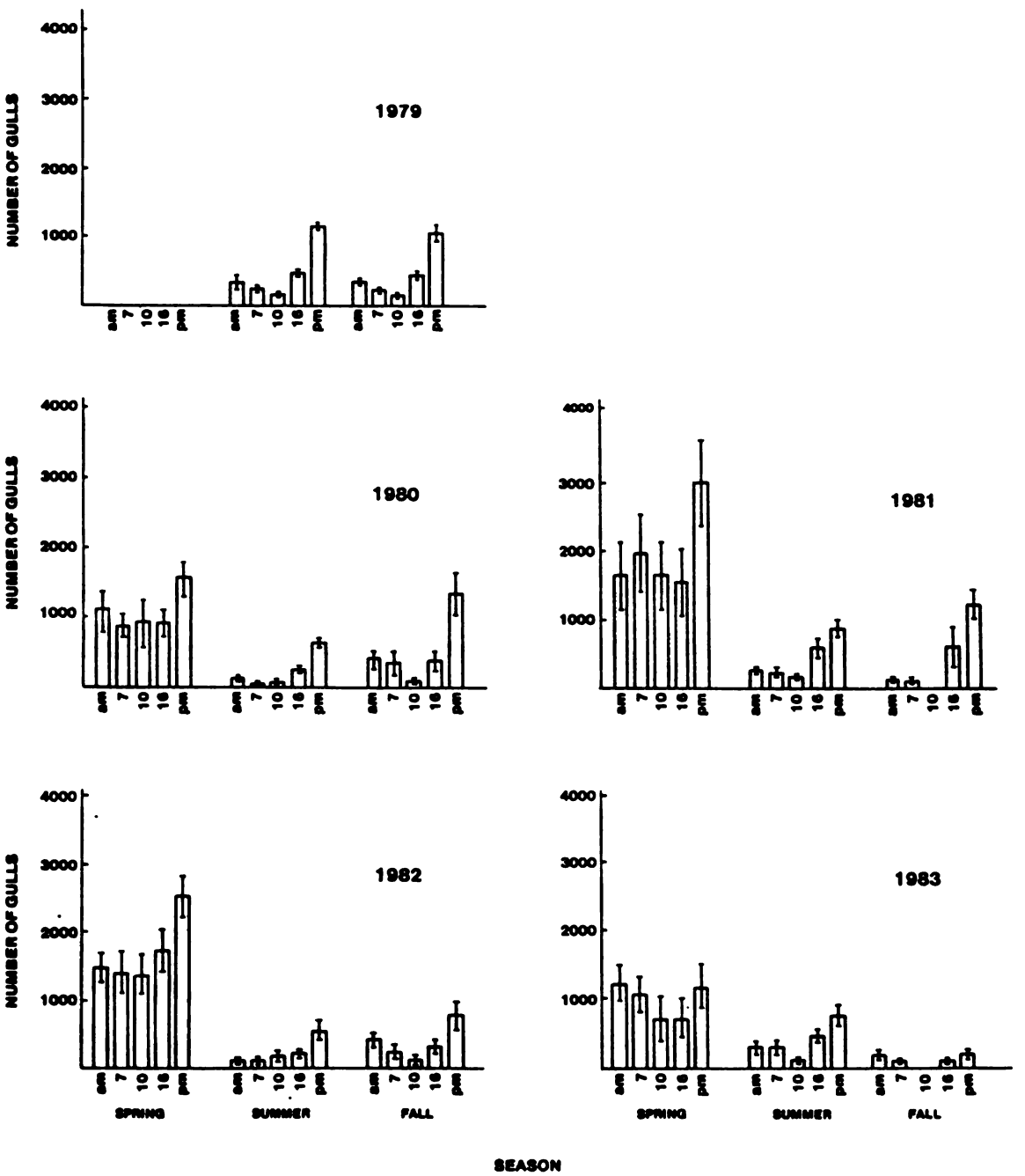

Figure 4. The number of ring-billed gulls ($\bar{x} \pm$ s.e.) present on the cooling pond by time period and season.

years during fall ($P < 0.05$) (Figure 4). The mean count was 1,080 $\pm$ 195 gulls in 1979 and 1,394 $\pm$ 322 gulls in 1980. Although the average afternoon count of 1,252 $\pm$ 236 gulls in 1981 was similar to 1979 and 1980, departure was 5 to 7 weeks earlier. The number of ring-billed gulls decreased to 805 $\pm$ 213 gulls in 1982 and 145 $\pm$ 67 gulls in 1983.

Seasonal variations in afternoon counts of ring-billed gulls occurred each year of the study (1980 to 1983). Use during summer was less than use during spring in 1980 ($P < 0.05$) (Figure 4). Spring counts in 1981, 1982 and 1983 ($P < 0.05$) were greater than both summer and fall.

Daily Use

There were no daily changes in ring-billed gull numbers during spring (Figure 4). During summer, more gulls were present on the cooling pond during late afternoon than during the other periods of the day ($P < 0.05$) for each year of the study. Most gulls left the cooling pond for feeding areas approximately one-half hour before sunrise and did not return to the cooling pond until sunset or later. Late afternoon counts were highest during fall, although the difference was less pronounced in 1980 and 1982 ($P < 0.10$).

Activity Patterns

Activity patterns of ring-billed gulls while on the cooling pond varied by season. Alert and social activities were more frequent during spring and the breeding seasons (Figure 5). Social activities were virtually nonexistant during summer and fall, and alert behaviors were greatly reduced. Maintainence activities (comfort and resting) were

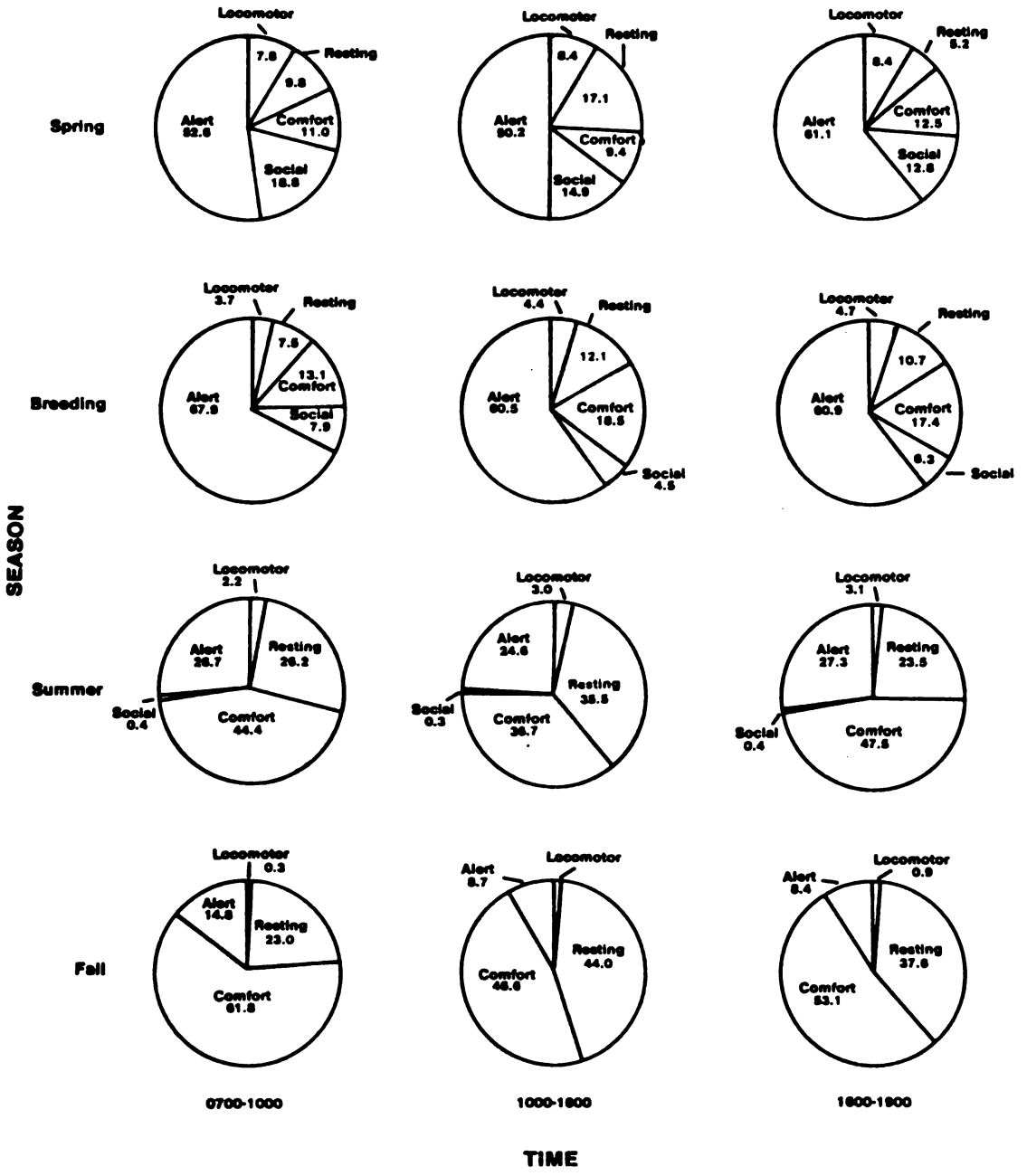

Figure 5. Frequency of occurrence of ring-billed gull activities observed on the cooling pond by time period and season.

more frequent during summer and fall. Locomotor activities remained similar through all chronological periods.

There were significant differences in the frequency of diurnal activities during each season ($P < 0.001$) (Figure 5). Resting behaviors were more frequent during afternoon in all seasons. Alert behavior was more common during morning while social activities were more frequent during morning in the spring and breeding seasons. Comfort behavior was greatest during morning and afternoon periods. Locomotor activities occurred at a similar frequency during each time period.

Directional data on the number of gulls entering and leaving the cooling pond showed seasonal changes in the use of areas outside the study area in 1981 (Figure 6). Throughout the spring and early summer ring-billed gulls were most frequently observed using flight paths bordering the southern edge of the cooling pond. Based on these data and off-site observations, the major food source for gulls during this period came from the cultivated fields south and west of the cooling pond. Ring-billed gulls began to utilize other areas as feeding sites as the growing season progressed and access to the cultivated fields declined. Most individuals departed to the north during late summer and fall (Figure 6). The area north of the cooling pond includes the city of Midland, the Midland Sanitary Landfill and the Tittabawasse River.

Reproduction

A breeding colony of ring-billed gulls became established on the baffle dike the first season after the cooling pond was filled with water (Figure 6). In 1979, 720 nests were

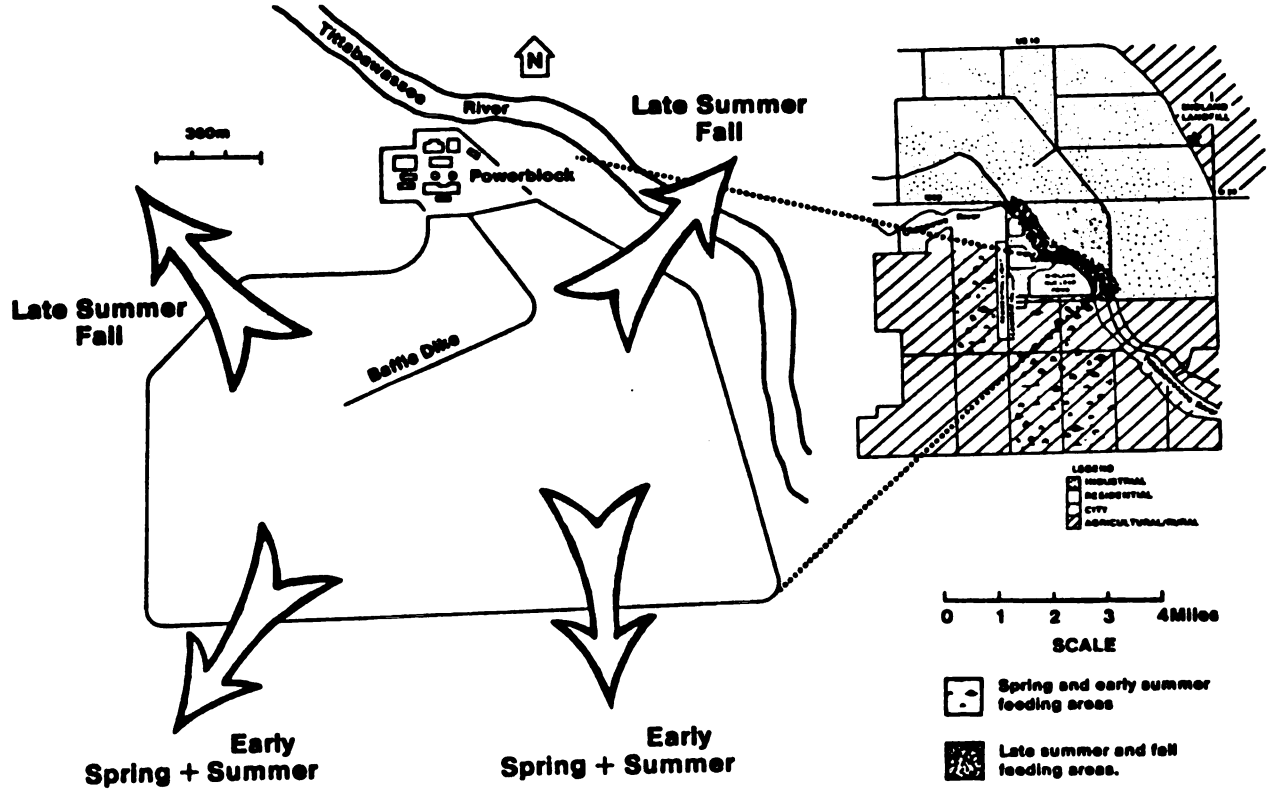

Figure 6. Seasonal flight paths of ring-billed gulls using the cooling pond during 1981.

present on the baffle dike. The number of nests increased by 6.4 time to over 4,600 nests during 1983 (Table 3).

The average clutch size during 1979 was significantly less than during the other years ($P < 0.05$), and the clutch size in 1982 was less than those in 1981, 1982 and 1983 ($P < 0.05$) (Table 3). Fledging success (chicks fledged per egg laid) ranged from 0.17 to 0.40 chicks per egg. Reproductive success (chicks fledged per nest) ranged from 0.45 to 1.04 chicks per nest.

Herring Gulls

Use of the cooling pond by herring gulls occurred mainly during fall. The highest number of nests on the cooling pond's baffle dike occurred during 1983 when 30 nests were counted. Large numbers of herring gulls were first observed on the cooling pond from late November until freeze-up on 1 December of 1980 (Figure 7). From 1981 to 1983 substantial use of the cooling pond by herring gulls occurred beginning in late September and early Ocotober. As many as 6,000 to 7,000 herring gulls were observed using the cooling pond as a night roost. They replaced ring-billed gulls as the most numerous species using the cooling pond.

During 1981 and 1983 ($P < 0.01$), and 1982 ($P < 0.05$), herring gull numbers were greater during late afternoon than during the other time periods (Figure 8). Many herring gulls often loafed on the cooling pond between foraging bouts on the adjacent Tittabawassee River. The herring gulls were responding to large numbers of gizzard shad (Dorosoma

Table 3. Colony size, and reproductive output of ring-billed gulls nesting on the cooling pond's baffle dike from 1979 to 1983.

YEAR	TOTAL NESTS	TOTAL EGGS	AVERAGE CLUTCH SIZE[1]	NUMBER OF CHICKS FLEDGED	FLEDGING SUCCESS	REPRODUCTIVE SUCCESS
1979	720	1,775	2.47(0.03)	500	0.28	0.69
1980	1,720	4,615	2.68(0.02)	1,064	0.23	0.62
1981	2,877	7,570	2.63(0.02)	3,000	0.40	1.04
1982	2,788	7,168	2.57(0.02)	1,450	0.23	0.52
1983	4,618	12,238	3.65(0.02)	2,100	0.17	0.45

[1] Standard error in parentheses.

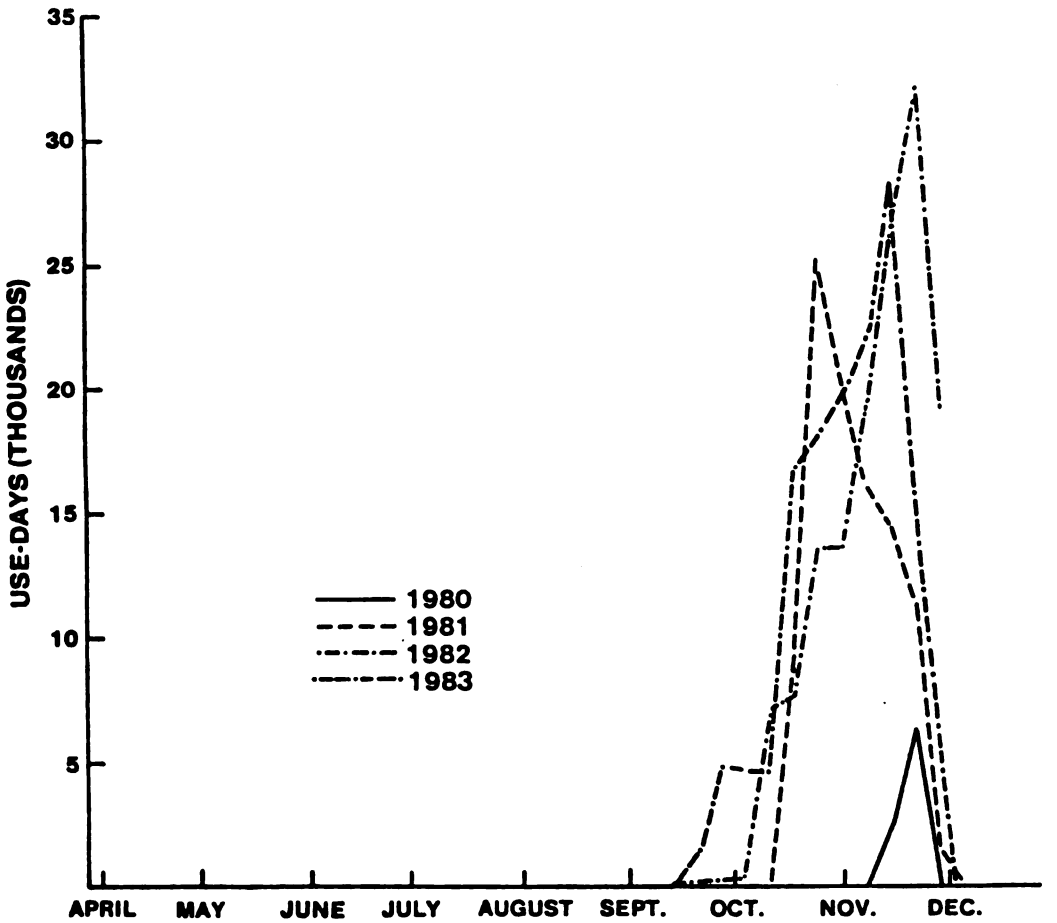

Figure 7. Chronology of use by herring gulls on the cooling pond from 1979 to 1983.

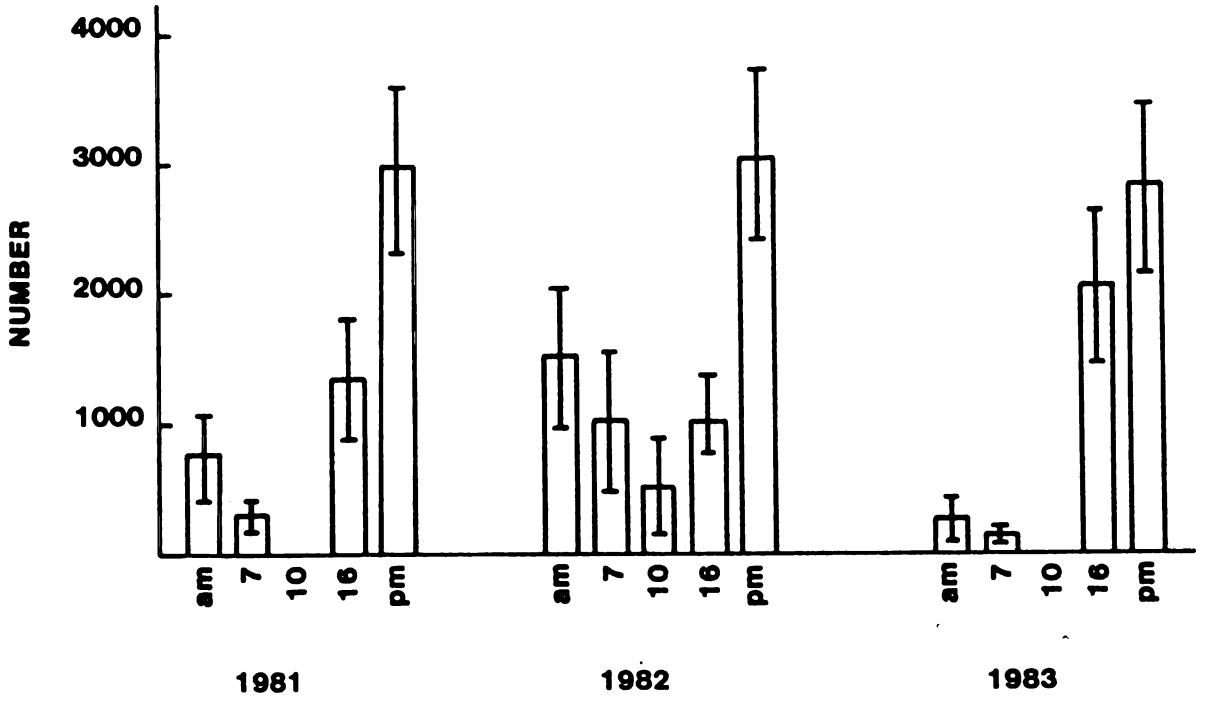

Figure 8. The number of herring gulls ($\bar{x} \pm$ s.e.) present on the cooling pond by time period during fall.

cepedianum) present in the river.

DISCUSSION

The ring-billed gull colony became established on the cooling pond during the first year after construction. The rapid colonization and subsequent increase in the breeding ring-billed gull colony is characteristic of this species. Blokpoel and Fetterholf (1978), and Blokpoel and Courtney (1982) documented the development of a colony with over 22,000 pairs of ring-billed gulls in 5 years at the Eastern Headland of the Toronto Outer Harbour in Lake Ontario. Ludwig (1974) characterized the ring-billed gull as an irruptive species which is able to adjust to catastrophic conditions such as those created by fluctuating water levels in the Great Lakes. Historically, the ring-billed gull has been noted to shift in large numbers from one nesting site to another (Ludwig 1943, Ludwig 1974). This ability to change sites in large numbers allows it to rapidly colonize newly available habitats such as man-made sites similar to the cooling pond.

Although to my knowledge the cooling pond is the only nesting site for ring-billed gulls in the Great Lakes region, they are especially suited for breeding on inland habitats (Vermeer 1970). Their adaptations include the ability to utilize seasonally abundant food sources. My observations indicate that the gulls preferred to forage in agricultural

areas during the breeding season, where they utilized abundant food sources such as earthworms and insects. This is consistent with important food items of ring-billed gulls breeding within the Great Lakes region identified by Jarvis and Southern (1976), Haymes and Blokpoel (1978) and, Ludwig (1962).

Ring-billed gulls began to arrive as soon as the cooling pond was free of ice, which normally occurs during late March or early April in mid-Michigan. Vermeer (1970) observed gulls on his study area before snow and ice had disappeared. Numbers of birds peaked by the first week in May, which coincides with the peak egg laying dates for ring-billed gulls and herring gulls within the region (Ryder and Ryder 1981, Morris and Haymes 1976). A short 4 to 5 week pre-nesting period is characteristic of ring-billed gulls (Vermeer 1970).

Conover and Miller (1980) observed more ring-billed gulls on a colony site during early morning and evening than during midday. This trend varied more early in the breeding season than later. Burger (1976) found early morning and evening peaks in breeding laughing gull (Larus atricilla) numbers during the pre-egg phase. The number of ring-billed gulls on the cooling pond during spring did not vary significantly with the time of day, although evening counts were generally higher than earlier time periods. In most cases, the majority of gulls which left the cooling pond in the morning did so before there was sufficient light to count them. As the egg laying period approached, the gulls traded back and forth between the colony and feeding sites constantly

throughout the day.

Clutch sizes of ring-billed gulls on the cooling pond were low during all years of the study (Table 4). Clutch sizes of other ring-billed gull colonies ranged from 2.73 to 3.17 eggs per nest (Dexheimer and Southern 1974, Ryder and Ryder 1981, Vermeer 1970). Lower clutch sizes are often assumed to be laid by young or inexperienced birds (Morris and Haymes 1976, Schreiber and Schreiber 1980, Ryder 1975). Young gulls tend to chose their first breeding colony at random, while older gulls often return to the colony where they previously nested (Southern 1967a, 1977). If a high proportion of young gulls were responsible for colonizing the cooling pond then lower clutch sizes may be expected.

Fledging success and reproductive success of ring-billed gulls on the cooling pond during the 5 year period were lower than values reported by Dexheimer and Southern (1974), Ryder and Ryder (1981) and, Vermeer (1970), with the exception of 1981 (Table 4). Both Ryder and Ryder (1981), and Dexheimer and Southern (1974) considered gull chicks to be successfully fledged at 21 days. My observations indicate that the peak of hatching occurred on the cooling pond during the first week of June. Therefore, gull chicks were approximately 30 to 35 days old when fledging censuses were conducted. Vermeer (1970) calculated an average age at first flight of 37 days for ring-billed gulls. Based on data from Kadlec et al. (1969) for herring gulls, an additional 13% decline in chick numbers would occur between 21 days and actual fledging. Hence, a reproductive success rate of approximately 1.0

Table 4. Clutch size, fledging success (chicks fledged per egg laid), and reproductive success (chicks fledged per nest) of ring-billed gull colonies.

COLONY SITE	CLUTCH SIZE	FLEDGING SUCCESS	REPRODUCTIVE SUCCESS	SOURCE
Midland, Michigan 1979	2.47	0.28	0.69	This study
Midland, Michigan 1980	2.68	0.23	0.62	" "
Midland, Michigan 1981	2.63	0.40	1.04	" "
Midland, Michigan 1982	2.57	0.20	0.52	" "
Midland, Michigan 1983	2.65	0.17	0.45	" "
Midland, Michigan (5 year average)	2.60(0.08)[1]	0.26(0.09)[1]	0.66(0.23)[1]	" "
Granite Island[2] (Lake Superior)	3.17	0.29	0.90	Ryder and Ryder (1981)
Bird Island[2] (Lake Huron)	2.83	0.54	1.54	Dexheimer and Southern (1974)
Calcite Colony[2] (Lake Huron)	2.73	0.41	1.13	" "
Miquelon Lake (Alberta, Canada)	2.92	0.34	1.00	Vermeer (1970)

[1] Standard deviation

[2] Fledging success and reproductive success adjusted downward by 13% from reported values.

reported by Ryder and Ryder (1981) could be adjusted to 0.90 chicks per nest.

Despite the low reproductive success of gulls on the cooling pond, the colony continued to increase during the 5 year study. Recruitment of breeding gulls from those fledged on the cooling pond can not account for the increase in breeding pairs even in 1983. Southern (1977) calculated a post-fledge to 2 years survival rate of 40% for ring-billed gulls, and 88% annual survival for subsequent years. Assuming that ring-billed gulls breed for the first time at 3 years, only birds raised in 1979 and 1980 could have nested in 1983. At best, approximately 530 gulls could have been recruited from the colony in 1983. The driving force behind the expansion of the colony appears to be immigration of gulls from other colonies. Blokpoel and Courtney (1982) noted that immigration of birds from nearby colonies was an essential feature of the growth of the ring-billed gull colony at Toronto. It is likely that existing colonies in the Saginaw Bay/Lake Huron region were the source of the expansion of the cooling pond's colony.

Based on reproductive data, the quality of the cooling pond as a ring-billed gull breeding habitat appears low when compared to other colonies. However, the overall attractiveness of the cooling pond as a breeding site was not affected. Blokpoel and Fetterholf (1978) discussed the features which make gull breeding habitats attractive. These include: immediate vicinity of water, ample food supply, low levels of disturbance from humans and predators, suitable nesting

substrates, sparse and low vegetation, and an unobstructed view in all or most directions. At stable colony sites, breeding ring-billed gulls exhibit high levels of colony site tenacity (Southern 1977). The cooling pond is a stable site which provides all of the features mentioned above. Low reproductive success by itself is apparently not an important factor influencing the attractiveness of a colony site, unless it is associated with physical disturbances such as high water levels or human and predatory disturbances.

With the exception of 1981, fledging success and reproductive success decreased as the number of nests increased. Schreiber et al. (1979) reported a decrease in clutch size of laughing gulls as nest density increased. Clutch size did not decrease in my study. Increasing nest density may increase the amount of social interaction between neighboring pairs and affect the reproductive success of a colony. Dexheimer and Southern (1974) found no relationship between reproductive success and nest density. Hence, it is unlikely that increased nest density resulted in lower reproductive output. It may be that the increase in breeding pairs resulted in increased competition for available food resources outside the study area.

My data suggest that substantial year to year variations in reproductive success can occur in ring-billed gull colonies. Weather can affect the overall success of a colony by delaying nest and clutch initiation and increasing the mortality of newly hatched chicks. The number of nests on the cooling pond during 1981 and 1982 were similar, yet

fledging success and reproductive success were significantly different. The spring of 1981 was milder and drier than 1982, and success rates were higer. During 1982, two severe thunderstorms passed over the cooling pond during the peak of hatching. I saw many dead gull chicks after both storms, and success rates were low.

The postbreeding dispersal and migration of ring-billed gulls in the Great Lakes region has been described in detail (Southern 1967b,1968, 1974a, b). Adult and juvenile gulls begin to disperse from the nesting colony in late July and early August. Most gulls head toward the lower Great Lakes (Southern 1974a). The cooling pond was unique because it was used as a postbreeding roosting site by both ring-billed gulls and herring gulls in addition to it use as a breeding habitat. A residual population of approximately 500 to 1,200 ring-billed gulls remained in the area during late summer and fall. The primary feeding areas were north of the cooling pond in the city of Midland and the Midland Sanitary Landfill. Use of the area during this period is apparently due to the abundant food sources close to the cooling pond and to the absence of disturbances on the cooling pond.

Few herring gulls were observed nesting on the cooling pond's baffle dike. The largest number of nesting herring gulls was recorded in 1983 when 30 pairs were counted. Because it was virtually impossible to distinguish juvenile herring gulls from ring-billed gulls during the fledging censuses, no attempt was made to determine reproductive success of herring gulls.

Herring gulls used the cooling pond as a night roost only during fall. Their numbers increased steadily beginning in 1980. The increase in use was apparently due to the large runs of gizzard shad which occurred in the Tittabawassee River. Up to 2,000 herring gulls were often observed foraging in the river adjacent to the cooling pond's outlet. The gulls would forage during the early morning period and intermittently throughout the day. Those gulls which foraged close to the cooling pond used it as a loafing site during the mid-morning and afternoon periods.

Few ring-billed gulls were observed using the cooling pond during the fall while herring gulls were present in large numbers. Burger (1981) observed that the larger herring gulls were able to displace laughing gulls at a dump site. Since ring-billed gulls were observed on the cooling pond during late fall in 1979, it is unlikely that the decrease in fall use of the cooling pond was due to migration out of the area. Herring gulls may have displaced ring-billed gulls on the cooling pond.

Gull use of the cooling pond was primarily as a breeding site, and a refuge and roosting area during the postbreeding period. During the postbreeding period use during daylight hours was minimal, with the exception of herring gulls in late fall. There was little evidence that the cooling pond was used as a feeding site, although on some occasions during summer ring-billed gulls were observed "hawking" insects over the cooling pond. Nearly all feeding was directed at seasonally abundant food sources in nearby agricultural and

urban areas. This season long food base, located in close proximity to a common breeding/roosting site was the most important reason leading to the attractiveness of the cooling pond.

Although reproductive output in the Midland nesting colony was low, numbers increased over 6 times in just 5 years. The Midland Energy Center cooling pond became an important nesting and roosting habitat for both ring-billed gulls and herring gulls. Although no published information exists over a comparable time period, the ring-billed gull breeding colony increased to over 2 times that of colonies on Shelter and Channel Islands in Saginaw Bay from 1976 to 1977 (Scharf et al. 1978). It became one of the largest colonies within the Lake Huron and Saginaw Bay region.

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