Food habits, movements and nesting of gulls on a waterfowl area, Freezout Lake, Teton County, Montana
by Robert A Rothweiler

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management
Montana State University

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ABSTRACT

Freezout Lake, Teton County, Montana is the site of a waterfowl management area developed by the Montana Fish and Game Department. Three species of gulls, California gull, Larus californicus, ring-billed gull, L. delawarensis, and Franklin's gull, L. pipixcan, have nesting colonies on the Freezout Lake Project. A study of the gull populations was conducted during the summer of 1958 and spring and summer of 1959, in an attempt to determine food habits, movements and nesting. Two hundred twenty-nine gulls were trapped and color-marked to facilitate observation on and off the Freezout Lake Project. Two hundred four gulls were collected to analyse stomach contents. The effect of gull activity on the waterfowl population of Freezout Lake is discussed.

INTRODUCTION

The Montana Fish and Game Department is developing Freezout Lake, Teton County, Montana into a waterfowl management area. Marsh habitat is being created and islands are being constructed. This development has resulted in more potential habitat for breeding gulls.

Many grain farmers in the area believe gulls reduce and even prevent insect losses to crops. Cottam (1935), Cottam and Williams (1939) and Greenhalgh (1952) have reported California gulls feeding on insects in Utah. Knowlton (1941) indicated California gulls reduced grasshopper numbers by 90 percent on an area in the same state. York (1949) observed gulls, believed to be California gulls, reduce grasshoppers on an area in Montana 80 percent in a five day period.

An increase of gulls may have a detrimental effect on the waterfowl population. Odin (1957) found that California gulls were responsible for destruction of 30 percent of the waterfowl produced on his study area on the Farmington Bay Bird Refuge in Utah. Twomey (1948) observed instances of adult gulls regurgitating eggs of ducks..... He also observed gulls killing the young of Canada geese, Branta canadensis. Ellig (1955) indicated that gulls may have been responsible for destroying some waterfowl nests on Freezout Lake. Greenhalgh (op. cit.) stated that gulls nesting on waterfowl refuges were accused of predation on ducks.

An ecological study of the gulls on Freezout Lake Project was conducted with special emphasis on food habits, movements and nesting.

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THE STUDY AREA

Freezout Lake is located in northcentral Montana approximately two miles northwest of Fairfield. The water source is waste and seepage from an irrigation project located east and south and considerable runoff from higher elevations around the lake (Montana Fish and Game Dept., 1956). The lake had no outlet and the water area steadily increased for a number of years. In 1952 and 1953, adjacent private property, a railroad line and a highway were flooded. Ellig (op. cit.) reported the size of the lake in 1952 as 4,100 acres; by 1953, this area had increased to well over 6,000 acres (Anon., 1955). At this time the Montana Fish and Game Department took control in order to develop the lake as a waterfowl area and reduce the flood conditions (Montana Fish and Game Dept., op. cit.). An outlet was constructed during 1953 and 1954 and drainage began in September 1954 (Salinas and Trueblood, 1954). Water impoundments to maintain a stable water level for marsh habitat was planned for the areas drained. Dike construction for this purpose began in 1955 and by 1959

three impoundments were completed.

In 1959, the Freezout Lake Waterfowl Management Area consisted of 9,650 acres, most of which was open water or marsh habitat (Fig. 1). Over 6,000 acres of this area is leased federal land, while the rest is owned by the State.

Davis Lake, a small lake adjacent to Freezout Lake was included in the study area (Fig. 1). Both lakes are relatively shallow with considerable aquatic vegetation, however Freezout Lake lacked marsh habitat of aquatic emergents. This may be due to wave action and water level fluctuation. Most of the shoreline consists of mud flats. Davis Lake has marsh habitat located almost entirely around the edges and also near the middle. The vegetation is described in the papers of Ellig (op. cit.) and Knight (1960).

METHODS

Gull observations were made on Freezout Lake Project and adjacent areas during the periods, June 11, 1958 to September 24, 1958 and March 23, 1959 to September 23, 1959.

Experimental trapping of gulls was attempted during the summer of 1958, but with little success. Two types of traps were used in the spring of 1959 when gulls moved onto the nests. Spring-operated traps (Atwater, 1958) were used to take single gulls for the purpose of obtaining individual nest data (Fig. 2). A cannon trap (Dill and Thornsberry, 1950) was used to take large numbers of gulls in concentrated nesting

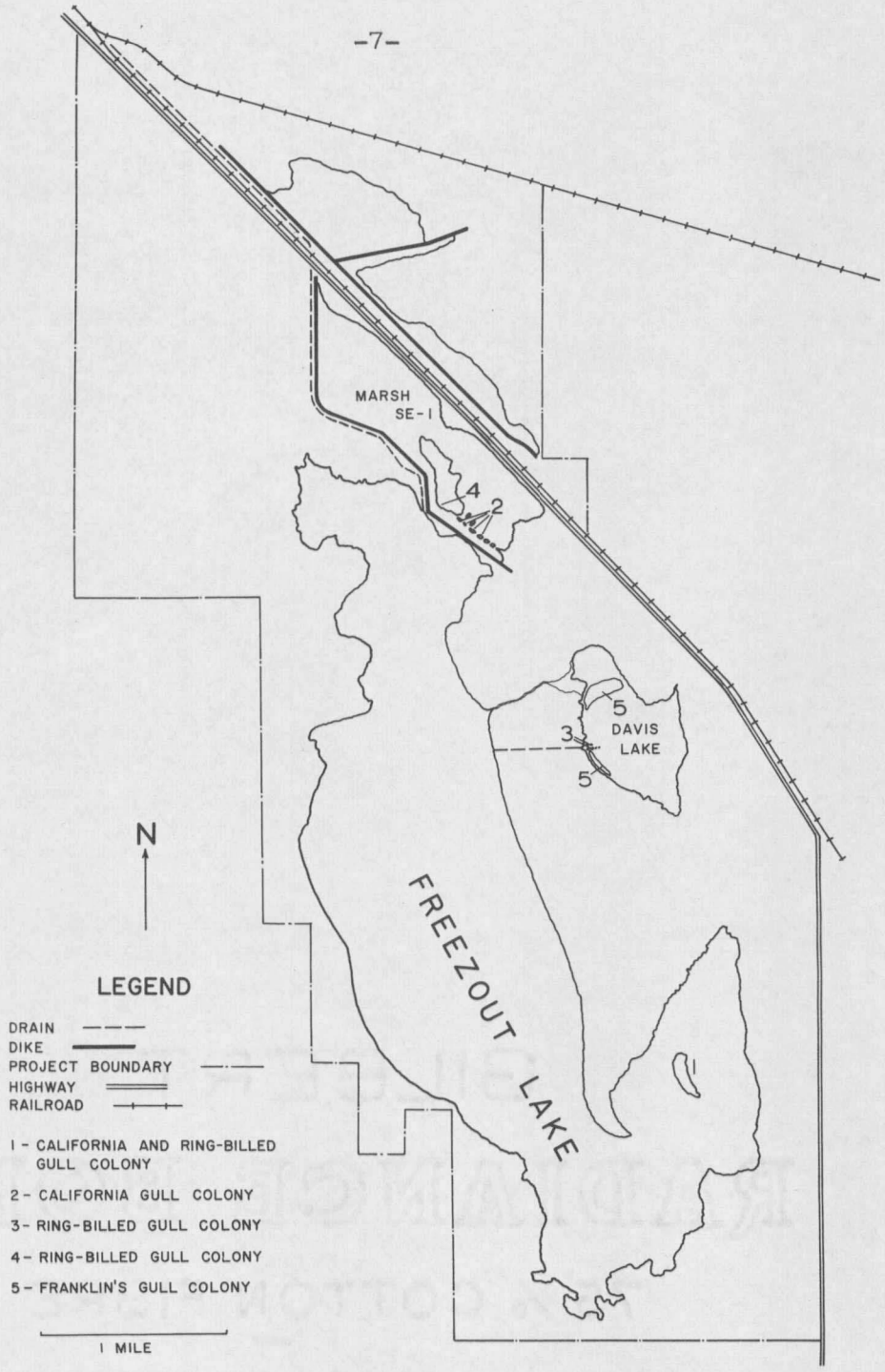

Fig. 1. Freezout Lake waterfowl management area showing water areas and location of gull colonies.

areas for movement data (Fig. 3). Gulls were taken to the Project headquarters for banding and color-marking, after which they were released directly or transported to the capture site and released.

Since gulls have a predominantly white plumage, many of the techniques used by Kozlik, Miller and Rienecker (1959) for marking white geese could be adapted to color-mark gulls. Only California and ring-billed gulls were color-marked due to the difficulties of capturing Franklin's gulls by the trapping methods used. The four basic colors used were basic fuchsin (red), gentian violet (blue), malachite green (green), and picric acid (yellow). These colors were tested for visibility at distances up to 500 yards and were found to be satisfactory using a 20x spotting scope and 8x binoculars. Yellow was found to be the most visible and was also the most permanent. Gulls taken by the spring-operated trap were marked individually with color combinations of head, tail, right and left wings; for example, red head and green tail, blue head and yellow tail. Gulls taken in the cannon trap were marked according to species and location where trapped; the markings were a single color over the entire body. A summary of trapping and color-marking activities is given in Table I.

Banding techniques followed those recommended by the United States Fish and Wildlife Service and Fish and Wildlife Service bands were used.

This study was given publicity by the Information and Education Division of the Montana Fish and Game Department. The public was urged to report any sightings of marked gulls.

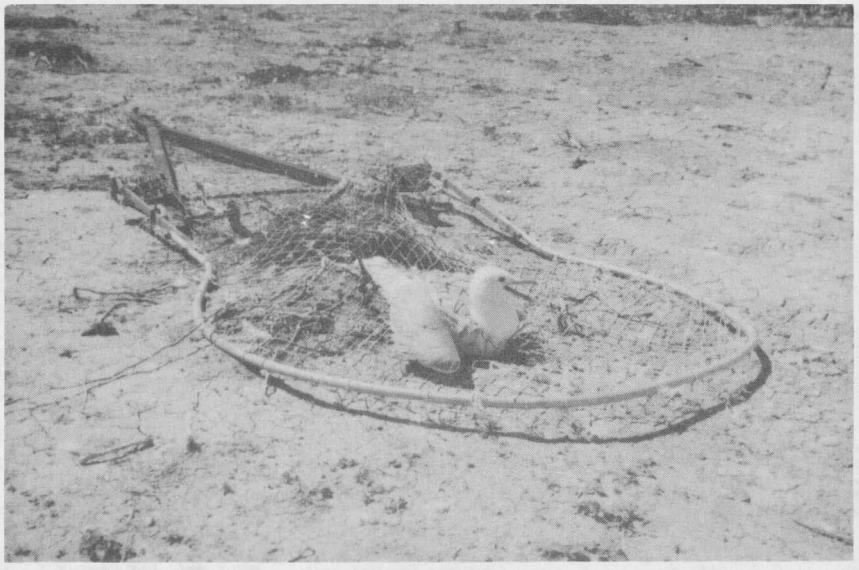

Fig. 2. Spring-operated trap with a California gull caught in an individual nest.

Fig. 3. Cannon trap after firing over a concentrated group of gulls.

Table I. Summary of trapping and color-marking of California and ring-billed gulls, 1959.

Species Gull	Number captured: Spring-operated trap	Number captured: Cannon trap	Location trapped	Dates	Markings	Location released
California	18		island, F.L.[1]	4/29-6/1	individual[4]	trap site
California	3		island, SE-1[2]	5/6-5/27	individual	trap site
Ring-billed	3		island, F.L.	5/8-6/2	individual	trap site
Ring-billed	2		island, D.L.[3]	5/9-5/11	individual	trap site
California		91	island, F. L.	6/4-6/18	red body	Hdq.
California		5	island, SE-1	5/5-5/12	blue body	Hdq.
Ring-billed		27	island, F.L.	5/5	green body	Hdq.
Ring-billed		80	island, SE-1	5/5-5/12	yellow body	Hdq.

1/ Freezout Lake

2/ Marsh SE-1, located north of Freezout Lake

3/ Davis Lake

4/ See text

Collections were made of all gull species for stomach analysis. These were taken with a shotgun at monthly intervals in all areas of the Project during the two periods of the study. The stomachs were removed and placed in a 10 percent formalin solution for later analyses. Stomach contents were removed and identified with a binocular microscope. The frequency of occurrence of the various items found was tabulated by monthly periods.

RESULTS

Three species of gulls nested on the Freezout Lake Project during 1958 and 1959: California gull, Larus californicus; ring-billed gull, L. delawarensis; and Franklin's gull, L. pipixcan.

Records of 1958 and 1959 showed that California gulls arrived on the Project on March 7 and March 12, respectively. Arrival of ring-billed gulls is not recorded, but in 1959, they were observed as early as the last week in March. Franklin's gulls first appeared during the last week of April of both years. In 1959, an estimated 800 Gulls were seen on the Project on April 1.

Approximately 500 gulls were observed on the island in Freezout Lake (Fig. 1). California and ring-billed gulls nested both years on this island, with ring-billed gulls generally located on the south end and east side, but no separation was found between the nesting areas of the two species. The island was formed when the water level was lowered and its size depends on the lake level. In 1959, it had a maximum length

of 1,700 feet and a maximum width of 460 feet. At the beginning of the nesting season, the only vegetation found was dried plants of the previous year and stumps of greasewood, Sarcobatus vermiculatus. Green vegetation at a later time consisted mainly of Kochia, Kochia scoparia, with some foxtail barley, Hordeum jubatum, red glasswort, Salicornia rubra, and lamb's quarter, Chenopodium alba. The west shore of the island had deposits of dislodged submerged aquatic plants washed up by wave action.

Nesting

Nesting activity in 1959 was first observed on the island on April 2. Nests were being constructed on dry ground and on the piles of vegetation on the west shore. Nests remaining from 1958 also showed evidence of use. The first egg-laying was on April 22 in the areas used by California gulls. On April 26, 41 nests were found, most of which contained a single egg, but nests with two and three eggs were also found. Nests of both species were distributed over the island and the distance between them varied from two to 75 feet. Nests varied in shape from depressions in the ground to constructed mounds. They were located among dried vegetation or on bare ground.

An estimated 50 ring-billed gulls were observed on the islands in Davis Lake on April 1. The observed numbers increased to an estimated 500 at the start of nesting. These gulls nested on small islands near the drainage ditch connecting the two lakes (Fig. 1). Nesting was on two

islands on the north side of the channel and all but one island on the south side. This island was the site of a nesting colony of common tern, Sterna hirundo. Vegetation on the islands consisted almost entirely of alkali bulrush, Scirpus paludosus, with some softstem bulrush, S. validus.

The first egg-laying of ring-billed gulls on Davis Lake was on May 1. On May 8, approximately 65 nests containing eggs were located on these islands. Most of the nests contained three eggs, but they varied from one to four. Nests were constructed of dried bulrush and were situated very close to each other, in many cases, the distance between them was less than six inches.

Franklin's gulls nested both years in a marsh on the west and north sides of Davis Lake (Fig. 1). This marsh has alkali bulrush with some softstem bulrush and cattail, Typha latifolia. Water depths vary from zero to six inches, however the water level was very unstable. Nests were made of alkali bulrush stems built up from the bottom of the marsh or were floating, anchored by standing emergents. Nests remaining from 1958 were also used. The total number of nests was not determined, however the density of nests varied from 5 to 111 nests in 10 sample plots (0.1 acre each). The first eggs were found on May 20.

Renesting

Two observations of marked gulls on second nests were made. Eggs were removed from the first nests of 229 trapped gulls to simulate nest destruction. When a spring-operated trap was used, eggs were removed

from the single nest covered by the trap; however, when the cannon trap was used, eggs from all nests under the trap net were removed, since individual gulls could not be traced to their nests.

A California gull, marked with a yellow tail, was seen on a second nest on the island in Freezout Lake. This gull had been captured with a spring-operated trap and marked on this island on April 29. On May 1, the gull was observed on an island in the marsh north of Freezout Lake. This area was found to be a nesting site for California gulls, but it was not determined if this gull had a nest. On May 11, the gull was observed again on the island in Freezout Lake on a nest which contained two eggs. Later observations on this nest showed the eggs began to hatch on June 6.

A green-marked ring-billed gull was observed on June 10, on the island in Freezout Lake on a second nest with two eggs. This gull was marked on May 5 on the same island. It was observed on the nest for two days following the first observation, but was not seen the third day. Subsequent observations indicated the nest was deserted. On June 17, the eggs were removed from the nest and no embryo development was found.

Movements

Groups of gulls moved their nesting colonies to different sites on the Freezout Lake Project and some moved off the Project to other water areas. These movements possibly resulted from disturbance caused by close observation and trapping activities. Bent (1921) reported California and ring-billed gulls located in areas remote from man and they were easily

driven from their breeding grounds. Behle (1949) observed that California gulls abandoned a nesting site on an island in Great Salt Lake because of loss of protection. A disturbance was caused each time the writer moved onto the nesting areas. Gulls flew overhead or landed on the water away from the nesting site. Additional disturbance resulted from the operation of the trap, commotion of the trapped gulls and release of the gulls from the netting of the trap.

Two days after trapping began, a decrease in the number of California gulls was noted on the island and vicinity in Freezout Lake. The following day (May 1), a nesting colony of California gulls was observed on the islands in the marsh designated as SE-1, where no gulls were observed on April 29 (Fig. 1). A gull, marked on the island in Freezout Lake, was observed in this colony.

Evidence indicated the Freezout Lake island colony site was deserted. Twenty nests were selected which contained one or two eggs, to determine if they had been deserted. The clutch size of California gulls is reported to be three eggs (Bent, op. cit.; Behle and Goates, 1957). On May 6, there was no increase in egg numbers in any of the nests and in many, eggs were missing or broken; also the nests had the appearance of being deserted.

On May 6, trapping of the newly established colony was begun in marsh SE-1. Two gulls were trapped. A decrease in gull numbers was apparent on May 7 in the area trapped, but no decrease was noted on un-

trapped sites. At this time a check of the island in Freezout Lake revealed an increase of the gull population. The marked gull, previously mentioned, was again observed on this nesting area. The evidence suggests at least some of the gulls returned to their original nesting site.

Subsequent trapping in both areas did not cause additional movement of the nesting colonies. On May 19, approximately 214 nests with eggs were found on the nesting islands in marsh SE-1, while 350 nests with eggs were found on the island in Freezout Lake.

Trapping was attempted on the ring-billed gull nesting site on Davis Lake starting on May 9. One gull was taken on this date and another on May 11. On the second trip to this site for the purpose of trapping, it was apparent that a number of gulls had left this area. This movement was similar to the movement of California gulls from their nesting site. During a check of marsh SE-1 on this same day (May 11), a ring-billed gull colony was found. On May 19, 124 nests were located in this colony.

Ring-billed gulls were not observed to return to the deserted nests on the island in Davis Lake. Eggs remaining in these nests showed evidence of predation; they disappeared or were eventually broken.

The sightings of marked gulls on areas at varied distances and directions from Freezout Lake may have indicated movement resulting from disturbance. Gulls marked on the island in Freezout Lake on May 7 were observed on May 11 near the gull nesting island in the Missouri River (Table II). Marked gulls were also observed on nesting islands located

Table II. Summary of color-marked gulls observed away from Freezout Lake Project, 1959.

Species Gulls	No.	Date	Location and miles from Freezout Lake	Activity
Calif.	3	5/11	Missouri R., 39 mi. E.	on the river
R-B	1	6/12	4 mi. E.	feeding in field
R-B	1	6/12	5 mi. S.E.	feeding in field
R-B	1	6/14	5 mi. E.	feeding in field
R-B	1	6/16	Priest L., 7 mi. N.	on the lake
Calif. R-B	many	mid-June	20 mi. S.W.	feeding in field
R-B	1	6/21	19 mi. S.E.	feeding in field
R-B	1	6/26	Aarod L., 24 mi. N.	on gull nesting island
Calif. R-B	1 2	6/28	5 mi. E.	feeding in field
Calif. R-B	1 1	7/1	14 mi. N.	flying north
R-B	3	7/2	Alkali L., 56 mi. N.	on gull nesting island
Calif.	2	7/3	Pishkun Res., 20 mi. W.	on gull nesting island
Calif.	1	7/6	8 mi. E.	feeding in field
R-B	1	7/6	7 mi. S.E.	feeding in field
R-B	1	7/7	12 mi. N.W.	feeding in field
Calif.	3	7/10	80 mi. N.W.	on a small pond
Calif.	1	7/19	Aarod L., 24 mi. N.	on a small lake
Calif.	1	9/10	Missouri R., 35 mi. E.	on the river

on Aarod Lakes (June 26), Alkali Lakes (July 2), and Pishkun Reservoir (July 3). These gulls may have had nests on these islands. The islands on the latter water areas were checked for marked-gull nesting, but no nests were found.

Approximately 2,500 California and ring-billed gulls including 85 marked gulls were observed on the Freezout Lake Project from May 1 to August 7. Gulls moved off the Project to feed, especially to the irrigated fields located east and south. Some movement to north fields was also noted. A summary of marked gulls observed off the Project is given in Table II. Of nine observations of marked gulls feeding off the Project, seven were on areas either east or south from Freezout Lake. These observations indicated gulls moved off Freezout Lake Project at least as far as 20 miles to feed.

The number of gulls observed on the Freezout Lake Project began to decrease during the first part of August. Recovery of bands from gulls indicate that gulls breeding on Freezout Lake spend the winter on the Pacific Coast. Band recoveries have been reported from Vancouver, British Columbia, Canada and Baja California, Mexico and from areas between these locations. Table III summarizes banding data and location of recoveries.

Food Habits

Food habits of gulls were determined by the analysis of stomach contents of 71 California gulls, 25 ring-billed gulls and 108 Franklin's gulls collected during two months of the 1958 study period and each month

Table III. Locations of band recoveries or observations of gulls banded on Freezout Lake Project, 1957, 1958 and 1959.

Species	Band No.	Date banded	Recovery of bands	
			Location	Date
R-B gull	535-74928	6/15/57	Blackfoot, Idaho	6/ /58
R-B gull	545-35082	6/22/57	Sonora, Mexico	3/26/58
Gull 1/	545-35384	6/ 6/57	N. Jelty, Oyhut, Washington	1/ 6/58
Gull	545-36560	6/17/58	Vancouver, B. C., Canada 2/	6/ 2/59
Gull	545-36569	6/17/58	Baja California, Mexico	3/ 9/59
Gull	545-36589	6/17/58	Vancouver, B. C., Canada 2/	6/12/59
Gull	545-36602	6/18/58	Vancouver, B. C., Canada 2/	6/10/59
Gull	545-36707	6/18/58	Watsonville, California	6/17/59

1/ Gulls were banded when juveniles; species not known.

2/ Bands observed on live gulls and number determined by Mr. Oldaker of Vancouver, B. C., Canada.

of the 1959 study period (Table IV). The majority of gull stomachs contained plant and animal materials. Greenhalgh (1952) indicated the California gulls collected in Utah had an omnivorous diet. A comparison of stomach contents of the three gull species indicate they had similar food habits. While gulls were commonly observed feeding in open fields, they also feed in water, as seen by the presence of aquatic insects found in gull stomachs. The stomach contents included invertebrates, vertebrates, grit and debris. Stones were classified as grit.

Oligochaeta (earthworms): Earthworms were taken by the three species of gulls but were found mainly in stomachs of ring-billed gulls, in which

Table IV. Food items identified in stomachs of 71 California gulls collected on Freezout Lake, 1958 - 1959.

	1958		1959					
No. gulls taken	4	2	14	12	15	9	10	5
Month	Aug	Sept	Apr	May	June	July	Aug	Sept
Invertebrate								
Oligochaeta	1(25.0)			1(8.3)	1(6.7)			
Crustacea	1(25.0)							
Insecta								
Orthoptera								
Gryllidae					3(20.0)		2(20.0)	1(20.0)
Acrididae	1(25.0)						1(10.0)	
Ephemerida								1(20.0)
Odonata		1(50.0)			2(13.3)			1(20.0)
Homoptera								3(60.0)
Hemiptera								
Corixidae			2(14.3)	1(8.3)		1(11.1)	6(60.0)	4(80.0)
Notonectidae		1(50.0)						
Gerridae							1(10.0)	
Coleoptera								
Carabidae	3(75.0)		5(35.8)	3(25.0)	7(46.6)	1(11.1)	1(10.0)	2(40.0)
Tenebrionidae			2(14.3)					
Scarabaeidae			5(35.8)	2(16.7)			3(30.0)	2(40.0)
Curculionidae					1(6.7)	2(22.2)		1(20.0)
Lepidoptera								
Phalaenidae	1(25.0)		1(7.1)	1(8.3)				
Diptera								
Tipulidae					1(6.7)	1(11.1)		
Chironomidae			2(14.3)	1(8.3)	1(6.7)			2(40.0)
Muscidae	3(75.0)		1(7.1)	1(8.3)	2(13.3)			
Hymenoptera								
Formicidae		1(50.0)						
Vertebrate								
Amphibia	2(50.0)	2(100.0)			3(20.0)			
Aves			2(14.3)	1(8.3)				
Unidentified	2(50.0)		6(42.9)	1(8.3)	1(6.7)	8(88.8)	8(80.0)	5(100.0)
Vegetation	4(100.0)		13(92.9)	11(91.7)	12(80.0)	7(77.7)	8(80.0)	5(100.0)
Grit	4(100.0)	1(50.0)	14(100.0)	12(100.0)	14(93.3)	5(55.5)	6(60.0)	5(100.0)
Debris			8(57.2)	4(33.3)	3(20.0)			

[1] First figure is the number of stomachs the item appeared in. The figure in parenthesis indicates percentage of stomachs the item appeared in.

Table IV. Food items identified in stomachs of 25 ring-billed gulls collected on Freezout Lake, 1958 - 1959.

	1958			1959		
No. gulls taken	3	6	5	6	3	2
Month	Aug	May	June	July	Aug	Sept
Invertebrate						
Oligochaeta		1(16.7)	1(20.0)	2(33.3)	3(100.0)	1(50.0)
Crustacea		1(16.7)				
Insecta						
Orthoptera						
Gryllidae			2(40.0)	1(16.7)		2(100.0)
Acrididae	3(100.0)		1(20.0)	1(16.7)	2(66.6)	1(50.0)
Coleoptera						
Carabidae	1(33.3)	4(66.6)	1(20.0)	1(16.7)	1(33.3)	
Elateridae		1(16.7)				
Tenebrionidae			2(40.0)	1(16.7)		
Scarabaeidae		1(16.7)		1(16.7)		
Curculionidae	1(33.3)	1(16.7)	3(60.0)	2(33.3)		
Lepidoptera						
Phalaenidae			1(20.0)	1(16.7)		
Diptera						1(50.0)
Tabanidae				1(16.7)		
Muscidae		1(16.7)	1(20.0)		1(33.3)	1(50.0)
Vertebrate						
Aves						1(50.0)
Mammalia		1(16.7)		1(16.7)		
Unidentified			1(20.0)	1(16.7)		
Vegetation	3(100.0)	6(100.0)	5(100.0)	6(100.0)	3(100.0)	2(100.0)
Grit	3(100.0)	4(66.6)	3(60.0)	3(50.0)	1(33.3)	1(50.0)
Debris			1(20.0)	2(33.3)		

Table IV. Food items identified in stomachs of 108 Franklin's gulls collected on Freezout Lake, 1958 - 1959

	1958		1959					
No. gulls taken	34	9	5	13	15	11	15	6
Month	Aug	Sept	Apr	May	June	July	Aug	Sept
Invertebrate								
Oligochaeta				3(23.1)				
Arachnida	3(8.9)	1(11.1)						
Insecta								
Orthoptera								
Tettigonidae								
Gryllidae	9(26.6)					1(9.1)		
Acrididae	31(91.5)	7(77.7)			2(13.3)	2(18.2)	13(85.8)	5(83.3)
Ephemerida	1(2.9)	2(22.2)		2(15.4)		4(36.4)	5(33.0)	1(16.7)
Odonata	5(14.7)	2(22.2)			4(26.8)	3(27.3)	2(13.3)	
Plecoptera						2(18.2)		
Homoptera	1(2.9)				1(6.7)			
Hemiptera								
Corixidae		5(55.5)	2(40.0)	1(7.7)		3(27.3)	2(13.3)	5(83.3)
Notonectidae		1(11.1)	1(20.0)	1(7.7)				3(50.0)
Gerridae		1(11.1)	1(20.0)	1(7.7)				
Miridae	1(2.9)						1(6.6)	1(16.7)
Nabidae			1(20.0)	1(7.7)				
Alydidae	4(11.8)							
Pentatomidae	2(5.9)		1(20.0)	2(15.4)				2(33.3)
Scutelleridae	1(2.9)		1(20.0)	2(15.4)				3(50.0)
Coleoptera	2(5.9)					1(9.1)		1(16.7)
Cicindellidae			1(20.0)	1(7.7)				2(33.3)
Carabidae	26(76.7)	5(55.5)	2(40.0)	6(46.2)	5(33.3)	6(54.6)	5(33.3)	5(83.3)
Dytiscidae		2(22.2)	2(40.0)	3(23.1)	1(6.7)			3(50.0)
Staphylinidae			1(20.0)	3(23.1)	1(6.7)	2(18.2)		
Histeridae			1(20.0)	1(7.7)				
Hydrophilidae		1(11.1)	1(20.0)	3(23.1)	1(6.7)			1(16.7)
Silphidae	2(5.9)		1(20.0)					
Elateridae	3(8.9)		2(40.0)	1(7.7)	4(26.8)	2(18.2)	4(26.7)	
Buprestidae	1(2.9)		1(20.0)	1(7.7)				
Tenebrionidae	3(8.9)						2(13.3)	
Scarabaeidae	12(35.4)	3(33.3)	3(60.0)	10(77.0)	7(46.9)	4(36.4)	5(33.3)	4(66.6)
Curculionidae	9(26.6)		1(20.0)	3(23.1)	4(26.8)	4(36.4)	3(20.0)	3(50.0)
Trichoptera		1(11.1)					4(26.7)	
Lepidoptera					1(6.7)	1(9.1)	2(13.3)	
Phalaenidae	7(20.7)	1(11.1)	1(20.0)		3(20.0)	2(18.2)	2(13.3)	1(16.7)
Diptera	1(2.9)	2(22.2)	1(20.0)					
Tipulidae				1(7.7)		1(9.1)	1(6.6)	
Chironomidae	3(8.9)		2(40.0)	5(35.5)	2(13.3)	5(45.5)	2(13.3)	2(33.3)
Tabanidae						1(9.1)		
Stratiomyiidae			1(20.0)	1(7.7)		1(9.1)		
Muscidae	2(5.9)		2(40.0)	3(23.1)		1(9.1)		1(16.7)
Hymenoptera								
Braconidae						2(18.2)		1(16.7)
Ichneumonidae	1(2.9)	1(11.1)					2(13.3)	
Formicidae	6(17.7)	1(11.1)		2(15.4)		6(54.6)	5(33.3)	3(50.0)
Sphecidae	1(2.9)		1(20.0)	1(7.7)				1(16.7)
Vertebrate								
Amphibia		1(11.1)						
Unidentified			2(40.0)	3(23.1)	3(20.0)	4(36.4)		
Vegetation	21(61.9)	7(77.7)	4(80.0)	12(92.4)	14(93.3)	11(100.0)	15(100.0)	5(83.3)
Grit	26(76.7)	7(77.7)	5(100.0)	13(100.0)	15(100.0)	9(81.9)	13(85.8)	6(100.0)
Debris			1(20.0)	4(26.8)	2(13.3)	2(18.2)	2(13.3)	1(16.7)

they appeared to be an important food item. In all stomachs where earthworms were found, soil was also found which was possibly taken incidental to feeding.

Arachnida and Crustacea were found in only a few stomachs. Gammerus and body parts of crayfish were found, indicating aquatic feeding by gulls.

Insecta (insects): Eleven orders of insects were found in stomach contents. Only three (Orthoptera, Coleoptera and Diptera) were found extensively in all three species of gulls.

Orthoptera (grasshoppers and crickets): The Acrididae and Gryllidae were the most abundant. These two families contributed substantially to the total gull diet, especially later in the study period as the insects matured. Tettigonidae were found in Franklin's gulls but were not found in the stomachs of the other two species.

Coleoptera (beetles): This order supplied the largest number of all insects taken. Carabidae were found in 90 stomachs, Scarabaeidae in 53 stomachs and Curculionidae in 38 stomachs. Aquatic beetles, Dytiscidae and Hydrophilidae, were found in stomachs of 18 Franklin's gulls.

Diptera (flies): Most of the flies taken were in larval forms, but adult Tipulidae and Chironomidae were found. Chironomids were found in the most stomachs.

Hemiptera (true bugs): Specimens of this order were found only in California and Franklin's gulls. Corixidae and Notonectidae were the important aquatic forms taken by both gull species and Pentatomidae and Scutelleridae were important terrestrial forms taken by Franklin's gulls.

Hymenoptera (wasps, ants): Ants (Formicidae) were the most common family of this order taken, especially by Franklin's gulls.

Three orders of insects were represented each by a single family, however, they were important items in the diet. Baetidae (Ephemerida) was found extensively in Franklin's gulls and to a lesser extent in California gulls. Coenagrionidae (Odonata) was found in stomachs of four California gulls and 16 Franklin's gulls. The larval form of Phalaenidae (Lepidoptera) appeared in 22 stomachs representing all three gull species.

The other orders of insects found in the stomachs were represented by one or two families, but were not taken to any great amount (Table IV).

Amphibia: Body parts of the tiger salamander, Ambystoma tigrinum, were found in eight stomachs. One California gull, collected in 1958, had an entire salamander measuring 10 inches long in its stomach. This specimen made up the entire stomach contents.

Aves: Body parts of a bird were found in one stomach while egg shells were found in four stomachs. Greenhalgh (op. cit.) reported that California gulls would eat or destroy any eggs from unprotected nests.

Mammalia: Two ring-billed gull stomachs contained mammals; one stomach contained hair and the other a mouse, Peromyscus sp.

Unidentified: Bones of vertebrates were found in some stomachs of all gull species. The appearance of vertebra and other bones indicated they may have been from amphibians.

Vegetation: Wheat and barley kernels and stems were the most common

plant items found. Cottam (1944) reported that normal food items of gulls were organic refuse, fish, insects and other animal life. Vegetation may be picked up in the feeding but plant items were not taken with any regularity. The amount of plant items found, however, did not appear to be taken incidentally. Some aquatic plants as well as leaves and stems from grass and broadleaf plants were found.

Debris: Debris consisted of miscellaneous items classed as food or garbage. Meat and chicken fragments were food items found in gull stomachs. Garbage included vegetative materials such as wood, sticks, fruit pits, paper and cloth.

DISCUSSION

The effect of gulls on Freezout Lake Project in relation to waterfowl populations was not completely evaluated. Gull food habits as revealed by this study indicate little or no gull predations on waterfowl. The shift of gull nesting colonies to sites in marsh SE-1 could possibly alter this since the locations of nesting colonies in marsh SE-1 are closer to waterfowl nesting and brooding areas. Greenhalgh (op. cit.) and Behle (op. cit.) reported that waterfowl predation resulted from gulls nesting in close proximity to waterfowl on a waterfowl refuge located on the east side of Great Salt Lake in Utah. The gulls had moved here from other nesting sites located on the lake as a result of disturbance. Greenhalgh also reported that gull predation was more extensive on waterfowl nests

close to the gulls' own nesting site. The movement of gull colonies on Freezout Lake may result in increased predation.

Conflict for space between nesting gulls and waterfowl was not easily evaluated. Searches for waterfowl nests on islands used by California and ring-billed gulls and the islands near by were unsuccessful. A search for nests in marsh habitat revealed seven redhead (Aytha americana) nests. Six of these were found on Davis Lake and one on marsh SE-1. A single nest was found in the area utilized by nesting Franklin's gulls. The movement of gulls to locations in marsh SE-1 may have the effect of impeding future waterfowl use of nesting sites in the marsh. Since 1959 was the first year marsh SE-1 had a controlled water level, future distribution of waterfowl nesting is not known. Further study of gull nesting is needed to determine effects on nesting waterfowl.

SUMMARY

Freezout Lake, Teton County, Montana is being developed into a waterfowl management area by the Montana Fish and Game Department. Marsh habitat is being created by construction of water impoundments.

A study of California gull, ring-billed gull and Franklin's gull populations on the Freezout Lake Project was conducted during the summer of 1958 and spring and summer of 1959. Gulls were trapped, banded, color-marked and released for observations of movements and possible renesting.

A total of 229 gulls was trapped and color-marked. Two renests of color-marked gulls were observed; one was a California gull, the other a

ring-billed gull. Eighteen observations of color-marked gulls were made on land and water areas off Freezout Lake Project. Color-marked gulls were observed on gull nesting islands in water areas located approximately 20, 24 and 56 miles from Freezout Lake. Nine observations of marked gulls feeding in fields up to distances of 20 miles were made. Color-marked gulls were seen as far distant as 80 miles from Freezout Lake. Movements of gull nesting colonies on the Project were indicated by observations of marked gulls and increase and decrease of gull numbers in the different nesting colonies.

Migration movements were indicated by recovery of gulls banded on Freezout Lake and observed during the winter in areas on the Pacific Coast.

Two hundred four gulls were collected for stomach analysis to determine food habits. Gulls were found to be omnivorous, taking invertebrate and vertebrate animals and plants. Invertebrate items included earthworms, spiders, crustaceans and insects. Insects constituted a major part of the food items taken. Orthoptera, Coleoptera, Hemiptera and Diptera were the most important orders on the basis of occurrence. Both terrestrial and aquatic insects were found. Vertebrates were represented by amphibians, birds and mammals; amphibians were taken extensively. A large percentage of stomachs of gulls taken contained vegetation, which was mainly wheat and barley plant parts. Food habits indicated there was little, if any, gull predation on waterfowl.

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