



Spring, summer, and fall use of stockponds by Canada geese in southeastern Montana
by Aaron Lloyd Hamilton

A thesis submitted in partial fulfillment of MASTER OF SCIENCE in Fish and Wildlife Management
Montana State University

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Abstract:

Nesting habitat, production, and movements of Canada geese were studied in 1976 and 1977 on stockponds in southeastern Montana. No physical or vegetational trends were found that would satisfactorily explain the use of a particular reservoir for nesting. Contrasting water levels between 1976-1977 and the change in security of existing islands may have resulted in few islands being selected for nesting activities. Intensive grazing by cattle, especially during the low water period in 1977, created a less attractive area both for nesting and brood rearing. Paired geese entered the study area by 1 April, 1977. Peninsulas were the most common nesting site and grassland was the most commonly used cover type. Forty-eight percent of the nests were successful. No evidence of reneating was found. The average clutch size was 5.53 eggs/nest. Little brood movement was observed in 1976, however, broods moved extensively between reservoirs in 1977. These overland movements contributed to a 55% mortality of goslings prior to flight stage. Nonbreeders entered the study area by 19 April, 1977, left by the end of May, and returned by the end of August.

Boles Reservoir and Trail Creek Reservoir Units were used as major feeding sites both in 1976 and 1977. Geese, both river and stockpond residents, were observed on these units by the end of July both years. Large reservoirs positioned close to large blocks of winter wheat appears to attract these geese. Utilization of wheat fields usually begins once the harvest is completed. River geese appear to use certain routes and reservoirs while traveling to these feeding sites. The Boles Reservoir Unit attracted geese from Hathaway downstream to Terry, Montana, and the Trail Creek Reservoir Unit, from Hathaway upstream to the Bighorn River. By 18 November, 1977, cold weather had resulted in the freeze-up of reservoirs and the virtual exodus of Canada geese from the area. Hunter access within much of the study area is influenced by landowner-hunter relationships on private land. Currently, most of this land is closed to hunting or available to a small segment of the hunting public.

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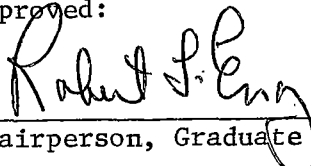
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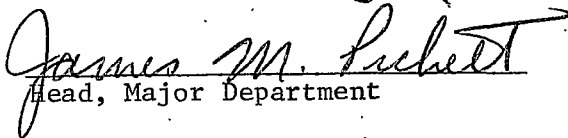
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ABSTRACT

Nesting habitat, production, and movements of Canada geese were studied in 1976 and 1977 on stockponds in southeastern Montana. No physical or vegetational trends were found that would satisfactorily explain the use of a particular reservoir for nesting. Contrasting water levels between 1976-1977 and the change in security of existing islands may have resulted in few islands being selected for nesting activities. Intensive grazing by cattle, especially during the low water period in 1977, created a less attractive area both for nesting and brood rearing. Paired geese entered the study area by 1 April, 1977. Peninsulas were the most common nesting site and grassland was the most commonly used cover type. Forty-eight percent of the nests were successful. No evidence of renesting was found. The average clutch size was 5.53 eggs/nest. Little brood movement was observed in 1976, however, broods moved extensively between reservoirs in 1977. These overland movements contributed to a 55% mortality of goslings prior to flight stage. Nonbreeders entered the study area by 19 April, 1977, left by the end of May, and returned by the end of August. Boles Reservoir and Trail Creek Reservoir Units were used as major feeding sites both in 1976 and 1977. Geese, both river and stockpond residents, were observed on these units by the end of July both years. Large reservoirs positioned close to large blocks of winter wheat appears to attract these geese. Utilization of wheat fields usually begins once the harvest is completed. River geese appear to use certain routes and reservoirs while traveling to these feeding sites. The Boles Reservoir Unit attracted geese from Hathaway downstream to Terry, Montana, and the Trail Creek Reservoir Unit, from Hathaway upstream to the Bighorn River. By 18 November, 1977, cold weather had resulted in the freeze-up of reservoirs and the virtual exodus of Canada geese from the area. Hunter access within much of the study area is influenced by landowner-hunter relationships on private land. Currently, most of this land is closed to hunting or available to a small segment of the hunting public.

INTRODUCTION

Large numbers of stockponds have been built or subsidized by various governmental agencies in recent years greatly increasing the waterfowl potential of southeastern Montana (Smith, 1953; Rundquist, 1973). Concurrently, numbers of Canada geese (*Branta canadensis*) have greatly increased during the fall migration in the lower Yellowstone Valley, especially on the river (Hinz, 1974). Hunter numbers and waterfowl harvests in this area have greatly increased within the last ten years. With the closing of certain sections of the Yellowstone River to waterfowl hunting, the hunting public seeks opportunities elsewhere.

Increased utilization of stockponds by geese is occurring, probably as a result of successful production and subsequent homing. Hinz (1974) found some intermingling between river and stockpond geese, especially in late summer and early fall. This study was initiated to determine the spring, summer, and fall use of stockponds by Canada geese and the possible relationships of these geese to populations on the lower Yellowstone River.

Field work was conducted from July through early September, 1976 and from late March through late November, 1977.

DESCRIPTION OF THE STUDY AREA

The study area was located in Rosebud, Custer, and Prairie counties, north of the Yellowstone River (Fig. 1) and included approximately $3,795 \text{ Km}^2$ ($1,440 \text{ mi}^2$). The boundaries were the Yellowstone River on the south, Custer Creek on the east and county roads on the north and west. These boundaries do not reflect major changes in land use or vegetational characteristics, rather they reflect well defined topographic features delineating an area of known Canada goose occupancy. Approximately 83% of the land is privately owned with the remaining Federal land largely controlled by limited access across private land.

Gieseke (1953) divided the area into three prominent physiographic types, rough broken, sharply rolling, and gently rolling land. The rough broken land or breaks form the stream banks for the Yellowstone River and the creeks draining the area. These breaks are sandstone-capped buttes and ridges in which shales locally outcrop. The shales are composed of bentonite, which erodes into steep, almost vertical faces. The sharply rolling land includes high rounded hills and ridges, with gullied valley slopes. Both of these areas are unsuitable for farming and are used for livestock grazing. The gently rolling land is suitable for farming.

Elevations within the study area vary from 773 m (2,535 ft) at Forsyth to 725 (2,377) at Miles City. The northern area, which represents the Yellowstone-Missouri Divide, is approximately 975 m

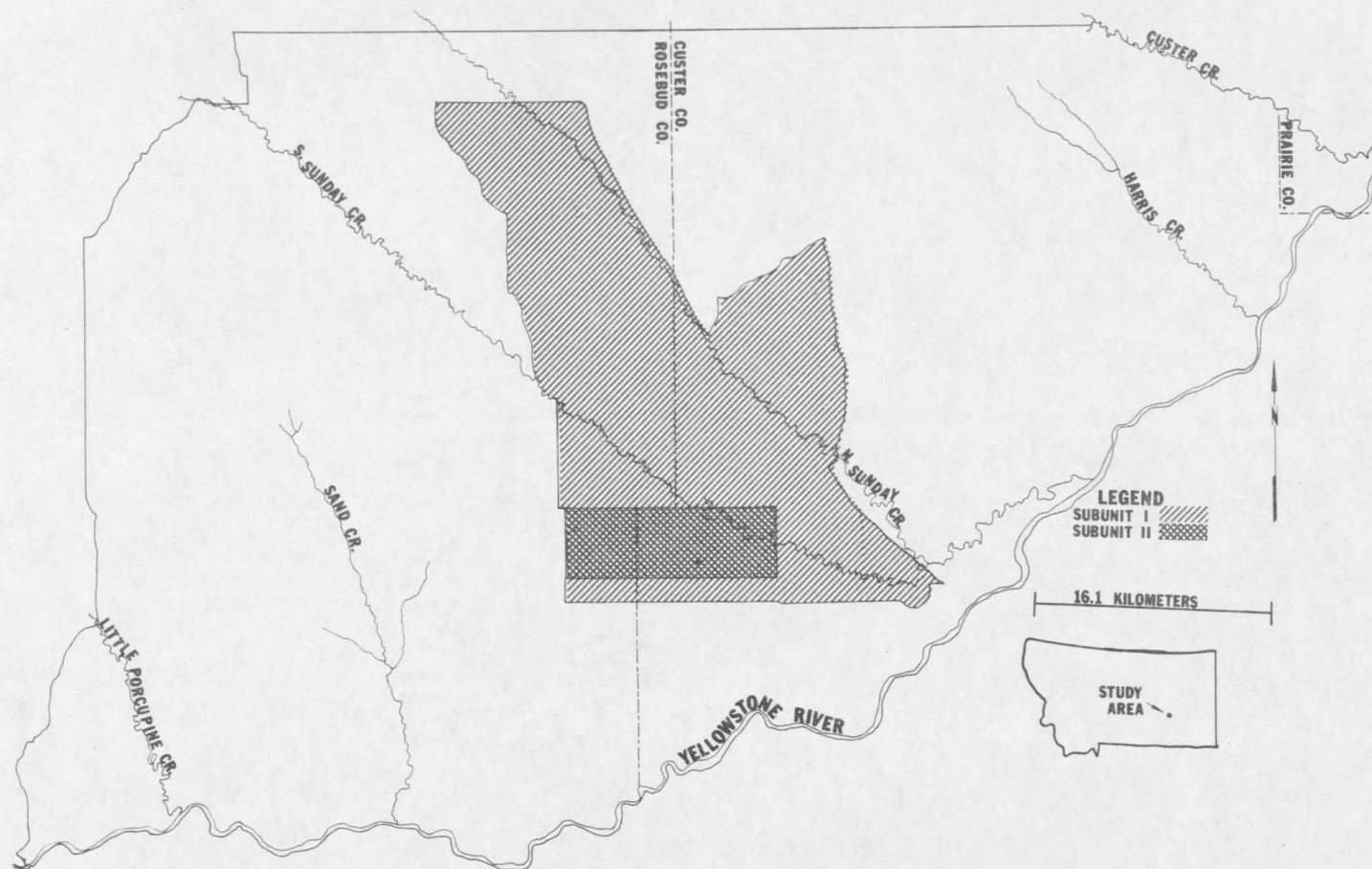


Figure 1. Map of the study area showing major features and position of Subunits I and II.

(3200 ft) in elevation.

The major streams draining the area are Little Porcupine, Sand, Sunday, Harris, and Custer Creeks. Sunday Creek, which is formed by the North and South forks, drains most of the study area. All are intermittent.

The climate is characterized by moderately low annual precipitation, a dry atmosphere, hot summers, cold winters, and a large proportion of sunny days (DeYoung et al., 1940). Average annual temperature and total precipitation, as well as 29 year means, were obtained at Miles City FAA AP (Table 1). Mean annual temperature and total precipitation for Miles City during 1941-1970 were 7.4 C (45.3 F) and 35.4 cm (13.9 in), respectively. For 1975, 1976, and 1977 the mean annual temperatures were 6.7 C (44.1 F), 8.6 C (47.4 F), and 7.7 C (45.9 F), respectively. Annual precipitation for these three years totaled 51.0 cm (20.1 in), 27.4 cm (10.8 in), and 40.1 cm (15.8 in), respectively (U. S. Department of Commerce, 1975-1977).

Vegetational characteristics of portions of the study area have been described by Schladoweiler (1976) and Hinz (1974). The study area can be divided into two general types: sagebrush-grassland uplands and riparian. Big sage (*Artemisia tridentata*) is the predominant shrub in the uplands, with silver sage (*Artemisia cana*) found locally in wetter sites. Dominant forbs include hairy goldaster (*Chrysopsis villosa*), pussytoes (*Antennaria* spp.), and fringed sagewort (*Artemisia*

Table 1. Climatological Data - Miles City FAA AP-U.S. Department of Commerce, 1975-1977.

Average Temperature (Degrees C)													
	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
1975	-5.44	-8.66	-2.39	3.77	12.38	17.76	24.86	20.76	14.65	8.49	-0.56	-5.22	6.72
1976	-7.44	0.22	0.28	9.21	15.04	18.65	24.64	23.37	17.15	6.77	-1.44	-3.61	8.55
1977	-13.49	-0.17	2.33	10.66	16.32	21.70	23.53	18.76	15.10	9.49	-1.94	-9.88	7.71
¹ Mean	-9.21	-5.77	-1.00	7.38	13.49	18.26	23.53	22.48	15.48	9.32	0.22	-5.55	7.38
Total Precipitation (Centimeters)													
1975	2.06	0.84	3.12	6.86	12.12	9.35	4.22	1.70	1.12	5.87	2.31	1.42	50.98
1976	0.58	0.46	0.91	3.63	2.54	8.66	2.82	1.98	2.69	1.91	0.48	0.69	27.36
1977	1.73	0.25	2.46	0.61	6.22	3.51	4.85	5.74	2.95	3.81	3.12	3.12	40.11
¹ Mean	1.24	1.30	1.65	3.20	5.23	8.43	3.94	3.05	3.02	1.80	1.30	1.22	35.38

¹Based on the period 1941-1970.

frigida). Commonly occurring grasses are blue grama (*Bouteloua gracilis*) and western wheatgrass (*Agropyron smithii*). In the riparian type, silver sage is the dominant shrub, with greasewood (*Sarcobatus vermiculatus*) and rubber rabbitbrush (*Chrysothamnus nauseosus*) important on some sites. Common riparian grasses are inland saltgrass (*Distichlis stricta*) and foxtail barley (*Hordeum jubatum*). The main emergents are cattail (*Typha latifolia*) and American bulrush (*Scirpus americanus*). Main submergents are water milfoil (*Myriophyllum* spp.), pondweed (*Potamogeton* spp.), and water plantain (*Alisma gramineum*). Willow (*Salix* spp.) and cottonwood (*Populus deltoides*) comprise the dominant woody plants.

METHODS

Two smaller study units were delineated within the study area (Fig. 1). Subunit I contained approximately 225 square kilometers (87 sections) and was located northwest of Miles City. Within this unit, spring and early summer distribution of breeding pairs and non-breeding Canada geese was determined. Fate of known nests and broods also were studied. Subunit II contained 70 square kilometers (27 sections) and was contained within Subunit I. More intensive data were collected on physical and vegetational characteristics of stock-ponds within this unit.

The location of breeding pairs and groups of non-breeders, within Subunit I, were determined by weekly aerial surveys. Information obtained during initial visits to the nests included: date found, location, vegetation type, distance from water, height above water, and clutch size (Appendix Table 12). After the initial visit, weekly observations were made from the ground or air. Observations on the ground using binoculars and a spotting scope kept disturbance to a minimum. However, if neither parent could be located or evidence of nest destruction existed, the nest was closely examined to determine fate and possible predator type. In 1977, web tags were attached to goslings before they left the nest. Mixing, and movement of broods to various reservoirs could then be documented when banding began in mid-June. Ponds were visited to record brood survival, movement, and feeding site locations. Feeding sites were examined after use to

determine plant species used.

Physical data gathered on each stockpond within Subunit II included size, type, shoreline slope, and presence of islands. Age was approximated by examining aerial photos from 1950, 1958, and 1968. The shoreline was measured and divided into one or more of ten slope categories. Stockponds or reservoirs were sorted into two types, retention or detention (McCarthy 1973).

The number of islands per reservoir and their permanency was recorded. Each was classified as temporary or permanent based on water levels during the course of the study.

Aerial photos were taken in 1976 and 1977. Changes in shoreline lengths and surface area during the two years were compared using a cartometer and a planimeter, respectively.

Vegetational data included percentage of shoreline vegetation classified as sagebrush grassland, marsh-meadow, wooded, and denuded. Brood rearing and/or feeding sites selected in 1976 were measured in 1977 using the canopy coverage method of vegetational analysis (Daubenmire, 1959). Nine 100-foot lines were positioned perpendicular to the shorelines of three stockponds. A 2x5 decimeter frame was placed at five foot intervals along the lines. The canopy coverage of taxa in each plot was estimated visually to occur in one of six classes: 1=0-5%, 2=5-25%, 3=25-50%, 4=50-75%, 5=75-95%, and 6=95-100%. The midpoint of each class was used in data tabulation. Statistical

tests were used for describing nesting reservoirs and comparisons between nesting and non-nesting reservoirs.

During the summers of 1976 and 1977, geese were counted by airplane and vehicle on the entire study area. Molting geese were banded on the area in conjunction with the banding program currently in operation on the Yellowstone River (Hinz, 1974; 1977). Geese were trapped along the Yellowstone River from Custer to Glendive and on reservoirs north of the river from Forsyth to Terry. Banding was conducted for approximately one month beginning near the middle of June.

Field-feeding geese were observed from 15 July to 14 September, 1976 and from 12 July until freeze-up about 20 November, 1977. During both years, observations were made during morning and evening periods. Type of field used, number of geese, and neck bands in each group were recorded. Once neck bands were recorded, individual geese could be followed to the reservoir or combination of reservoirs used as loafing sites. Loafing sites on each reservoir were examined intensively, because sloughed bands could be recovered from such sites.

Landowners, Montana Department of Fish and Game Department personnel, and local people all offered information about the past history of the Canada goose on the study area. Traditional use of the area was assessed with the aid of this information.

RESULTS AND DISCUSSIONS

Physical and Vegetational Characteristics

Nine stockponds were located on Sage Creek and seven on Coal Creek (Fig. 2). Four of the reservoirs were at least 27 years old; the remainder were between 10 and 20. Fourteen retention and two detention type reservoirs (McCarthy, 1973) were present in Subunit II.

Stoudt (1971) and Rundquist (1973) stated that early spring precipitation, either rain or snow, is quite effective in filling stockponds. They further state, that late spring and summer rains may not accumulate in the ponds because, in the absence of frozen or saturated ground, little or no runoff occurs.

Figure 3 shows total monthly precipitation for 1975, 1976, and 1977 and the 29 year mean. Precipitation levels during 1975 were well above normal. That which fell during October, November, and December helped supply moisture needed to fill the reservoirs in the spring of 1976 and created an attractive situation for breeding pairs of Canada geese entering the area. Precipitation during 1976 was below normal and with two exceptions, reservoirs did not fill during the spring of 1977.

Figure 4 shows the average monthly temperature from Miles City for 1975-1977 and the 29 year mean. Temperature levels were below normal for most of 1975, and above normal in 1976 and 1977. These above normal temperatures combined with below normal moisture, resulted in the low pond levels in 1977.

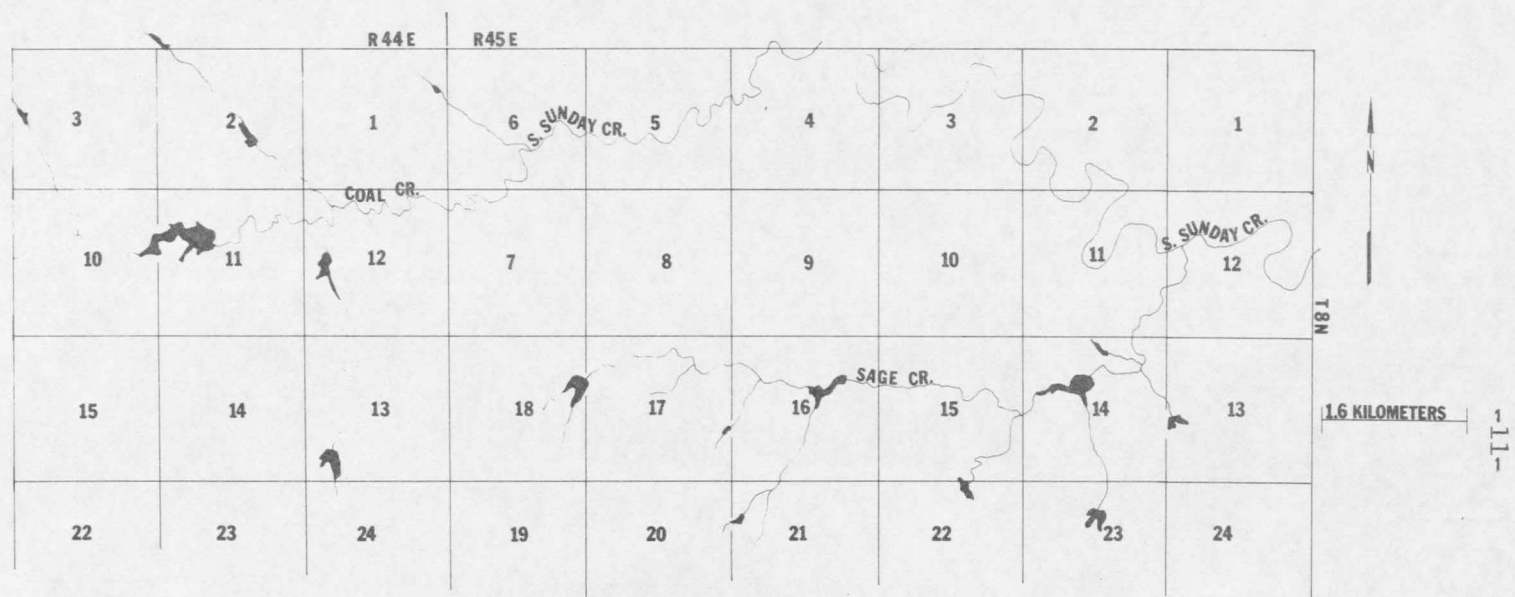


Figure 2. Location of reservoirs and major creeks within Subunit II, 1977.

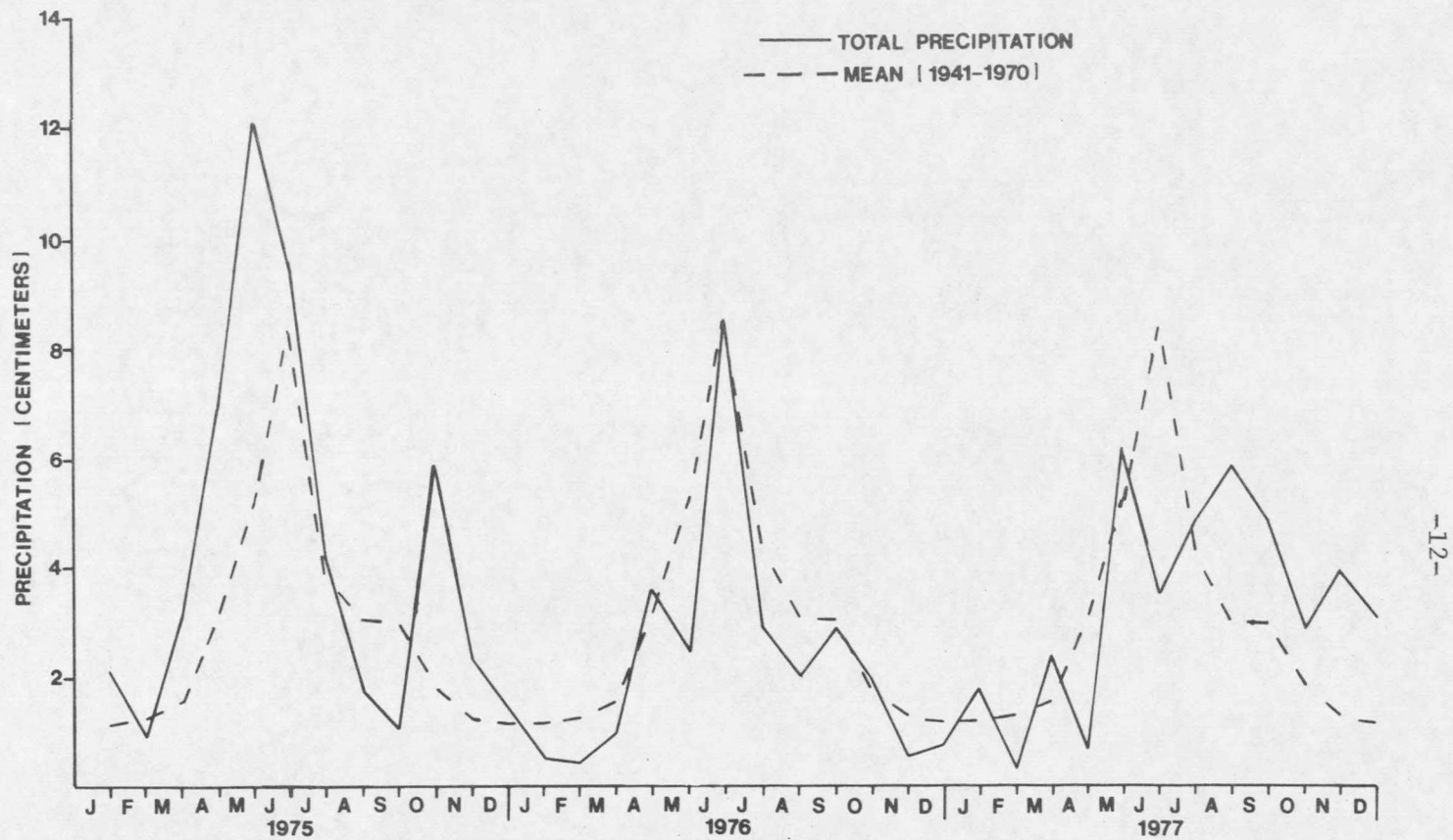


Figure 3. Total monthly precipitation and 29 year mean recorded at Miles City FAA AP, 1975-1977.

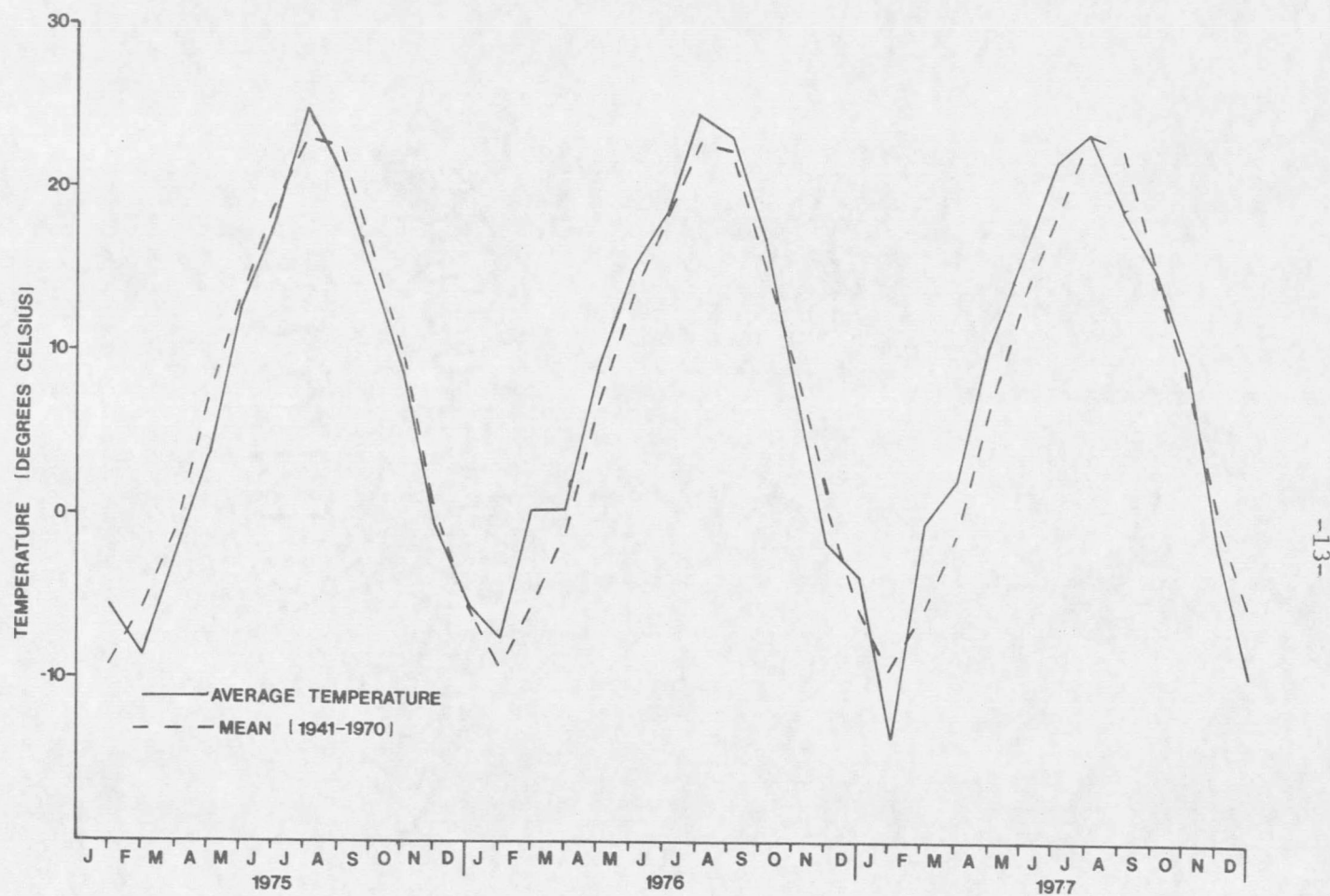


Figure 4. Average monthly temperature and 29 year mean recorded at Miles City FAA AP, 1975-1977.

The physical characteristics of the stockponds in Subunit II are presented in Tables 2, 3 and 4. Surface area and shoreline length of the stockponds in Subunit II decreased overall from 1976 to 1977 (Table 2). Two reservoirs became completely dry in 1977, while the most significant decrease in surface acreage, occurring in ponds retaining some water, was in Pond 6 which declined 53%.

Reservoirs with islands in Subunit II are listed in Table 3. Fourteen islands were present in 1976, while only six were found in 1977. Ponds 4 and 13, because of their stable water levels, provided secure island situations. Islands, in the remaining ponds with one exception, were connected to the mainland in spring of 1977. Pond 11 had an island, a small mound, only at low water levels. These conditions created insecure island nesting sites in 1977. For example, broods were banded on Ponds 6, 11, 13, and 14 in 1976. Islands in both Pond 6 and Pond 14 had evidence of nesting activity. In 1977, these same islands were attached to the mainland and no indications of nesting activity were found. Pond 6 still received brood use, but the nest was never located.

Shoreline slope on individual reservoirs showed considerable variation (Table 4). Several reservoirs had large amounts of >45 degree slope, most of which was represented by high, abrupt banks. Observations in 1976 and 1977, showed a decided preference by broods for feeding in areas of <30 degrees shoreline slope. Similar observa-

Table 2. Surface area, shoreline length and percent change within each reservoir in Subunit II, 1976-77.

Location	Surface Acreage - Hectares (Acres)			Shoreline Length - Meters		
	1976	1977	Percent Change	1976	1977	Percent Change
Pond 1 (T8N, R45E, S13)	1.83 (4.52)	1.41 (3.49)	-23	916.94	822.96	-10
Pond 2 (T8N, R45E, S14, NE1/4)	0.35 (0.86)	- - ¹	-100	396.24	- ¹	-100
Pond 3 (T8N, R45E, S14, NW1/4)	4.99 (12.34)	3.43 (8.48)	-31	1930.40	1325.88	-31
Pond 4 (T8N, R45E, S23)	1.74 (4.31)	1.76 (4.36)	+1	924.56	924.56	0
Pond 5 (T8N, R45E, S22)	- - ²	1.30 (3.21)		- ²	670.56	
Pond 6 (T8N, R45E, S16)	11.50 (28.41)	5.38 (13.29)	-53	2875.28	2219.96	-23
Pond 7 (T8N, R45E, S21)	- - ²	1.74 (4.29)		- ²	942.44	
Pond 8 (T8N, R45E, S17)	- - ²	0.06 (0.16)		- ²	104.24	
Pond 9 (T8N, R45E, S18)	2.34 (5.53)	1.68 (4.16)	-28	1026.16	904.24	-12
Pond 10 (T8N, R44E, S1)	0.85 (2.10)	- - ¹	-100	530.96	- ¹	-100
Pond 11 (T8N, R44E, S13)	5.52 (13.65)	4.15 (10.25)	-25	1925.32	1493.52	-22
Pond 12 (T8N, R44E, S12)	5.35 (13.22)	4.66 (11.51)	-13	2197.10	2095.50	-5
Pond 13 (T8N, R44E, S10-11)	16.98 (41.96)	19.68 (48.64)	+18	4636.58	4693.92	+1
Pond 14 (T8N, R44E, S2)	2.01 (4.96)	1.52 (3.76)	-24	1109.99	912.37	-18
Pond 15 (T9N, R44E, S33)	1.13 (2.78)	0.91 (2.25)	-19	769.62	721.36	-6
Pond 16 (T8N, R44E, S3)	0.99 (2.44)	0.74 (1.85)	-25	848.36	690.88	-19

¹ Pond dry.

² Measurements unavailable.

Table 3. Number of islands and nests within reservoirs in Subunit II, 1976-77.

Location	Islands		Nests	
	1976	1977	1976	1977
Pond 1 (T8N, R45E, S13)	0	0	0	0
Pond 2 (T8N, R45E, S12, NE $\frac{1}{4}$)	0	0	0	0
Pond 3 (T8N, R45E, S12, NW $\frac{1}{4}$)	1	0	0	1
Pond 4 (T8N, R45E, S23)	2	2	0	0
Pond 5 (T8N, R45E, S22)	- ^a	0	- ^a	0
Pond 6 (T8N, R45E, S16)	1	0	1	1 ^b
Pond 7 (T8N, R45E, S21)	- ^a	0	- ^a	0
Pond 8 (T8N, R45E, S17)	- ^a	0	- ^a	0
Pond 9 (T8N, R45E, S18)	1	0	0	0
Pond 10 (T8N, R44E, S1)	0	0	0	0
Pond 11 (T8N, R44E, S13)	0	1	1 ^b	0
Pond 12 (T8N, R44E, S12)	3	1	0	0
Pond 13 (T8N, R44E, S10-11)	3	2	1 ^b	1 ^b
Pond 14 (T8N, R44E, S2)	2	0	1	0
Pond 15 (T9N, R44E, S33)	0	0	0	0
Pond 16 (T8N, R44E, S3)	1	0	0	0

^aMeasurements unavailable.

^bNest not located on island.

Table 4. Percent of shoreline slope in 5 degree intervals and average slope on reservoirs within Subunit II, 1977.¹

Location	Shoreline Slope - Percent										Average Slope - Percent
	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	>45	
Pond 1 (T8N, R45E, S13)	23	0	4	2	29	23	14	6	0	0	21.075
Pond 2 (T8N, R45E, S14, NE1/4)	5	32	7	11	10	6	5	2	3	18	25.025
Pond 3 (T8N, R45E, S14, NW1/4)	3	6	8	3	7	8	5	2	2	56	46.850
Pond 4 (T8N, R45E, S23)	2	18	4	11	8	24	17	1	3	11	26.825
Pond 5 (T8N, R45E, S22)	0	16	19	11	4	5	14	3	2	26	31.850
Pond 6 (T8N, R45E, S16)	10	19	9	7	9	2	1	7	3	33	33.100
Pond 7 (T8N, R45E, S21)	1	9	40	7	5	5	6	5	3	20	28.025
Pond 8 (T8N, R45E, S17)	11	11	28	18	16	17	0	0	0	0	16.025
Pond 9 (T8N, R45E, S18)	3	15	48	13	2	2	1	2	12	2	18.000
Pond 10 (T8N, R44E, S1)	4	22	17	3	2	1	1	7	1	41	36.175
Pond 11 (T8N, R44E, S13)	4	6	25	9	16	8	5	2	11	14	27.550
Pond 12 (T8N, R44E, S12)	0.3	20	14	5	16	19	11	0.8	1	12	25.358
Pond 13 (T8N, R44E, S10-11)	2	20	18	1	6	4	2	4	4	39	36.600
Pond 14 (T8N, R44E, S2)	4	7	55	14	3	5	2	0.7	0	9	18.988
Pond 15 (T9N, R44E, S33)	3	10	25	6	5	7	3	4	1	36	35.250
Pond 16 (T8N, R44E, S3)	2	13	15	5	2	4	3	2	2	53	43.675

¹ Slope was approximated assuming normal water levels within reservoirs.

tions were made by McCarthy (1973).

Multiple regression tests were used to compare nesting use on reservoirs with numbers of islands, surface acreage, shoreline length, average shoreline slope, and each shoreline vegetation type. No significant correlations were found between nesting use and number of islands, average shoreline slope, or shoreline vegetation types. Significant correlations existed between nesting activity and surface acreage and shoreline length. However, the sample size was small and this significance may not be real. T-tests comparing reservoirs with nests vs. reservoirs without showed significant differences only in shoreline length. Numbers of islands, surface acreage, average slope, and shoreline vegetation types were not significantly different between the two types. McCarthy (1973), after comparing similar data with nesting use, concluded that the presence of an island was a major influence in the selection of a reservoir for nesting. Data, from this study, do not clearly support his conclusion since existing islands in Subunit II were not consistently used by nesting geese. However, the contrasting water levels between 1976 and 1977 and resulting change in security of existing islands, may have had a masking effect.

The percent coverage by the various shoreline vegetation types are listed in Table 5. Sagebrush-grassland was the most common vegetation type. Intensive grazing, within Subunit II, kept

Table 5. Percentage of shoreline in various vegetational types on reservoirs in Subunit II, 1977.

Location	Vegetation Types			
	Wooded	Denuded	Marsh-Meadow	Sagebrush-Grassland
Pond 1 (T8N, R45E, S13)	Tr ¹	15	26	59
Pond 2 (T8N, R45E, S12, NE $\frac{1}{4}$)	- ²	- ²	50	50
Pond 3 (T8N, R45E, S12, NW $\frac{1}{4}$)	- ²	- ²	19	81
Pond 4 (T8N, R45E, S23)	30	- ²	10	60
Pond 5 (T8N, R45E, S22)	- ²	9	36	56
Pond 6 (T8N, R45E, S16)	- ²	8	49	43
Pond 7 (T8N, R45E, S21)	- ²	85	15	- ²
Pond 8 (T8N, R45E, S17)	- ²	50	- ²	50
Pond 9 (T8N, R45E, S18)	- ²	19	58	24
Pond 10 (T8N, R44E, S1)	- ²	41	- ²	49
Pond 11 (T8N, R44E, S13)	- ²	29	16	55
Pond 12 (T8N, R44E, S12)	- ²	38	18	44
Pond 13 (T8N, R44E, S10-11)	- ²	10	21	69
Pond 14 (T8N, R44E, S2)	Tr ¹	28	28	45
Pond 15 (T8N, R44E, S33)	- ²	26	8	66
Pond 16 (T8N, R44E, S3)	Tr ¹	9	31	60

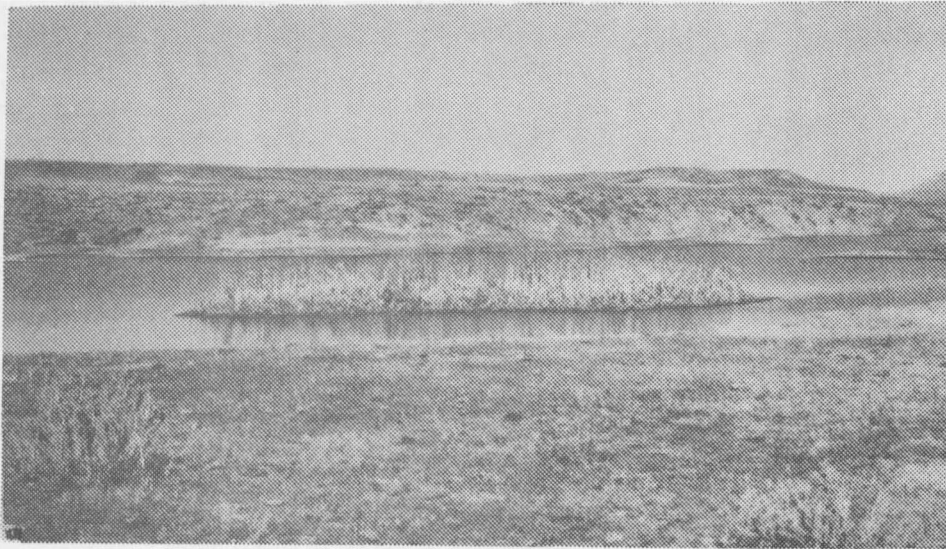
¹Trace

²Vegetational type not represented.

riparian vegetative types at a minimum. This was especially true during 1977 when lowering water levels allowed cattle to graze on succulent emergent and submergent vegetation. Islands were heavily grazed, once cattle reached them. Figure 5 shows an island in 1976 prior to cattle grazing and the same island in 1977 following grazing. Intensive use by cattle around reservoirs was amplified in 1977 because of limited water supplies. Gjersing (1975) and Evan and Kerbs (1977) both stated that adequate vegetation for nesting and brood use will develop under rest-rotation grazing systems. During this study, Subunit II was continuously grazed.

Average canopy coverage and percent frequency of occurrence of various plant taxa at goose and gosling feeding areas are listed in Table 6. All three areas (Pond 3, 6, 13) have grass and grass-like plants and forbs in abundance. Bue et al. (1952) observed that shoreline cover was influenced by cattle grazing intensity. Little use by broods was observed along sections of the shoreline most heavily utilized by cattle. Beside grazing on grasses and forbs in these situations, geese also utilized insects, especially grasshoppers.

Within Subunit II and the period of this study, grass shorelines capable of providing secure feeding areas for goose broods appeared to be decreasing. This condition is probably related to poor environmental conditions, coupled with intensive grazing.



1976



1977

Figure 5. Island cover change (Pond 14) resulting from low water levels and subsequent intensive grazing.

Table 6. Average canopy coverage and percent frequency of taxa from 2x5 dm plots on major feeding sites within Subunit II, 1977.

	Lower Sage Creek Reservoir (Pond 3) (T8N, R45E, S14)		Upper Sage Creek Reservoir (Pond 6) (T8N, R45E, S16)		Coal Creek Reservoir (Pond 13) (T8N, R44E, S10-11)	
	Average Canopy Coverage	Percent Frequency	Average Canopy Coverage	Percent Frequency	Average Canopy Coverage	Percent Frequency
<u>GRASS AND GRASS-LIKE PLANTS</u>						
<i>Agropyron smithii</i>	0.4	3				
<i>Agropyron spicatum</i>					9.4	60
<i>Bouteloua gracilis</i>					2.3	7
<i>Bromus japonicus</i>					0.2	8
<i>Carex</i> spp.			0.8	14	0.2	7
<i>Distichlis stricta</i>	17.9	68	0.66	3		
<i>Eleocharis palustris</i>	9.9	38	1.1	11	8.1	43
<i>Eleocharis</i> spp.	0.4	3	1.2	13		
<i>Hordeum jubatum</i>	9.1	60	24.8	98	5.7	57
<i>Poa</i> spp.					2.0	10
<i>Scirpus americanus</i>	2.5	38	0.22	3	0.5	15
<u>FORBS</u>						
<i>Agoseris glauca</i>			0.33	1	1.0	13
<i>Artemisia frigida</i>					0.04	2
<i>Chenopodium glaucum</i>			1.8	26		
<i>Grindelia squarrosa</i>	0.9	13	0.06	3	6.8	62
<i>Melilotus officinalis</i>					0.3	3
<i>Polygonum aviculare</i>			3.00	33		
<i>Ranunculus glaberrimus</i>	0.06	3	0.13	5	1.5	5
<i>Taraxicum officinale</i>			0.09	4	4.8	35
Unknown forbs	0.06	3	1.4	20	1.1	28
<u>SHRUBS</u>						
<i>Artemisia cana</i>					0.7	10
<i>Artemisia tridentata</i>			0.19	1		
<u>LITTER</u>	19.1	93	8.0	43	17.7	78
<u>BARE GROUND</u>	13.0	65	41.72	89	17.8	78

Banding

Two-hundred seventy five and 211 geese were neck-banded in 1976 and 1977, respectively. Ninety-two geese or 33% were banded on the study area in 1976, while only 36 (17%) were banded in 1977 (Appendix Table 11). The green neck bands with white lettering used in 1976 were discontinued because the lettering became discolored making the bands very difficult to read (Hinz, 1976). Increased observability was obtained from yellow bands with black lettering.

Chronology of the Nesting Season

Paired geese and non-specific groups of geese were well dispersed in the area by 1 April, 1977. The non-specific groups probably included migratory family units and resident non-breeders from family unit breakups. Martin (1964) and Sherwood (1967) documented that family units remain intact through the following spring. Raveling (1969) and Sherwood (1967) suggested that progeny, both yearling and some two-year olds, may return to their parent and brood once the molt is completed. This association then lasts through the winter until the return to the breeding grounds.

Figure 6 shows the number of groups, pairs, and the total number of geese within Subunit I at approximately weekly intervals from 1 April to 31 May, 1977. Group size averaged 8.2, with a range of 3-21. Single geese could not always be used as evidence of a breeding pair on a specific reservoir. Twice during the breeding season, nesting

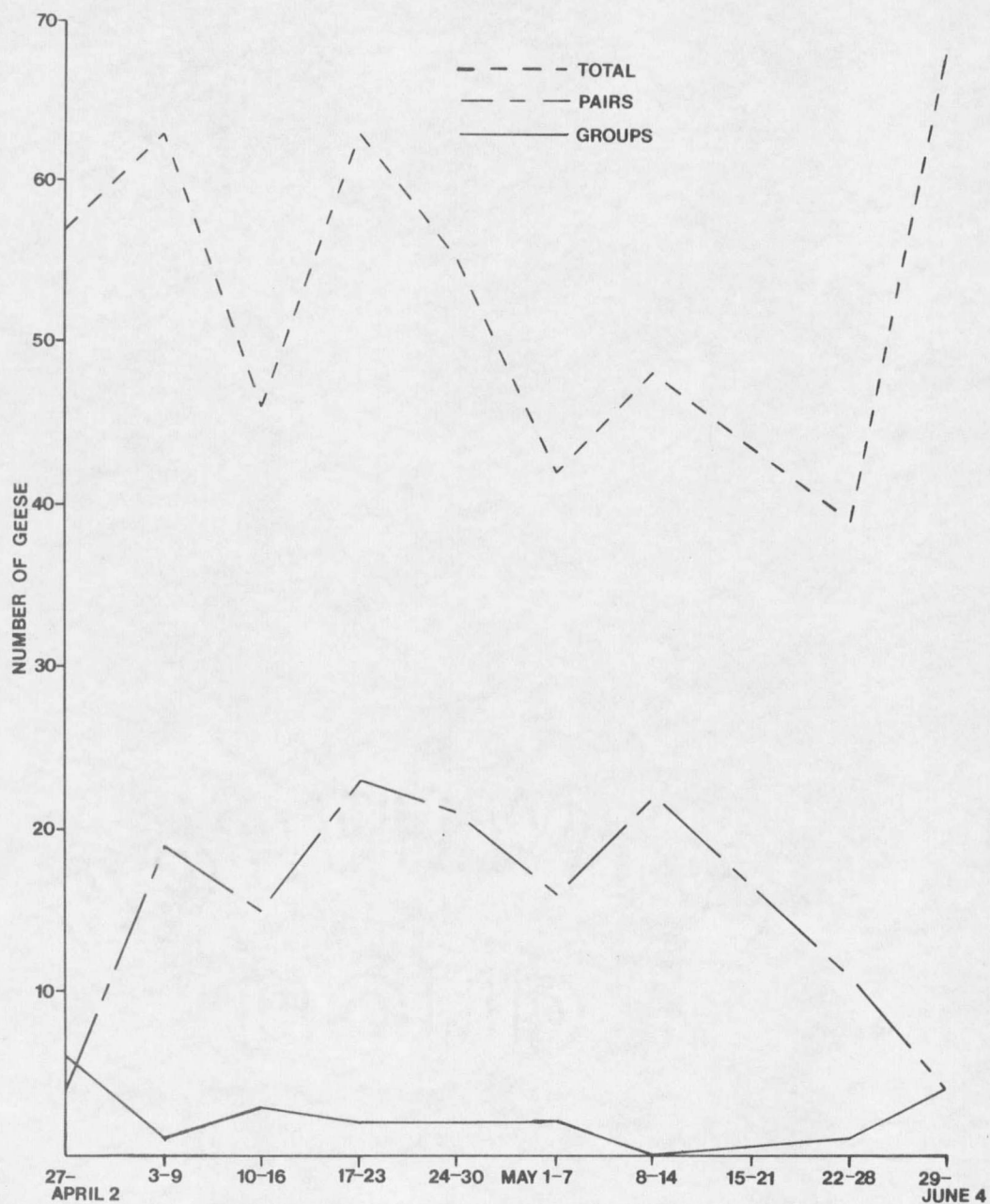


Figure 6. Aerial censuses of groups, pairs, and total numbers of Canada geese within Subunit I, 27 March-4 June, 1977.

hens were located on reservoirs with no mate in attendance. The goose when flushed, would join her mate, who was usually located about 1 km away on another reservoir. In both cases, the nesting reservoirs were 1-2 hectares (2-3 acres) and contained islands. The presence of islands probably attracted the nesting effort (Atwater 1959, McCarthy 1973). However, the lack of intense competition could have resulted in unusually large territories including more than one pond. Martin (1964) stated that territory size was partially regulated by density of the breeding pairs. The highest pair count was 23, providing a calculated density of approximately 10 pairs per square kilometer (3.8 pairs per section). Territorial behavior was observed only once during the spring season. This occurred at Ballensky's reservoir (T10N, R45E, S33) just before nesting began. The breeding pair that had nested on the island in 1976 was displaced by another pair in 1977. The displaced pair nested along the shoreline about 46 meters (50 yards), and out of sight from the nest island. Two other reservoirs within Subunit I supported two nesting pairs. In both cases, pairs could see each from the nest, but no conflict was ever observed.

The first evidence of nesting was observed on Ballensky's reservoir on 8 April, 1977. Figure 7 shows the distribution of reservoirs used for nesting. The peak of the onset of incubation, determined by backdating of 15 nests (Kossack 1950), was between 17-23 April (Fig. 8). It appeared that early nests were more vulnerable to destruction than

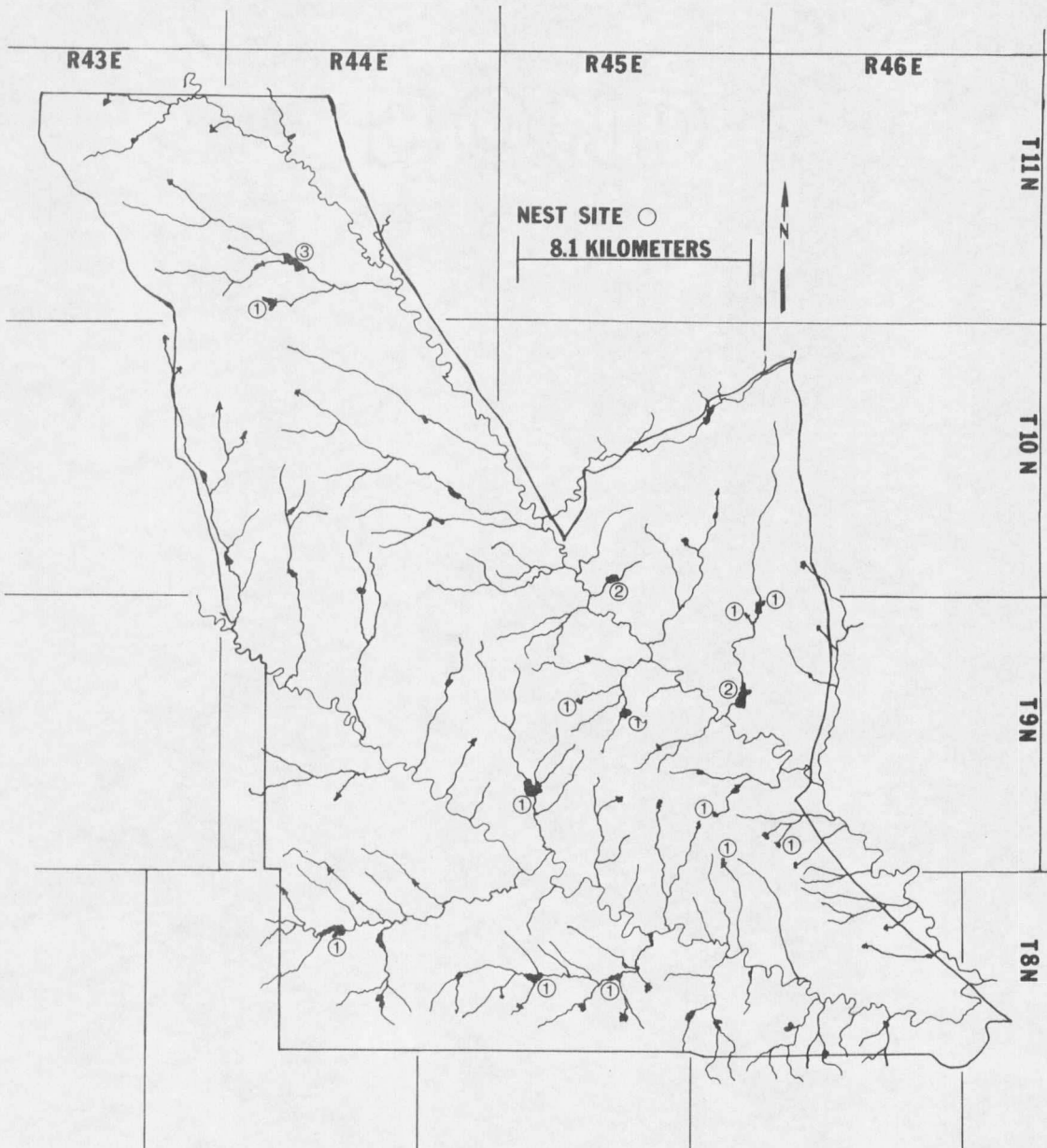


Figure 7. Location of nest sites and number of nests per site in Subunit I, 1977.

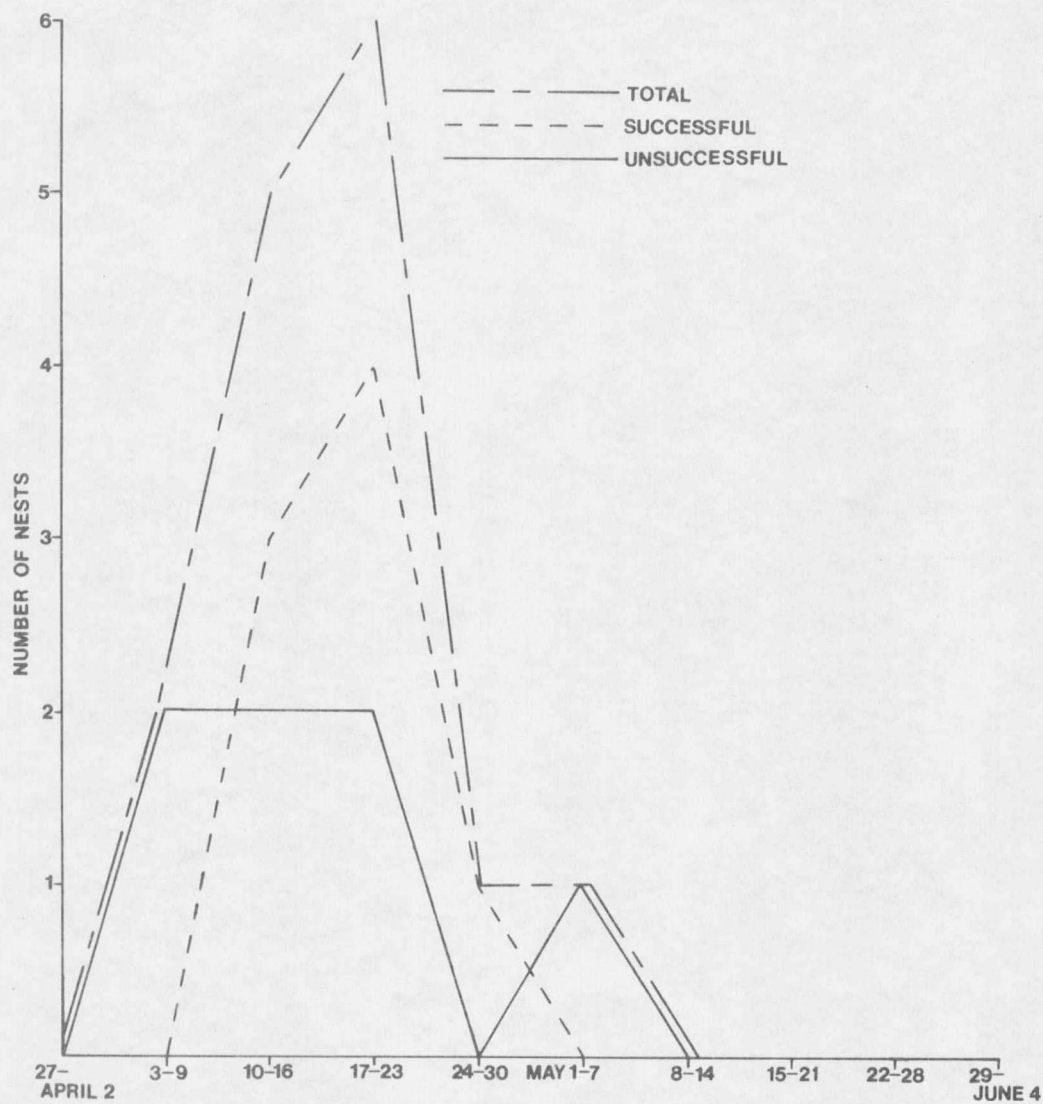


Figure 8. Total number of nests and nest success in Subunit I, 27 March-4 June, 1977.

nests started during the middle of the nesting period. As geese return in the spring, their presence or territorial activities may attract predators. This would account for the predation at the beginning of the nesting period. The lack of secure nesting sites on suitable reservoirs during 1977 probably caused marginal sites to be selected resulting in increased predation throughout the nesting period.

Most of the successful nests hatched within a two-week period from 8 May - 21 May. Successful nests were defined as nests where at least one gosling was led away from the nest site.

The physical locations of the nest sites are summarized in Table 7. Even permanent islands, that at normal water levels are quite secure, became marginal nesting sites. Water levels between the shore and these islands were reduced and ranged from 1/3 to 1-1/4 meters (1-4 feet) in depth.

Table 7. Physical location of nest sites in Subunit I, 1977.

Sites	Number of Nests	Percent of Total
Island (Permanent)	3	16
Island (Temporary)	3	16
Shoreline	4	21
Peninsula	7	37
Unknown	2	10
Total	19	100

Peninsulas were the most commonly used nesting site. These sites averaged 3.3 m (10.7 ft) from water and 3.2 m (10.4 ft) above water. Of the nests found in these locations, 57% were successful.

Thirty-two percent of the nests were located on islands. Distances from and above water were calculated for temporary islands assuming normal water levels in the reservoir. Combined with data from permanent islands, nesting sites averaged 6.0 m (19.8 ft) from and 1 m (3.1 ft) above water. Only one of the three nests or 34% were successful in the permanent and temporary island types, respectively.

The shoreline nests averaged 5.9 m (19.4 ft) from and 1.9 m (6.2 ft) above water. One of these nests was found in a small stand of cattails immediately above the waterline. One of four nests was successful.

Two of the nest sites were not found. In both cases, pairs with broods appeared on reservoirs where no indication of nesting was observed. Both sites were probably located well away from the reservoirs in the sagebrush-grassland.

Reservoirs in Subunit I were constructed to maximize water storage and thus did not include the building of islands. Those islands which occurred were small rock or dirt mounds which were formed incidental to construction or were natural high points that became surrounded by water as the pond was filled.

Cover types utilized for nesting are listed in Table 8. These cover types describe the vegetational types found immediately surrounding the nest site and do not necessarily reflect the materials used in building the nest.

Table 8. Cover Types Utilized for Nesting by Geese in Subunit I, 1977.

Cover type	Number of Nests	Percent
Cattail	1	5
Grassland	7	37
Big Sage	1	5
Sagebrush-grassland	5	26
Rock	1	5
Bare Ground	2	11
Unknown	2	11
Total	19	100

Several authors (Miller and Collins 1953, Naylor 1953, Geis 1956, Hammond and Mann 1956) have noted that vegetational cover seems of little importance in nest site selection and that good visibility from the nest is more important. Most nesting sites found in this study support this. The success rates for exposed sites (bare ground, rock, grassland, cattail) and concealed sites (sagebrush-grassland, big sagebrush, unknown) were compared, testing visibility versus vegetational cover. Thirty-five percent of concealed sites were successful compared to 65% of exposed sites. However, if an island nest site was selected without regard to vegetational cover or

visibility, such sites should be excluded from this comparison. Then, the success rates increase in concealed sites to 36% and decrease in exposed sites to 64%.

Nine of nineteen nests or 48% were successful in Subunit I. No direct evidence of desertion was found during the nesting period. Although nests were visited only once a week, nests that were deserted and then preyed upon would have been recorded as destroyed nests. However, using established criteria (Munro 1960, Hanson and Browning 1959), all unsuccessful nests were probably destroyed and then deserted. By using criteria reported by Sooter (1946) and Rearden (1951), four of ten nests were lost to coyotes (*Canis latrans*). The predator could not be identified for the remaining six nests. A bull snake (*Pituophis melanoleucus*) was found in the near vicinity at two different nests, but could not be classified as the predator responsible. At two of the coyote-destroyed nests, the incubating goose was also destroyed. It may be that coyotes working the edges of reservoirs in search of food, attempted to kill the hen and the nest became a secondary target.

No evidence of renesting was found in this study. Atwater (1959) concluded that only a small percentage of Canada geese renest. The actual percentage of two and three-year old geese nesting for the first time on the area was unknown. No known yearling or two-year old birds nested on the area. Competition, between adult pairs for marginal nesting sites, probably excluded nesting by two year olds. Further-

more, lack of attractive nest sites during the nesting period apparently resulted in no renesting by unsuccessful nesting pairs (Surrendi, 1970).

The clutch size of all located nests is listed in Figure 9. The average clutch size for the 15 nests was 5.53 eggs/nest.

From a total of 83 eggs laid in 1977, 33 goslings or approximately 40% were led from the nests. Of these 33 goslings, only 15 or 18% survived to flight stage. This success rate does not compare favorably with a success rate of 74% which was approximated from observations and banding attempts in 1976 (Table 9).

In 1976, broods were banded on the area. Little effort was expended observing specific broods, because of banding efforts in other areas, particularly on the lower Yellowstone River. However, limited observations suggest that few if any movements occurred between ponds, probably because of the optimum environmental conditions existing that year.

Extensive brood movements were observed in 1977. By late May and June, reservoir water levels were very low. Figures 10 and 11 illustrate two locations where extensive movement occurred. Solid lines reflect movement documented through the use of neck-banded geese while dashed lines show those based on upon size and age of known broods within the immediate area. Water was released and flooded the area between the reservoirs (Figure 11). This may have stimulated movement

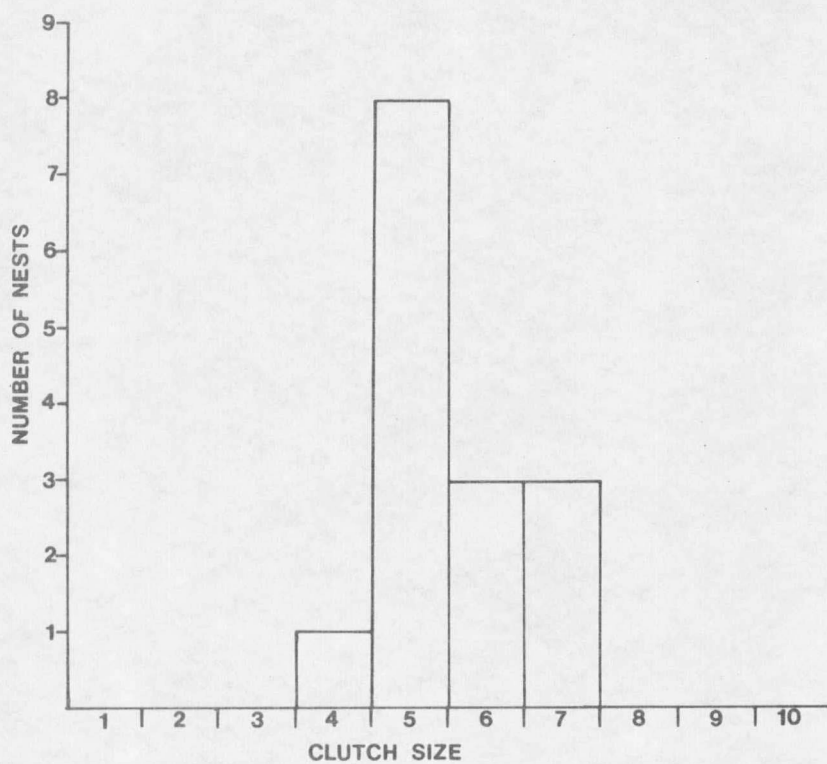


Figure 9. Frequency distribution of clutch sizes from 15 nests within Subunit I, 1977.

Table 9. Summary of nesting activities within Subunit I, 1976.

Location	No. of Goslings Banded	Probable No. of Nests
1 Ballensky's Res. (T10N, R45E, S28)	6 ₁	2
2 Brewer's Pond (T9N, R45E, S25)	1	1
3 Coal Ck. Res. (T8N, R44E, S10-11)	6	1
4 Coal Ck. Res. (T8N, R44E, S13)	4	1
5 Hook Ranch Pond (T10N, R44E, S24)	6	1
6 McRae's Reservoir (T11N, R44E, S29)	16	3
7 Sage Ck. Res. (T8N, R45E, S16)	2	1
8 Venn's Lower Res. (T9N, R45E, S13)	7 ₂	2
9 Venn's Upper Res. (T9N, R45E, S1)	5	1
Total	<u>53</u>	<u>13</u>

¹Two banding trips - 6/26/76 and 7/13/76.

²Two banding trips - 7/6/76 and 7/8/76.

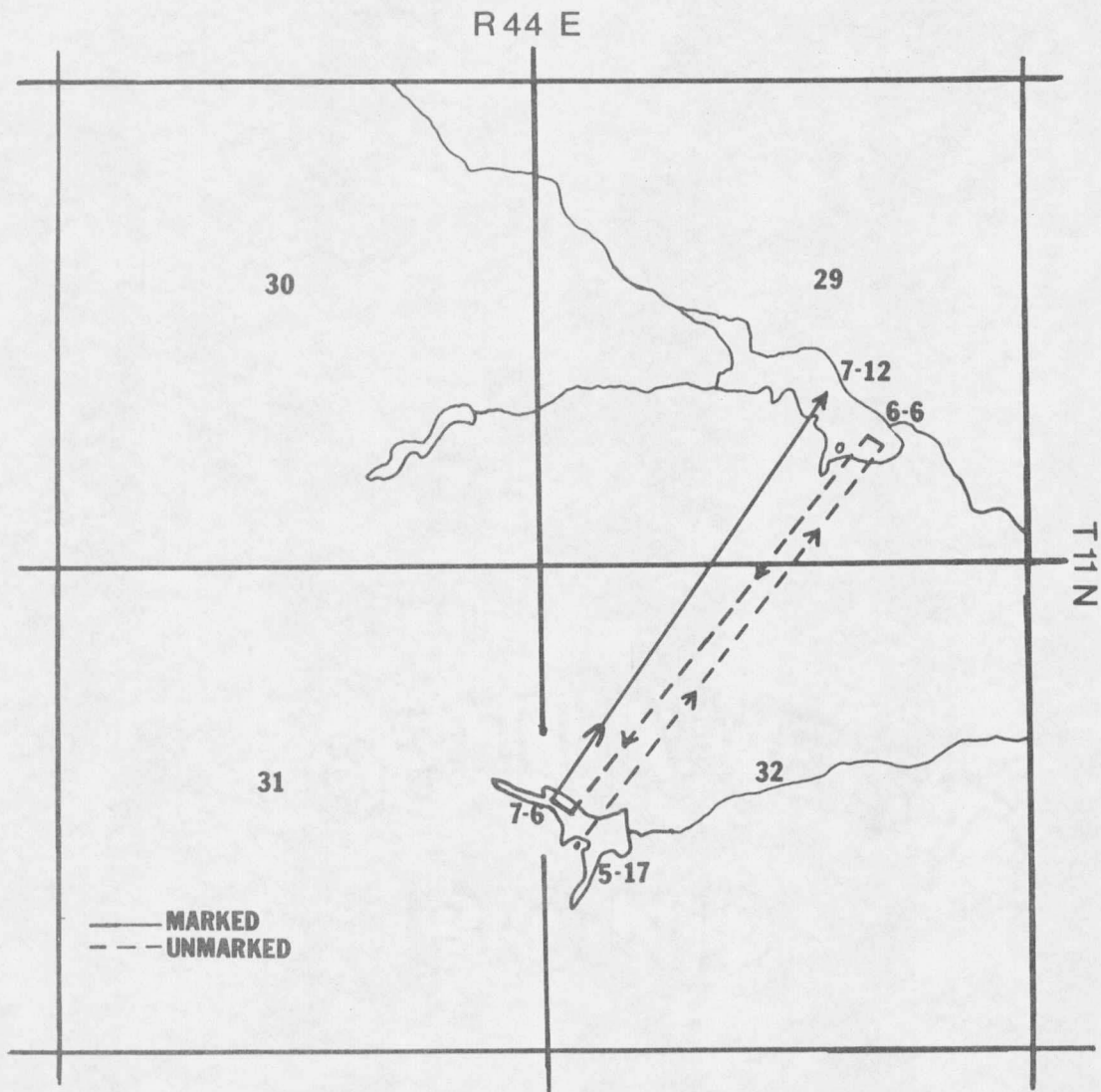


Figure 10. Map showing movement of a brood before and after marking between two reservoirs within Subunit I, 1977.

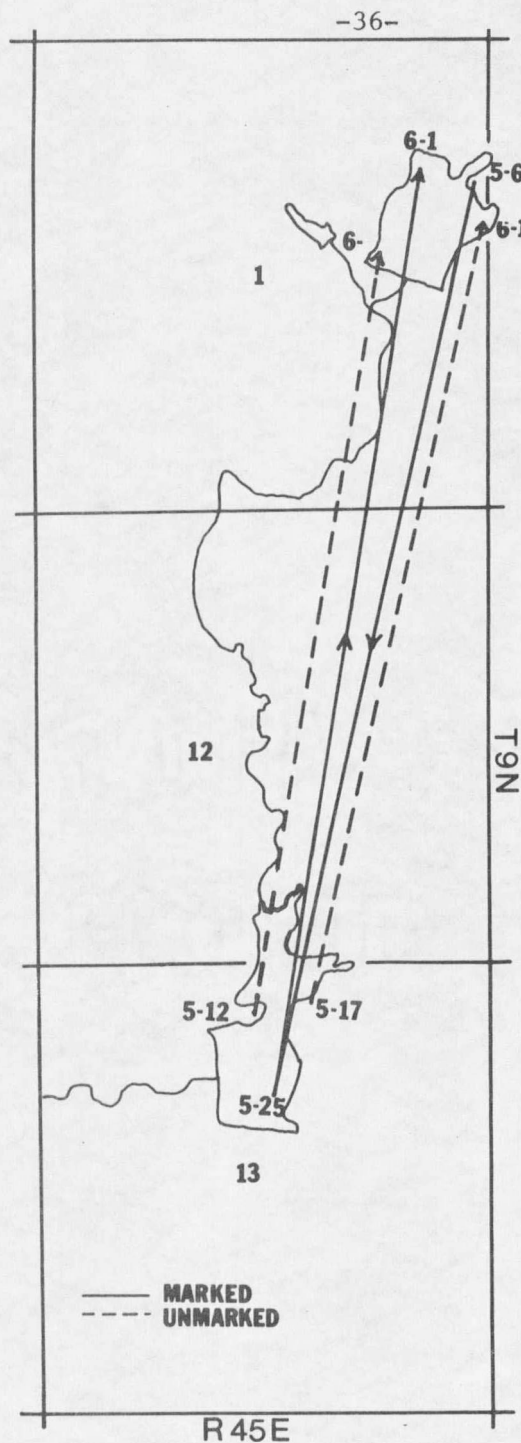


Figure 11. Map showing movement of three broods between Venn's lower and upper reservoirs within Subunit I, 1977.

from the upper to the lower reservoir.

Extensive overland movements appeared to result in high gosling mortality. At one reservoir, the gander and hen were observed leading the goslings (web-tagged) away from the water. This particular family was not seen again, even though most goslings in the area were later trapped and banded. McCarthy (1973) reported increased mortality of broods when overland movement made young vulnerable to predators. This was suggested in this study by the loss of 18 of 33 goslings prior to flight stage.

Spring Observations

Breeding Pairs

By the time of the first aerial count on 1 April, 1977, geese were moving into and through the study area (Fig. 6). Several marked adult females returned to the study area in 1977. Two adult females returned to the same reservoir on which they had nested successfully in 1976. Two other females, one adult and one sub-adult, were banded on a single reservoir in 1976. In 1977, the adult was observed on Sage Creek Reservoir (T8N, R45E, S16) with a brood of two goslings, although her nest was not located. The sub-adult nested unsuccessfully on a small pond (T9N, R45E, S16, SE1/4) about 7 miles away.

The only banded male observed as a member of a nesting pair in Subunit I was AR20. This goose was banded as a juvenile bird on the Yellowstone River, west of Terry, in 1975. The nest of this pair was

predated.

Eight adult geese (5 males, 3 females), trapped in association with broods in Subunit I in 1976, were not observed in a nesting effort in 1977. Five (4 males, 1 female) not observed and the remaining three (1 male, 2 females) were observed, but displayed no activities typical of a nesting effort.

One possible reason for the lack of reobservations of adult geese may be the loss of the collar, although other studies (Ballou and Martin 1964, Sherwood 1966) have indicated a high retention rate for these markers. Hinz (1977) attributed neck band loss to poor banding of the adhesive. However, three neck bands were found on loafing sites which suggested the bands were removed during preening activities. Insufficient data were available to permit analysis of band loss differences between age groups.

Another possibility for the low return rate of marked adults to Subunit I may be the unreported hunter harvest of these birds (Alwood and Geis 1960, Martin 1964) lessening the potential return by approximately one-half. However, Hinz (1977) felt the presence of a neck band would serve as an additional incentive for the hunter to report his kill.

Nonbreeders

Nonbreeding geese were first observed on the study area on 19 April, 1977. Banded yearlings had been observed earlier along the

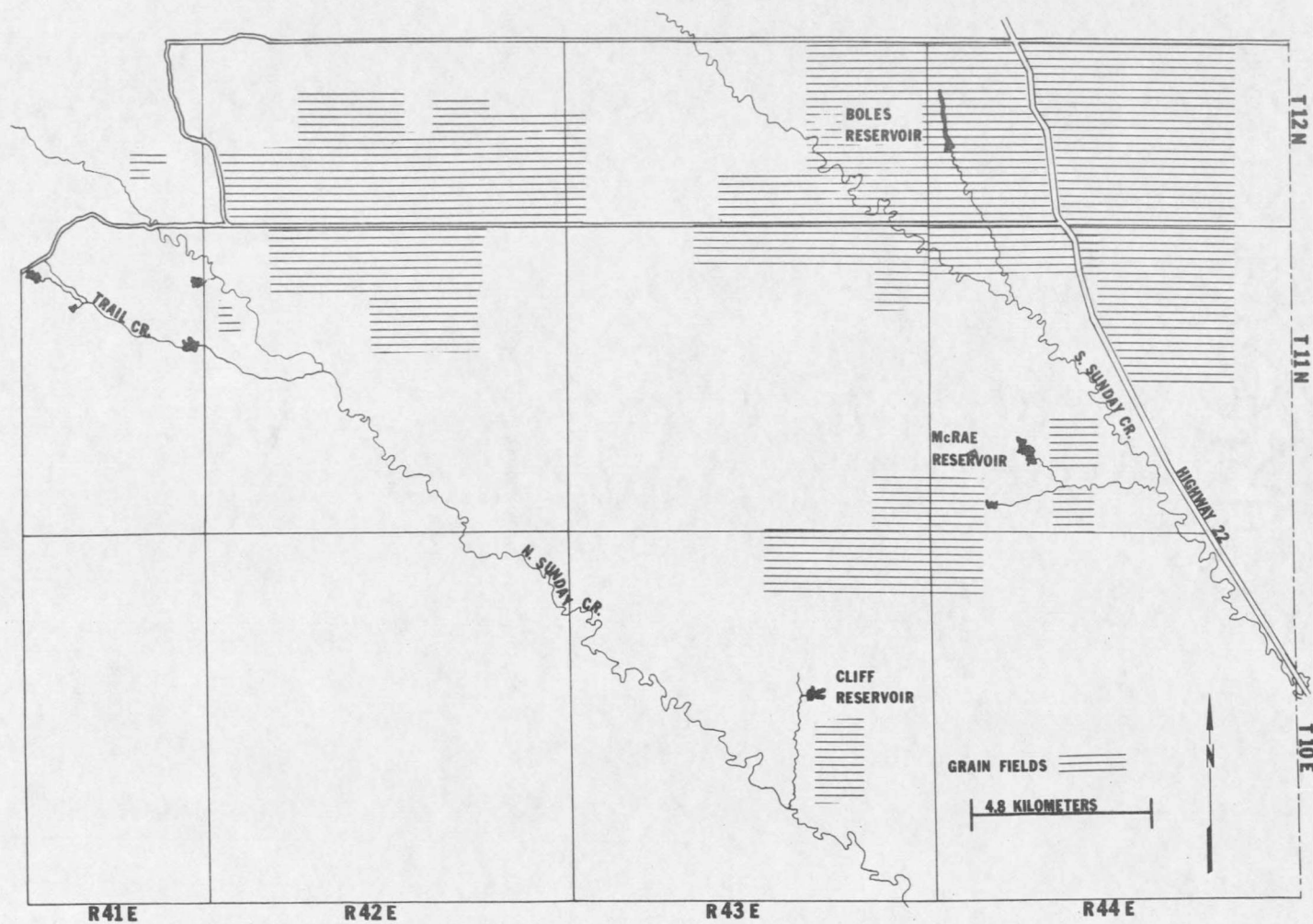
Yellowstone River at Rosebud where they were seen loafing along the river and feeding in disced corn (*Zea mays*) fields. Hinz (1977) reported high numbers of geese, which he believed to represent nonbreeders, in his Hathaway study area. By the end of May, nonbreeders had left the study area. This molt migration (Hanson, 1965) of nonbreeders has not been described for the geese of this area and the molting site is unknown.

By the end of August, the nonbreeders began to move back into the study area. The first nonbreeder was observed on the 27th of July, but the majority arrived from the 28th of August to the 3rd of September.

Field Feeding Movement: 15 July through 13 September, 1976

As various groups of geese completed the molt, a northerly movement onto and within the study area was observed. Most of this movement appears to involve geese from the Yellowstone River.

Two distinct areas were used by these geese, the Boles Reservoir and Trail Creek Reservoir Units (Fig. 12). Geese appeared to concentrate in these areas because of the juxtaposition of large, flat wheat (*Triticum aestivum*) fields and large reservoirs (MacLennan, 1973). Intensive ground and aerial counts were initiated on these two units about mid-July, 1976 and late July, 1977. Numbers of geese were largely determined from aerial counts, supplemented by ground



-40-

Figure 12. Map showing Trail Creek Reservoir and Boles Reservoir Units and existing grain fields.

verification.

Geese were first observed on Boles Reservoir on 15 July. Most of these birds were resident to the immediate area (Fig. 13). Numbers of geese increased through 30 July. Most of this increase was believed to involve geese migrating north from the Yellowstone River. However, only two neck-bands were observed to definitely support this. During the next two weeks, declining numbers reflected a movement of resident geese southward in the study area and the initial return of some river geese. Geese migrating from the north began to enter the area near the end of August, again increasing the numbers on this unit. The decline in numbers at the end of September reflects the start of southward movements by migrant geese.

Geese were first observed on the Trail Creek Unit on 26 July, when 193 birds were present (Fig. 13). Observations of seventeen tagged birds verified the presence of river geese at this time. Numbers increased to 575 by 9 August, decreased to 69 by 30 August, and increased to 503 by 13 September. The numbers increased initially because of a northerly migration of river and resident geese and subsequently decreased as these birds moved south. At this time, increased use of reservoirs along the river became apparent. These reservoirs served as loafing sites, while geese feed in grain fields along the river. Numbers increased again in the Trail Creek Unit by 13 September as migrants began entering the study area from the north. Geese were

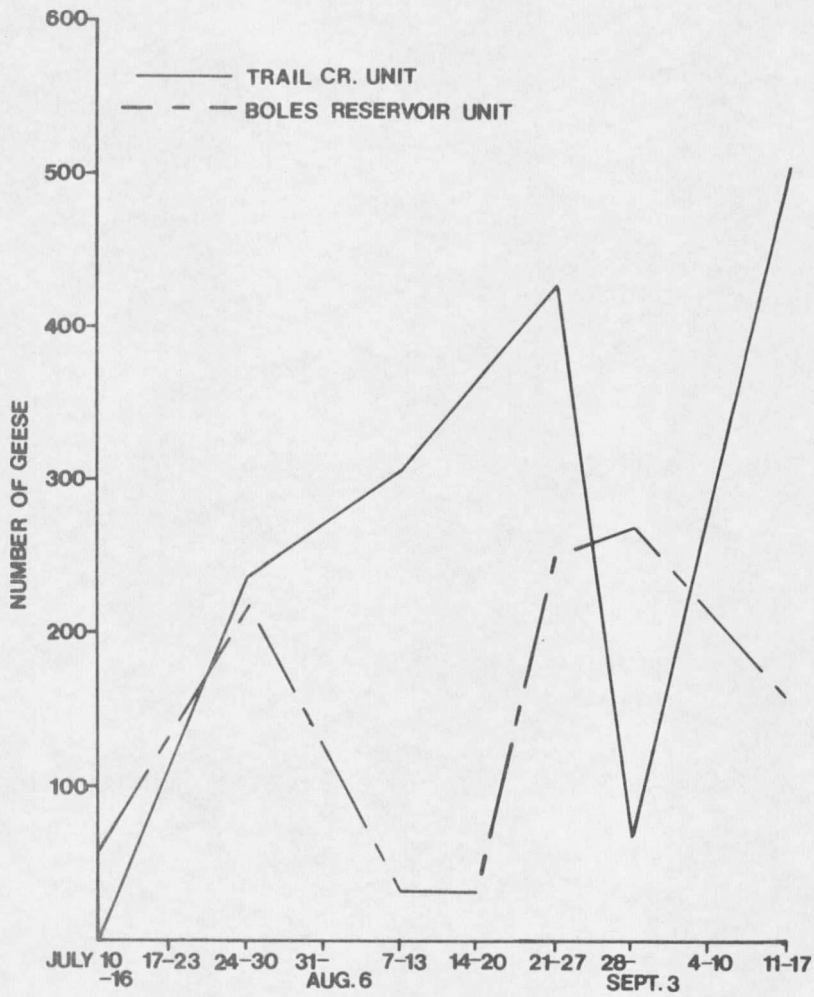


Figure 13. Aerial censuses in Boles Reservoir and Trail Creek Reservoir Units from 15 July-13 September, 1976.

still in this unit by the beginning of the waterfowl season (Martin 1977).

Field Feeding Movement: 26 July through 18 November, 1977

During the fall of 1976, approximately 30-40 sections of range-land was plowed and planted with winter wheat in the Boles Reservoir Unit. These fields greatly influenced the degree of use in this unit in 1977.

By 26 July, 245 geese were already in the Boles Reservoir Unit (Fig. 14). Numbers increased to 318 by 23 August and were decreasing by 12 September. By 18 October, numbers of geese were erratic and short periodic increases after this time undoubtedly involved migrant geese from the north. Large tracts of wheat lying immediately adjacent to Boles Reservoir concentrated geese on a sustained and higher level in 1977. By contrast, in 1976 the nearest fields were located 2-5 km (1-3 miles) away.

In the Trail Creek Reservoir Unit, 160 geese were observed by 26 July (Fig. 14). Numbers increased to 561 by 12 September and dropped to 0 by 27 September. Small increases after the end of September possibly reflected small groups of migrant geese which stopped on their way south. This early and rapid decrease is uncharacteristic for this unit (Martin 1977). Declining water levels within the study area may have made the reservoirs within the unit less attractive.

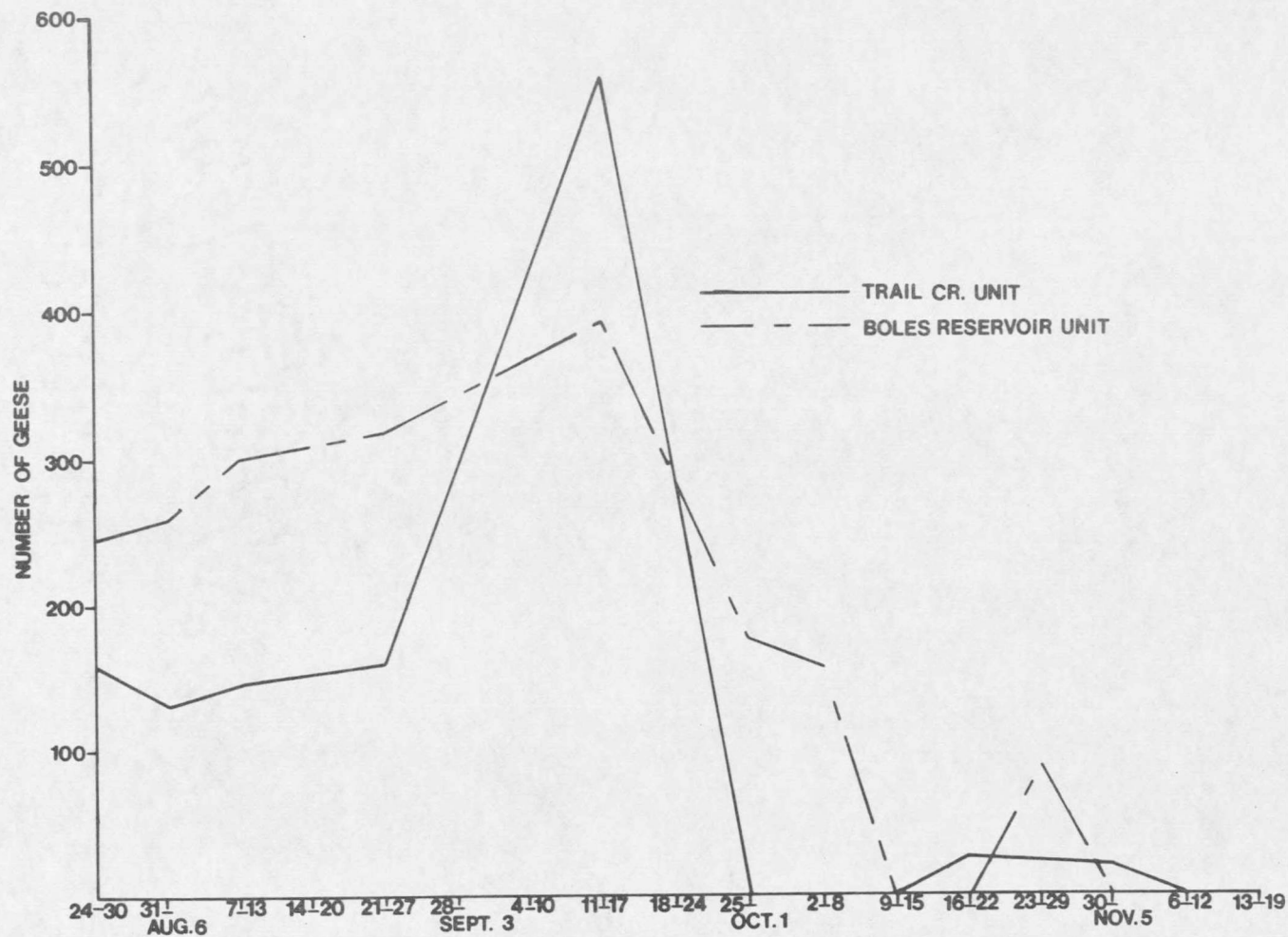


Figure 14. Aerial censuses in Boles Reservoir and Trail Creek Reservoir Units from 26 July-18 November, 1977.

During both years, utilization of wheat fields was observed only after the grain was harvested. Usually goose numbers increased in each unit before the grain was harvested at which time they would land in summer fallow fields and graze on young volunteer wheat plants and other green vegetation. A hail storm in the Boles Reservoir Unit in 1976, resulted in 80-100% crop damage. Geese concentrated in these fields before the harvest. As a result of the drought of 1977, wheat only grew about 5-6 inches high and could not be harvested by combine, so cattle were turned into the field about 1 July to utilize it. After having been grazed for a month, the average height of the plants was 3 inches, and the average number of wheat heads per Daubenmire frame was 0.6. Geese were never observed in these fields, although they were often seen in reservoirs in the immediate area. Fields harvested by combines which were utilized by geese averaged 5.4 heads per frame. These fields were also utilized by livestock after the harvest was completed, although their use at this time did not appear to seriously influence movement into or length of time spent in such fields by geese.

Migration

The Boles Reservoir and the Trail Creek Reservoir Units both are used by distinct populations of river geese. Table 10 shows the neck bands observed in these areas during 1976 and 1977 by banding location (nearest town), sex, and age at time of observation. It appears that certain areas of the river contribute to the northern feeding migration

Table 10. Neck bands observed in the Boles Reservoir Unit and the Trail Creek Reservoir Unit during 1976 and 1977.

Boles Reservoir Unit (1976)				Trail Creek Reservoir Unit (1976)			
Neck Bands	Age ^a	Sex	Banding Location	Neck Bands	Age ^a	Sex	Banding Location
AR20	2	M	Kinsey	AJ07	2	M	Rosebud
AR25	2	F	Kinsey	AE31	1	F	Big Horn
*AK05	1	M	Rosebud	AE32	1	M	Big Horn
AK68	1	F	Cliff Res.	AE33	1	F	Big Horn
AK71	1	M	Metal Shed Res.	AE34	1	F	Big Horn
AK72	1	F	Metal Shed Res.	AE49	1	M	Myers
AK73	4	F	Metal Shed Res.	AK03	1	M	Rosebud
AK74	4	M	Metal Shed Res.	AK04	1	F	Rosebud
AK75	1	M	Metal Shed Res.	*AK05	1	M	Rosebud
AK76	1	M	Metal Shed Res.	AK06	1	M	Rosebud
AK77	1	F	Metal Shed Res.	AK07	1	M	Rosebud
AK78	1	F	Metal Shed Res.	AK08	4	F	Rosebud
*AK79	1	M	McRae's Res.	AK09	1	M	Rosebud
AK82	1	F	McRae's Res.	AK11	1	F	Rosebud
*AK83	1	F	McRae's Res.	AK12	1	F	Rosebud
AK84	1	F	McRae's Res.	AK14	1	M	Rosebud
AK85	1	M	McRae's Res.	AK18	1	F	Rosebud
AK86	4	M	McRae's Res.	AK53	1	F	Upper Trail Ck. Res.
AK87	1	M	McRae's Res.	AK58	1	F	Upper Trail Ck. Res.
AK88	1	M	McRae's Res.	AK61	1	F	Upper Trail Ck. Res.
AK90	1	M	McRae's Res.	AK63	1	F	Upper Trail Ck. Res.
*AK91	1	M	McRae's Res.	AK65	1	F	Cliff Res.
AK94	1	M	McRae's Res.	*AK79	1	M	McRae's Res.
AF15	3	F	(T8N, R44E, S13)	*AK83	1	F	McRae's Res.
				*AK91	1	M	McRae's Res.
				AK92	1	F	McRae's Res.
				<u>1977</u>			
<u>1977</u>				AR02	4	F	Kinsey
AR20	3	M	Kinsey	AR57	4	F	Steiger Ck. Res.
				AR72	3	F	Kinsey

Table 10 (continued)

Boles Reservoir Unit (1977)				Trail Creek Reservoir Unit (1977)			
Neck Bands	Age ^a	Sex	Banding Location	Neck Bands	Age ^a	Sex	Banding Location
AJ20	3	M	Hathaway	AJ07	3	M	Rosebud
AK02	4	F	Ballensky's Res.	AJ12	3	F	Hathaway
AK65	2	F	Cliff Res.	AJ70	2	F	Myers
AK67	2	M	Cliff Res.	AJ81	2	F	Rosebud
AK76	2	M	Metal Shed Res.	AE29	2	F	Myers
AK78	2	F	Metal Shed Res.	AK01	4	M	Forsyth
AF05	4	F	Coal Ck. Res.	AK07	2	M	Forsyth
AF19	4	M	Venn's Upper Res.	AK08	4	F	Forsyth
AF23	2	F	Venn's Upper Res.	AK57	4	F	Upper Trail Ck. Res.
AF25	2	F	Witcher's Upper Res.	AF21	2	M	Venn's Upper Res.
AF29	2	F	Ballensky's Res.	MA29	1	F	Forsyth
MA05	1	F	Kinsey	MA30	1	F	Forsyth
MA07	4	F	Kinsey	MA31	1	M	Forsyth
MA08	1	M	Kinsey	MA32	1	F	Forsyth
MA11	4	F	Kinsey	MA33	4	F	Forsyth
MA12	1	M	Kinsey	MA34	1	F	Forsyth
MA13	1	M	Kinsey	MA35	1	M	Forsyth
MA16	4	F	Kinsey	MA36	1	M	Forsyth
MA20	4	M	Kinsey	MA39	1	M	Forsyth
MA21	2	F	Kinsey	MA46	1	F	Hathaway
MA66	1	F	Hysham	MA47	1	M	Hathaway
*MA81	1	F	Forsyth	MA48	1	F	Hathaway
*MA82	4	M	Forsyth	MA80	4	F	Forsyth
MA86	1	M	Cliff Res.	*MA81	1	F	Forsyth
MA87	1	M	Cliff Res.	*MA82	4	M	Forsyth
MA88	4	M	Cliff Res.	MA84	1	F	Forsyth
MA89	3	M	(T10N, R44E, S33)	MA85	1	M	Forsyth
MA91	1	F	(T10N, R44E, S33)	MA97	4	M	Forsyth
				MA98			
				(AJ83)	4	F	Forsyth
				MC75	1	M	Big Horn
				MC76	1	M	Big Horn
				MC78	1	F	Big Horn
				MC98	1	F	Big Horn
				*MM02	4	M	Hathaway

Table 10 (continued)

<u>Boles Reservoir Unit (1977)</u>				<u>Trail Creek Reservoir Unit (1977)</u>			
<u>Neck</u> <u>Bands</u>	<u>Age</u> ^a	<u>Sex</u>	<u>Banding</u> <u>Location</u>	<u>Neck</u> <u>Bands</u>	<u>Age</u> ^a	<u>Sex</u>	<u>Banding</u> <u>Location</u>
MC88	1	F	McRae's Res.				
MC92	1	F	Hathaway				
MC93	1	F	Hathaway				
MC94	4	F	Hathaway				
MC97							
(AK00)	4	F	Venn's Upper Res.				
*MM02	4	M	Hathaway				
MM03	1	F	Hathaway				
MM07	1	M	Hathaway				

- ^a
 1 - Juvenile
 2 - Yearling
 3 - Subadult (2 year old)
 4 - Adult (3+)

*Banded bird observed at both units.

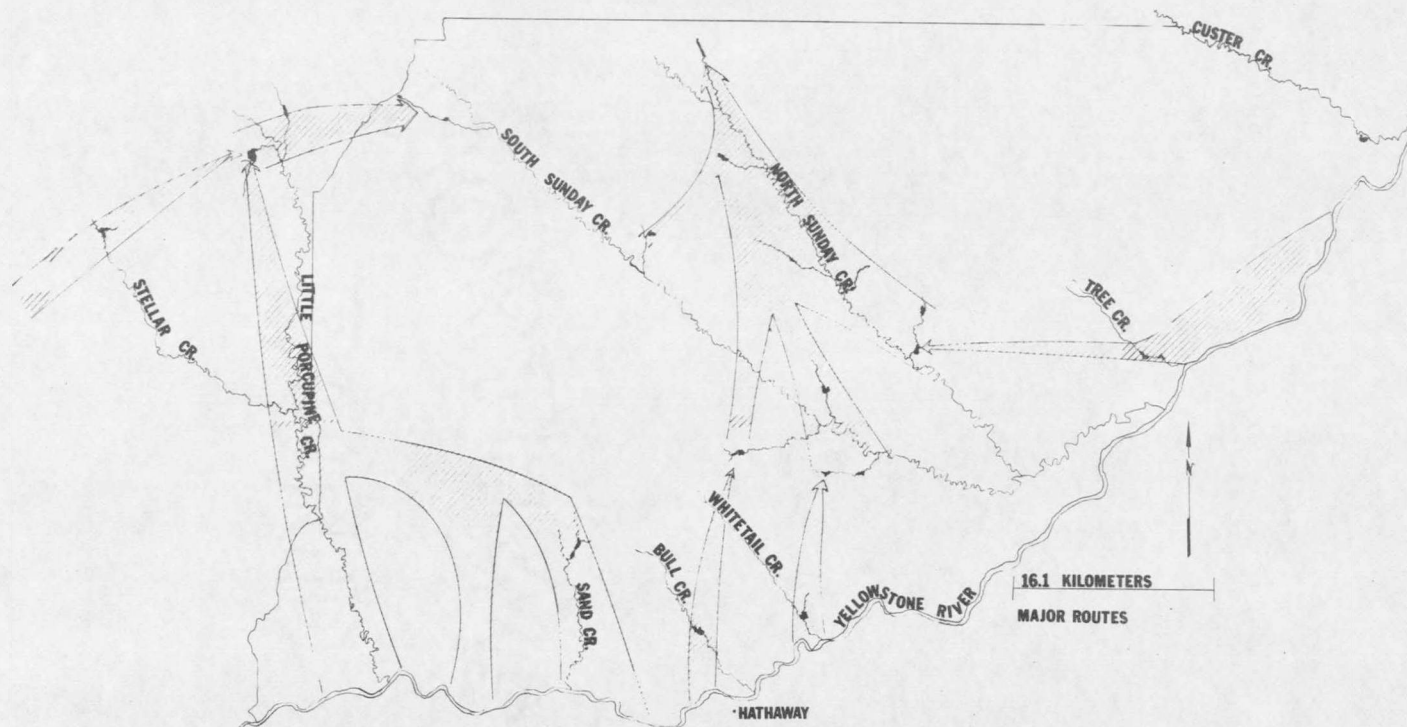
into each area. The Boles Reservoir Unit receives geese primarily from Hathaway downstream to Terry and the Trail Creek Reservoir Unit from Hathaway upstream to the Bighorn River.

In 1976, only two banded geese from the Yellowstone River (Terry-Powder River area) were observed on the Boles Reservoir Unit. The remaining banded geese observed were raised in the immediate area. In 1977, river geese were much more common. Family groups from Shirley, Kinsey, and Hathaway were noted on the area. Resident geese were again common in the area.

Seventeen banded geese from the river were observed on the Trail Creek Reservoir Unit in 1976. They represented river locations such as Rosebud, Forsyth, and Bighorn. Marked resident geese were also contributing to this unit. This same trend was repeated in 1977 except that no resident geese were seen.

Interchange, between both units, appears to be low. Four banded geese were seen in both units in 1976, but three of them were residents to the area. Only one goose was observed in both units in 1977.

Figure 15 illustrates the major routes used by both resident and river geese while moving to the northern feeding units within the area. Although the northward movements to the units by river geese may be quite abrupt, the return movements may be prolonged due to the influence of resident family groups and nonbreeders which did not return to the river immediately. This protracted return to the river was influenced



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Figure 15. Major routes used by Canada geese traveling to Boles Reservoir and Trail Creek Reservoir Units, 1976-1977.

to some extent by the location of water and feeding areas and the degree to which these areas were subjected to hunting pressure.

However, cold weather resulting in the freeze-up of reservoirs in the study area, caused all geese to move south to the river. By 10 November, 1977, all reservoirs except those with large concentrations of geese were frozen over; by 18 November, freeze-up had occurred on all reservoirs within the study area.

Geese banded on the Yellowstone River were recovered in north-central Colorado (Hinz, 1977). Five geese, banded in the study area, were also recovered in the same location. Mixing of stockpond and river geese, initiated in July, appears to result in shared wintering areas.

CONCLUSION

During this study, the reproductive potential of Canada geese in the study area was suppressed. However, during years of optimum environmental conditions, the contribution to the lower Yellowstone goose population could be significant. Present reservoir construction techniques and grazing patterns have not permitted the potential of these areas to be expressed. Secure island nesting sites are at a premium, although the possibility exists for alteration of peninsulas to create such sites. During low water periods, previously selected areas could be altered at minimal cost, especially if done in conjunction with reservoir maintenance. Less intensive grazing by livestock would create more favorable brood rearing sites around reservoirs.

The study area supports a large number of geese from late July until late November. Information, both from landowners and Montana Fish and Game personnel, indicate that use of both the Boles Reservoir and Trail Creek Reservoir Units is traditional. Continuation and increased wheat farming in these areas may attract larger proportions of geese (river and resident) during the late summer-early fall period. The longer these geese remain in the fall, the greater the potential for attracting migrant geese. Under these conditions, more geese would be available for hunting opportunities. However, the acceptance of additional hunting pressure within these areas remains unpredictable. At the present time, most of the land is closed to hunting or available

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to a very small segment of the hunting population.

APPENDIX

Table 11. Summary of Canada geese captured on the study area during 1976 and 1977.

<u>1976</u>				
<u>Date</u>	<u>Location</u>	<u>Neck Band</u>	<u>Age</u> ¹	<u>Sex</u> ²
6-28	Ballensky's Reservoir (T9N, R45E, S33)	AK02	Adult	F
6-28	Ballensky's Reservoir	--	Juv.	M
6-28	Ballensky's Reservoir	--	Juv.	F
6-28	Ballensky's Reservoir	--	Juv.	F
6-30	Witcher's Reservoir (T9N, R47E, S13-14)	AK43	Subadult	M
6-30	Witcher's Reservoir	AK44	Juv.	M ₃
6-30	Witcher's Reservoir	AK45	Juv.	M ₃
6-30	Witcher's Reservoir	AK46	Juv.	M
6-30	Custer Creek Reservoir (T11N, R48E, S2)	AK47	Adult	M
6-30	Physic Creek Reservoir (T12N, R48E, S35)	AK48	Adult	F
6-30	Physic Creek Reservoir	AK49	Juv.	M
6-30	Physic Creek Reservoir	AK50	Juv.	F
6-30	Physic Creek Reservoir	AK51	Juv.	M
6-30	Physic Creek Reservoir	AK52	Subadult	F
7-1	Trail Creek Reservoir (T11N, R42E, S10)	AK53	Juv.	F
7-1	Trail Creek Reservoir	AK54	Juv.	F
7-1	Trail Creek Reservoir	AK55	Juv.	M ₃
7-1	Trail Creek Reservoir	AK56	Subadult	M ₃
7-1	Trail Creek Reservoir	AK57	Adult	F
7-1	Trail Creek Reservoir	AK58	Juv.	F
7-1	Trail Creek Reservoir	AK59	Juv.	M
7-1	Trail Creek Reservoir	AK60	Juv.	F
7-1	Trail Creek Reservoir	AK61	Juv.	F
7-1	Trail Creek Reservoir	AK62	Juv.	F ₃
7-1	Trail Creek Reservoir	AK63	Juv.	F ₃
7-1	Cliff Reservoir (T10N, R43E, S14-15)	AK64	Juv.	M
7-1	Cliff Reservoir	AK65	Juv.	F
7-1	Cliff Reservoir	AK66	Juv.	F
7-1	Cliff Reservoir	AK67	Juv.	M
7-1	Cliff Reservoir	AK68	Juv.	F
7-1	Cliff Reservoir	AK69	Juv.	M

Table 11 (continued)

1976				
Date	Location	Neck Band	Age ¹	Sex ²
7-2	Brewer's (T9N, R45E, S25)	AK70	Juv.	M
7-2	Metal Shed Pond	AK71	Juv.	M
	(T10N, R44E, S23-24)			
7-2	Metal Shed Pond	AK72	Juv.	F ³
7-2	Metal Shed Pond	AK73	Adult	F
7-2	Metal Shed Pond	AK74	Adult	M
7-2	Metal Shed Pond	AK75	Juv.	M
7-2	Metal Shed Pond	AK76	Juv.	M ³
7-2	Metal Shed Pond	AK77	Juv.	F ³
7-2	Metal Shed Pond	AK78	Juv.	F
7-2	McRae's Reservoir	AK79	Juv.	M
	(T11N, R44E, S29)			
7-2	McRae's Reservoir	AK80	Juv.	M
7-2	McRae's Reservoir	AK81	Juv.	F
7-2	McRae's Reservoir	AK82	Juv.	F ³
7-2	McRae's Reservoir	AK83	Juv.	F ³
7-2	McRae's Reservoir	AK84	Juv.	M
7-2	McRae's Reservoir	AK85	Juv.	M
7-2	McRae's Reservoir	AK86	Adult	M ³
7-2	McRae's Reservoir	AK87	Juv.	M ³
7-2	McRae's Reservoir	AK88	Juv.	M
7-2	McRae's Reservoir	AK89	Juv.	F
7-2	McRae's Reservoir	AK90	Juv.	M
7-2	McRae's Reservoir	AK91	Juv.	M
7-2	McRae's Reservoir	AK92	Juv.	F
7-2	McRae's Reservoir	AK93	Juv.	F ⁴
7-2	McRae's Reservoir	AK94	Juv.	M ⁴
7-2	McRae's Reservoir	AK95	Juv.	F ⁴
7-6	Venn's Lower Reservoir	AK96	Juv.	M
	(T9N, R45E, S13)			
7-6	Venn's Lower Reservoir	AK97	Juv.	M
7-6	Venn's Lower Reservoir	AK98	Juv.	F
7-6	Venn's Upper Reservoir	AK99	Juv.	M
	(T9N, R45E, S1)			
7-6	Venn's Upper Reservoir	AK00	Adult	F
7-6	Venn's Upper Reservoir	AF01	Juv.	F
7-6	Venn's Upper Reservoir	--	Juv.	M
7-6	Venn's Upper Reservoir	--	Juv.	F

Table 11 (continued)

<u>1976</u>				
<u>Date</u>	<u>Location</u>	<u>Neck Band</u>	<u>Age</u> ¹	<u>Sex</u> ²
7-6	Pond 14, Subunit II (T8N, R44E, S2)	AF04	Adult	M
7-6	Coal Creek Reservoir (T8N, R44E, S10-11)	AF05	Adult	F
7-6	Coal Creek Reservoir	AF06	Juv.	F
7-6	Coal Creek Reservoir	AF07	Juv.	F
7-6	Coal Creek Reservoir	AF08	Juv.	M
7-6	Coal Creek Reservoir	AF09	Juv.	F
7-6	Coal Creek Reservoir	AF10	Juv.	F
7-6	Coal Creek Reservoir	AF11	Juv.	M ₃
7-6	Pond 11, Subunit II (T8N, R44E, S13)	AF12	Juv.	F
7-6	Pond 11, Subunit II	AF13	Adult	F ₄
7-6	Pond 11, Subunit II	AF14	Subadult	M
7-6	Pond 11, Subunit II	AF15	Subadult	F
7-6	Pond 11, Subunit II	AF16	Juv.	F
7-6	Pond 11, Subunit II	AF17	Juv.	F ₃
7-6	Pond 11, Subunit II	AF18	Juv.	M
7-8	Venn's Lower Reservoir (T9N, R45E, S13)	AF19	Adult	M
7-8	Venn's Lower Reservoir	AF20	Juv.	M
7-8	Venn's Lower Reservoir	AF21	Juv.	M
7-8	Venn's Lower Reservoir	AF22	Juv.	F
7-8	Venn's Lower Reservoir	AF23	Juv.	F
7-9	Witcher's Reservoir (T9N, R47E, S13-14)	AF24	Subadult	F
7-9	Witcher's Reservoir	AF25	Juv.	F
7-9	Witcher's Reservoir	AF26	Juv.	F
7-9	Witcher's Reservoir	AF27	Juv.	F
7-13	Ballensky's Reservoir (T10N, R45E, S33)	AF28	Juv.	F
7-13	Ballensky's Reservoir	AF29	Juv.	F ₃
7-13	Ballensky's Reservoir	AF30	Juv.	M
7-13	Sage Creek Reservoir (T8N, R45E, S16)	AF31	Juv.	F
7-13	Sage Creek Reservoir	AF32	Juv.	F
7-13	Sage Creek Reservoir	AF33	Adult	F
7-13	Sage Creek Reservoir	AF34	Juv.	M

Table 11 (continued)

1977				
<u>Date</u>	<u>Location</u>	<u>Neck Band</u>	<u>Age</u> ¹	<u>Sex</u> ²
7-6	Cliff Reservoir (T10N, R45E, S14-15)	MA86	Juv.	M
7-6	Cliff Reservoir	MA87	Juv.	M
7-6	Cliff Reservoir	MA88	Adult	M
7-6	Hook Ranch Pond (T11N, R44E, S32)	MA89	Subadult	M
7-6	Hook Ranch Pond	MA90	Juv.	M
7-6	Hook Ranch Pond	MA91	Juv.	F
7-6	Hook Ranch Pond	MA92	Juv.	F
7-7	Witcher's Reservoir (T9N, R47E, S13-14)	MA93	Juv.	F
7-7	Witcher's Reservoir	MA94	Juv.	F
7-7	Witcher's Reservoir	MA95	Juv.	M
7-7	Witcher's Reservoir	MA96	Adult	M
7-7	Witcher's Reservoir	MC01	Adult	F
7-7	Witcher's Reservoir	--	Juv.	F
7-7	House Creek Reservoir (T9N, R47E, S24)	MC02	Adult	M
7-7	House Creek Reservoir	MC03	Adult	M
7-7	House Creek Reservoir	MC04	Juv.	M
7-7	House Creek Reservoir	MC05	Juv.	F
7-7	House Creek Reservoir	MC06	Juv.	M
7-7	House Creek Reservoir	MC07	Juv.	F
7-7	House Creek Reservoir	MC08	Juv.	M
7-7	House Creek Reservoir	MC09	Juv.	M
7-7	House Creek Reservoir	MC10	Juv.	F
7-7	House Creek Reservoir	MC11	Juv.	F
7-12	Physic Creek Reservoir (T12N, R48E, S35)	MC79	Juv.	M
7-12	Physic Creek Reservoir	MC80	Juv.	F
7-12	Physic Creek Reservoir	MC81	Juv.	F
7-12	Physic Creek Reservoir	MC82	Juv.	M
7-12	Physic Creek Reservoir	MC83	Juv.	F
7-12	Physic Creek Reservoir	MC84	Juv.	F
7-12	Physic Creek Reservoir	MC85	Juv.	M
7-12	Physic Creek Reservoir	MC86	Juv.	M
7-12	Physic Creek Reservoir	--	Juv.	F
7-12	Physic Creek Reservoir	MC87	Juv.	M

Table 11 (continued)

<u>1977</u>				
<u>Date</u>	<u>Location</u>	<u>Neck Band</u>	<u>Age</u> ¹	<u>Sex</u> ²
7-12	McRae's Reservoir (T11N, R44E, S29)	MC88	Juv.	F
7-12	Venn's Upper Reservoir (T9N, R45E, S1)	MC89	Adult	M
7-12	Venn's Upper Reservoir	MC90	Juv.	M
7-12	Venn's Upper Reservoir	MC91	Juv.	F
7-12	Venn's Upper Reservoir	MC97(AK00)	Adult	F ⁵

¹Adult(3+), Subadult (1-2), Juvenile (<1).

²F (Female), M (Male).

³Geese harvested.

⁴Band found.

⁵Collar changed.

Table 12. Summary of nest site locations, physical and vegetative characteristics, and survey of nests within Subunit I, 1977.

Location	Nest Site	Cover Type	Distance from Water	Height above Water	Clutch Size	Nest Success ¹
Ballensky's (T10N, R45E, S33)	Island (Permanent)	Sagebrush- grassland	0.46 meters (1.5 feet)	0.91 meters (3.0 feet)	5	U
Ballensky's (T10N, R45E, S33)	Shoreline	Sagebrush- grassland	15.24 meters (50.0 feet)	1.22 meters (4.0 feet)	5	U
Brewer's (T9N, R45E, S26)	Peninsula	Sagebrush- grassland	3.30 meters (10.8 feet)	0.6 meters (2.0 feet)	6	S
Brewer's (T9N, R45E, S31)	Shoreline	Cattail	0	.2 meters (0.6 feet)	3 ²	U
Brewer's (T9N, R45E, S36)	Peninsula	Grass	2.84 meters (9.3 feet)	0.9 meters (3.0 feet)	5	S
Coal Creek (T8N, R44E, S10-11)	Peninsula	Grass	0.61 meters (2.0 feet)	7.6 meters (25.0 feet)	5	U ³
Hardings (T9N, R45E, S16)	Island (Temporary)	Grass	1.5 meters (5.0 feet)	0.5 meters (1.5 feet)	6	U
Hardings (T9N, R45E, S17)	Island (Permanent)	Grass	2.1 meters (7.0 feet)	0.5 meters (1.5 feet)	4	U
Hardings (T9N, R45E, S30)	Peninsula	Big Sage	6.1 meters (20.0 feet)	4.6 meters (15.0 feet)	5	U
Hook Ranch (T11N, R44E, S32)	Peninsula	Grass	5.3 meters (17.5 feet)	1.8 meters (6.0 feet)	7	S
McRae's (T11N, R44E, S29)	Peninsula	Sagebrush- grassland	0.91 meters (3.0 feet)	1.2 meters (4.0 feet)	5	U
McRae's (T11N, R44E, S29)	Island (Permanent)	Rock	1.83 meters (6.0 feet)	1.4 meters (4.5 feet)	7	S
McRae's ⁴ (T11N, R44E, S29)						S
Sage Creek (T8N, R45E, S11)	Island (Temporary)	Grass	15.2 meters (50.0 feet)	0.6 meters (2.0 feet)	Unknown	U

Table 12 (continued)

Location	Nest Site	Cover Type	Distance from Water	Height above Water	Clutch Size	Nest Success ¹
Sage Creek ⁴ (T8N, R45E, S16)						S
Venn's (T9N, R45E, S1)	Peninsula	Bare ground	3.7 meters (12.0 feet)	5.5 meters (18.0 feet)	7	S
Venn's--small pond (T9N, R45E, S1)	Shoreline	Sagebrush- grassland	0.6 meters (2.0 feet)	0.9 meters (3.0 feet)	5	U ³
Venn's (T9N, R45E, S13)	Shoreline	Bare ground	3.7 meters (12.0 feet)	5.5 meters (18.0 feet)	5	S
Venn's (T9N, R45E, S13)	Island (Temporary)	Grass	15.1 meters (49.5 feet)	1.8 meters (6.0 feet)	6	S

¹ U - unsuccessful, S - successful.

² Clutch incomplete.

³ Incubating hen also destroyed.

⁴ Nest location never found, however brood was present.

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