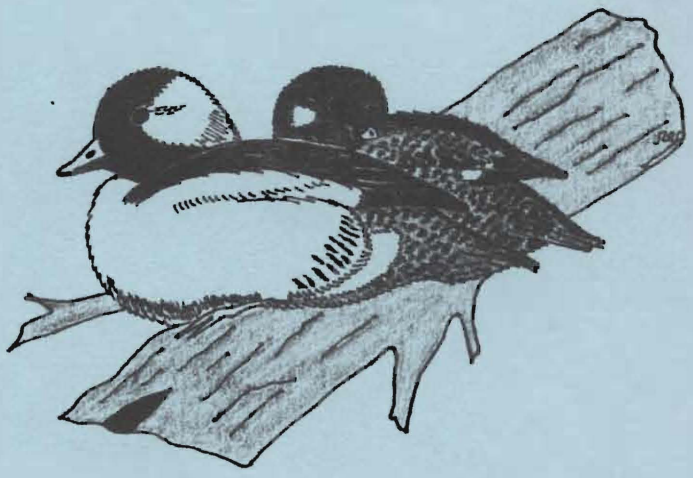
McCLUSKY CANAL STUDIES



INTRODUCTION

The McClusky Canal, extending through McLean, Burleigh, and Sheridan Counties, is the principal waterway for the initial stage of the Garrison Diversion Unit. The canal is 118.4-km (73.6-mi) long with a capacity of 55.2 m^3/s (1,950 ft^3/s). The canal will have a water depth of 5.3 m (17.3 ft), bottom width of 7.62 m (25 ft), and water surface width of 29 m (94 ft), making it the largest man-made water conveyance facility in the State.

Study Area

Five sample areas totaling 308 ha (761 acres), or 6 percent of the 4,980-ha (12,305-acre) canal right-of-way (Figure 8), are being studied to determine values to mammals and breeding, migrating, and wintering birds. Vegetation and land use are being studied on these sites to determine relationships between habitat and wildlife use of the canal. Three study areas are located along the canal channel and two are near the canal Chain-of-Lakes (East Park, West Park, Heckers, and New Johns Lakes). The canal channel is that area within the constructed prism of the canal. The canal lakes are all the water areas on the canal alinement, but not contained within the prism. These areas were selected because their vegetative cover, water areas, and adjacent land use are typical of the McClusky Canal right-of-way (Table 26).

A 40.2-km (25-mi) canal survey route was established for wildlife surveys. To permit comparisons of wildlife use along the canal to wildlife use in adjacent agricultural areas, a second 40.2-km (25-mi) route was established south of the canal for use as a control. The control route begins 5.6 km (3.5 mi) north of Washburn on Highway 200A and continues east, paralleling the canal (Figure 8). Land uses and water areas along the two routes are not significantly different (Table 27).

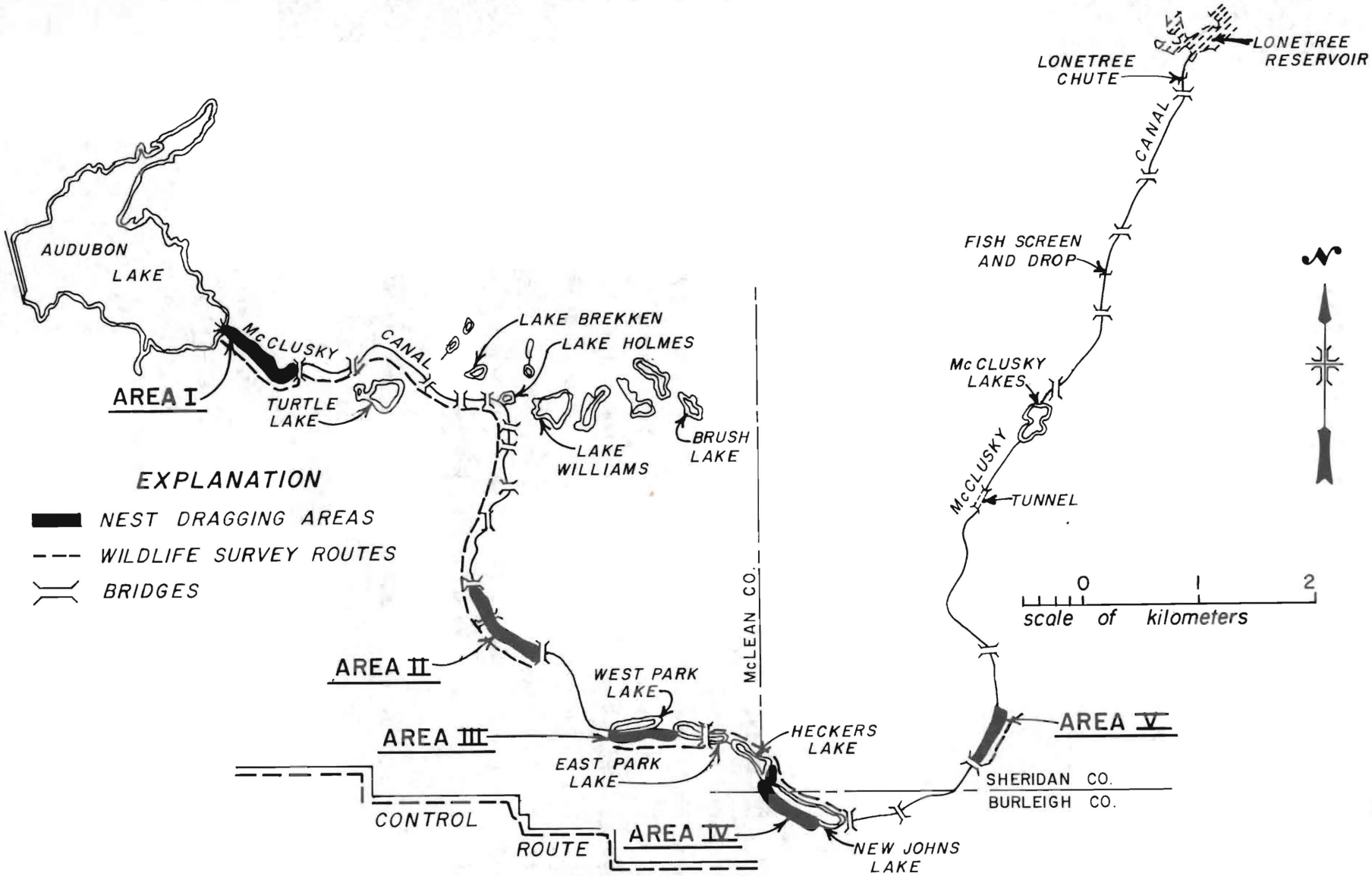


FIGURE 8
McCLUSKY CANAL
WILDLIFE STUDY AREAS

Table 26

LAND USE ADJACENT TO McCLUSKY CANAL NEST SEARCH AREAS AS COMPARED TO LAND USE ADJACENT TO ENTIRE CANAL [1/]

Land Use	Total Canal	Study Areas
Cropland	49.0%	43.5%
Grassland	40.5%	51.1%
Trees	0.3%	0.2%
Wetlands	6.1%	4.7%
Farmsteads	1.1%	0.5%
Gravel pits	0.5%	-0-
Roadsides	2.5	-0-

1/ No significant difference in distribution of habitats between areas ($x^2 = 2.44$, 3df, $P > .05$).

Table 27

LAND USE ADJACENT[1/] TO THE CANAL AND ON THE CONTROL CENSUS ROUTES[2/]

Land Use/Habitat	Canal	Control
Cultivated	61.05%	64.39%
Grassland	32.75%	26.54%
Wetlands	4.81%	4.46%
Farmsteads/trees	1.39%	4.61%

1/Immediately adjacent to canal right-of-way fence and to roadside right-of-way edge.

2/No significant difference in the distribution of habitats between routes (x^2=2.44, 3df, $P \geq .05$).

METHODS

Waterfowl

The following methods were used to determine waterfowl use of the canal right-of-way. Other bird species were recorded during the nest searches.

The canal was surveyed in a light plane on May 4, 1979, to determine use by spring migratory and breeding waterfowl.

Two breeding duck pair counts, using methods described by Hammond (1969), were conducted on May 14-15 and May 29-31, 1979. The counts were made on each of the five study areas, the Chain-of-Lakes, a continuous 40.2-km (25-mi) route along the canal, and a 40.2-km (25-mi) control route south of the canal.

Residual vegetation height-density measurements, using a method described by Robel, et. al (1970), were taken on the five study areas to determine the quality of the nesting habitat. Measurements were taken in April before the growth of new vegetation. The areas sampled were those where nest searching was conducted (Figure 8). Areas selected for vegetation measurement represented cover types occurring on the canal right-of-way including native prairie, reseeded native and domestic grasses, and idle domestic grasses with invading forbs and native grasses. Robel readings were taken at 0.48-km (0.3-mi) intervals off the study sites on the remainder of the canal. Vegetation density was also measured at each observed nest site, to determine if the residual vegetation height densities on the study areas were representative of the entire canal right-of-way.

Permanent vegetation transects established in 1978 were surveyed within each of the five study areas using a modification of the technique described by Cain and Castro (1959) to document changes in species composition and effects on waterfowl nesting densities and success. Plant species were also recorded at each observed nest site.

Land use immediately adjacent to the 40.2-km (25-mi) canal survey route and the 40.2-km (25-mi) off-canal control route were recorded. All natural and man-made water areas were identified and recorded on the waterfowl pair and brood counts.

The five study areas were searched four times for bird nests at approximately 2-week intervals between May 7 and July 24, 1979. Nests were located by dragging a 53-m (174-ft) cable-chain device between two Jeeps as described by Higgins, et al. (1977). Nests were revisited after the calculated hatching dates and success determined.

Three duck brood counts were conducted (June 27-29, July 16-18, and August 13-15), using ground survey methods described by Hammond (1970). Routes for conducting brood counts were the same as those used for breeding pair counts.

Roadside Bird Survey

Routes on the canal right-of-way and on a parallel control route (Figure 8) were surveyed four times in 1979 using the U.S. Fish and Wildlife Service's Cooperative Breeding Bird Survey Technique (1975) as modified and described in the Biology Branch Techniques Manual (unpublished 1979). Surveys were conducted in winter (February 20-21), spring (April 30-May 1), summer (June 26-27), and fall (September 18-19).

Mourning Doves

Mourning doves were censused on a 32-km (20-mi) canal route and on a 32-km (20-mi) control route using the standard U.S. Fish and Wildlife Service call-count technique (1973, available from Office of Migratory Bird Management, Laurel, Maryland).

Mammalian Predators

Scent post survey procedures outlined by Linhart and Knowlton (1975) were used in 1978 and modified for use on smaller study areas in 1979 as

described by Roughton (1979, in press). Surveys were conducted during the second week of September. Twelve survey lines were established on the canal right-of-way and 12 lines along the control route.

Deer

An aerial survey along the 118.4-km (73.6-mi) McClusky Canal and 135.2-km (84-mi) control route was conducted on March 2, 1979. Snow cover of 15.0 cm (6 inches) in depth was adequate for censusing deer throughout the area. The control route was located in agricultural land adjacent to the canal extending eastward from Lake Audubon through McLean and Sheridan Counties to an area northeast of the town of McClusky.

A spotlight survey was conducted August 29-30, 1979, on 61 km (38 mi) of the canal right-of-way and on 38.6 km (24 mi) of county road off the right-of-way. Observers recorded the location and numbers of all wildlife observed.

Small Mammals

A snap-trap, line transect technique similar to that used by Golley, et al. (1965) and described in the Biology Branch Techniques Manual (unpublished 1979) was used to sample small mammal populations in four canal plant communities and on four off-canal control plots in agricultural lands typical of the canal land before development.

Four idle grassland types typical of the canal right-of-way were selected for transect placement. All canal transects were located within the nest search plots (Figure 8), which are representative of the entire canal (Table 26).

Four transects were sampled on off-canal agricultural lands to serve as a control. Control sites were selected to obtain samples of four typical agricultural land uses near the canal sites.

Vegetation density (Robel, et al. 1970) was measured along all transects to permit comparison of vegetation quality to small mammal populations.

RESULTS AND DISCUSSION

Waterfowl

A total of 3,655 ducks was counted on the canal waters during the May 4 aerial survey. Of these, 402 were dabbling ducks, 2,513 were diving ducks, and 740 were unidentified. The diving ducks showed a preference for the lake areas with 86 percent in the canal lakes, while 86 percent of the dabbling ducks preferred the canal channel waters. This agrees with last year's spring data and contrasts with the fall data where 92 percent of the dabblers and 99 percent of the divers were recorded in the canal lakes.

The high duck use of the canal channel in the spring is probably related to individual pairs spreading out on individual territories. Evans and Black (1956) point out that "...breeding ducks in the spring are responsive to conditions that enable them to disperse and remain separated from other pairs of the same species. They show little preference for areas especially attractive from the standpoint of food, cover, or any other measurable factor." Migrating ducks in the fall gather into flocks on the larger canal lakes and avoid the more narrow canal channel where they are more vulnerable to hunting pressure.

Breeding ducks averaged 7 pairs/km (11 pairs/mi) on both the canal route and on the parallel, off-canal, control route (Table 28). Duck pairs per km were approximately the same as in 1978 along the canal route, while the number of pairs on the control route increased by approximately three times. Forty-seven percent of the pairs recorded along the canal route were seen in the channel, and 53 percent were seen in wetlands adjacent to the channel (Table 28). There were 4.7 duck pairs/km (7.6 pairs/mi) of lake shoreline along the canal alinement compared to 1.5 duck pairs/km (2.4 pairs/mi) of channel shoreline.

Table 28

INDICATED DUCK PAIR DENSITY[1]

Control Route and McClusky Canal Route
14-15 May and 29-31 May 1979

Species	Control Route Total	Canal Route		
		Total	In[2]	Off[3]
Mallard	40	32	11	21
Gadwall	18	36	20	16
Pintail	98	26	8	18
Green-winged teal	1	2	1	1
Blue-winged teal	70	123	73	50
American wigeon	7	3	3	--
Northern shoveler	34	30	7	23
Total Dabbling Ducks	268	252	123	129
Redhead	1	--	--	--
Canvasback	4	--	--	--
Lesser scaup	2	3	2	1
Ruddy Duck	2	9	--	9
Total Diving Ducks	9	12	2	10
TOTAL INDICATED PAIRS	277	264	125	139
TOTAL INDICATED PAIRS/ KM OF ROUTE	6.89	6.57	3.11	3.46

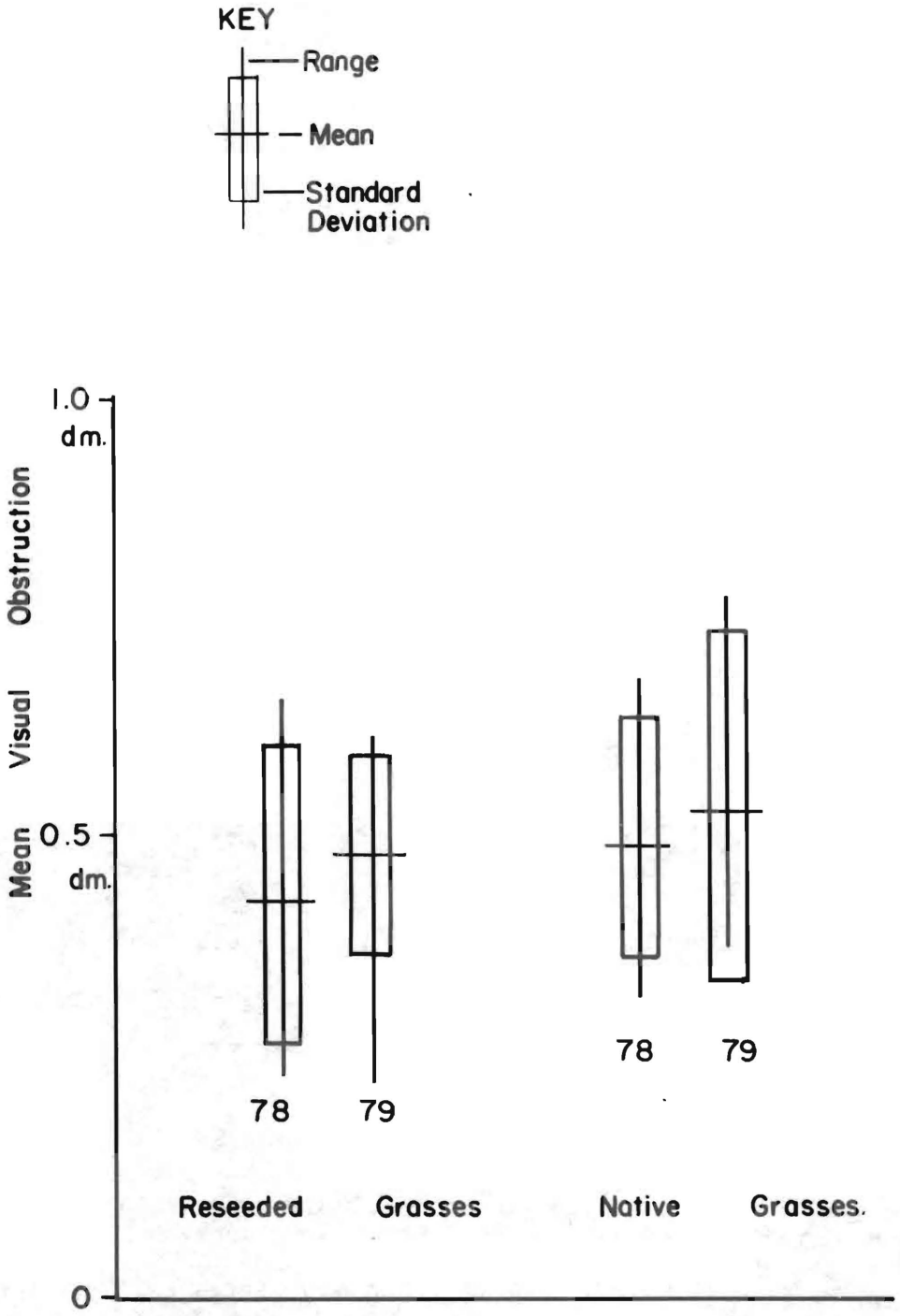
1/Indicated pair density is the result of two duck pair counts conducted on 14-15 May and 29-31 May 1979. The 14-15 May pair count was used to determine indicated pairs of early nesting species (mallard, canvasback, and pintail). Indicated pairs of all other duck species were obtained from the 29-31 May pair count.

2/"In" denotes only those indicated pairs found in the canal channel.

3/"Off" denotes those indicated pairs found on wetlands within, and adjacent to, the canal right-of-way, but not in the canal channel.

FIGURE 9

HEIGHT DENSITY READINGS OF RESIDUAL VEGETATION ON THE McCLUSKY CANAL APRIL, 1978 and 1979.



Residual vegetation density readings for all nest search areas were taken on April 24-26, 1979. The average visual obstruction reading (density) of all habitats for all study areas was 0.43 dm (1.7 in). The average visual obstruction reading was 0.53 dm (2.1 in) for native prairie and 0.48 dm (1.9 in) for reseeded grass. The residual vegetation density on the canal in 1979 was up slightly over 1978 (Figure 9). Study Area I averaged the highest visual obstruction with 0.53 dm (2.1 in), and Study Area V averaged lowest with 0.38 dm (1.5 in). The vegetation density on the remainder of the canal, measured on May 3, averaged 0.56 dm (2.2 in).

The vegetation surrounding the marsh hawk nests had the highest average reading with 3.23 dm (12.7 in), while marbled godwit nest vegetation received the lowest average with 0.19 dm (0.75 in). A killdeer nest on gravel had a density reading of zero. Densities near pintail and shoveler nests averaged lowest for duck species (1.39 dm or 5.5 in), and gadwall averaged the highest (3.18 dm or 12.5 in). As in 1978, all duck species, except pintail and northern shoveler, had a higher average Robel reading at successful nests than at destroyed nests.

On the plant transects, dried plant litter made up 75 percent of all material found. Bare ground totaled 10 percent, and live plant material made up 15 percent. The three species observed most frequently on vegetation transects were green needlegrass (27 percent), smooth brome (17 percent), and western wheatgrass (16 percent).

Two hundred ninety-nine nests of 18 species of birds were located during four upland nest searches between May 7 and July 24, 1979, on 308 ha (761 acres) of McClusky Canal right-of-way. Eight species of ducks initiated 256 of the 299 nests located.

The number of mallard nests found was about double the number found in 1978, while shoveler nests dropped to one-half the number found last year. Other duck species occurred in approximately the same numbers as last year, except for green-winged teal nests (5), which were located for the first time this year.

Other species recorded nesting on the right-of-way for the first time were sora, Wilson's phalarope, marbled godwit, killdeer, and ferruginous hawk. A ferruginous hawk pair unsuccessfully nested on a dirt pile near the headworks of the canal.

Duck species nesting on the canal right-of-way were, in decreasing order of abundance:

Species	No. of Nests	Nest/Km^2	Hatching Success
Blue-winged teal	96	31	55%
Mallard	61	20	36%
Gadwall	35	11	51%
Pintail	25	8	60%
Northern shoveler	22	7	50%
American wigeon	6	2	33%
Lesser scaup	6	2	17%
Green-winged teal	5	2	100%
TOTALS	256	83	50%

Other nesting species were:

Species	No. of Nests	Nest/Km^2	Hatching Success
Mourning dove	14	5.0	33%
Sharp-tailed grouse	8	3.0	50%
Upland sandpiper	7	2.0	29%
Wilson's phalarope	4	1.0	0%
American bittern	3	1.0	0%
Marsh hawk	3	1.0	0%
Marbled godwit	1	0.3	0%
Killdeer	1	0.3	0%
Sora	1	0.3	100%
Ferruginous hawk	1	0.3	0%

Duck nest initiation began a week later, peaked a week later, but terminated at the same time as in 1978. Duck nesting began the third week in April with four nests established, reached a peak the third week of May with 42 nests, and ended with the last known nest being initiated the second week in July. Mallard and pintails nested earliest, followed in order by northern shoveler, blue-winged teal, gadwall, American wigeon, lesser scaup, and green-winged teal.

Nest density was 1.2 times greater than in 1978 and 7 times greater than in 1977 (Figure 10). The five study areas yielded an overall bird nest density of 97 nests/km^2 (251 nests/mi^2) of which duck nest density totaled 83 nests/km^2 (215 nests/mi^2). Study Area IV had the highest duck nest density with 134 nests/km^2 (346 nests/mi^2), while Study Area V had the lowest duck nest density with 11 nests/km^2 (28 nests/mi^2).

The density of duck nests found on the canal right-of-way from 1977 to 1979 is positively correlated with the number of ponds found on statewide surveys conducted by the State Game and Fish Department during the same time period (Figure 11). This agrees with findings of other investigators (Weller, et al. 1958; Salyer 1962; Rogers 1959 and 1964; and de Bates 1964). Other factors that could be involved in the increase in nest densities include greater vegetation densities (Figure 9), population recruitment with the homing of young to natal areas and the return of successful hens.

Observed nesting success was 45 percent for all bird species and 50 percent for ducks on the canal right-of-way in 1979. This is a lower duck nesting success than encountered in 1978 (56 percent) and in 1977 (65 percent) (Figure 10). Overall nesting success for ducks was highest (61 percent) in Study Area III and lowest (27 percent) in Study Area I. The fate of 250 of the 256 duck nests was determined. Fifty percent hatched, 44 percent were destroyed, and 7 percent were abandoned. Of the 109 duck nests destroyed, mammalian predators accounted for 94 percent, vehicles for 2 percent, and unknown causes for 4 percent. Nesting success was lower on the plots along the channel (34 percent) than on the wider plots along the canal lake (58 percent).

The fate of duck nests by search area is tabulated below:

	Search Area					
	I	II	III	IV	V	All Areas
Nests initiated	57	27	68	99	5	256
Nests/km^2	71	55	119	134	11	83
Successful nests	15	13	40	54	2	124
Destroyed nests	37	11	25	35	1	109

FIGURE 10 DUCK NESTING SUCCESS AND DENSITY ON THE McCLUSKY CANAL 1977–1979.

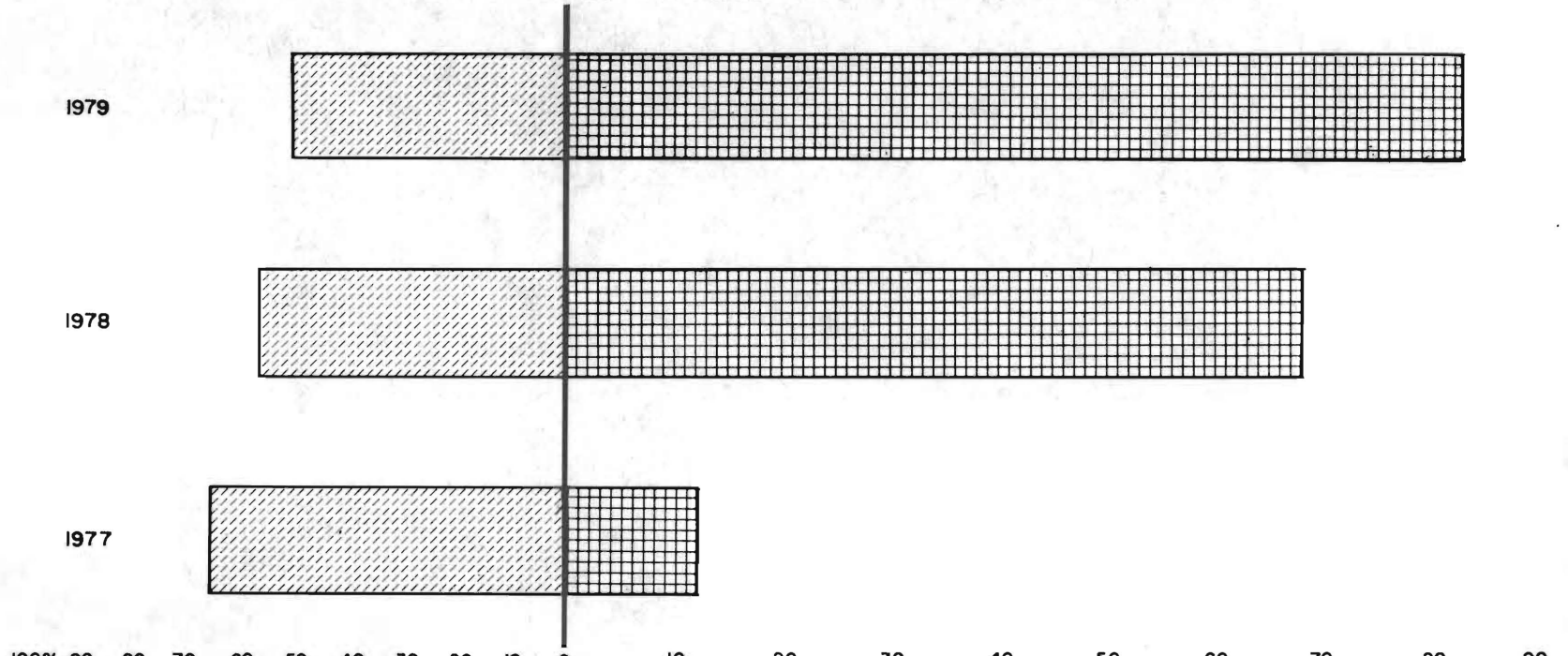
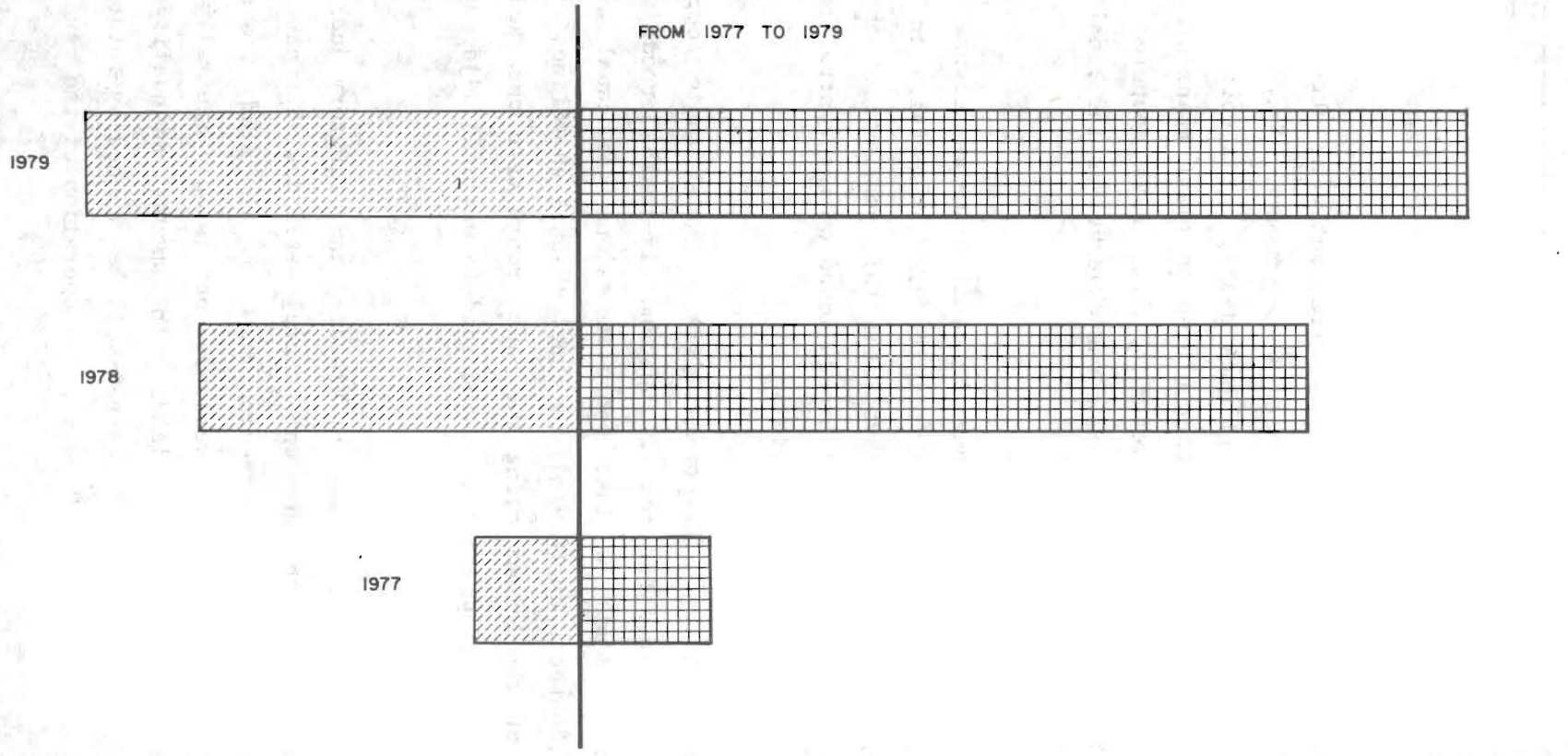


FIGURE 11 INCREASE IN THE NUMBER OF PONDS IN NORTH DAKOTA[1] COMPARED TO THE INCREASE IN THE NUMBER OF DUCK NESTS ON THE McCLUSKY CANAL FROM 1977 TO 1979



[1] Schroeder, C.H. 1978. and Pers. Comm.

(continued)

	Search Area					
	I	II	III	IV	V	All Areas
Abandoned nests	3	3	1	8	2	17
Nest fate unknown	2	--	2	2	--	6
Percent success	27	48	61	56	40	50

The three plant species occurring most frequently at duck nest sites were smooth brome, sweet clover, and wheatgrasses. Smooth brome was found adjacent to 48 percent of all duck nests, but accounted for only 17 percent of all plant species encountered on plant transects. Sweet clover was encountered at 29 percent of the nests compared to only 4 percent in 1978. More sweet clover was observed on the canal in 1979 than in 1978.

The number of waterfowl broods along the canal route was down 23 percent from 1978. This is possibly related to brood dispersion to the increased number of natural ponds available this year off of the right-of-way (Figure 11). The number of broods found on the control route was over double the number seen last year.

Waterfowl broods averaged 1.4/km (2.3/mi) of canal route compared to 0.6/km (1.0/mi) of control route. Two and six-tenths broods were observed per km (4.2/mi) of lake shoreline along the canal alinement compared to 0.5 broods/km (0.9/mi) of canal channel shoreline. Seventy-five percent of the broods along the canal route were observed in the canal channel, and 25 percent were recorded in wetlands adjacent to the canal channel (Table 29).

Although the canal water is used by breeding and migratory ducks, it is not as important as are the adjacent natural wetlands. The canal right-of-way is regularly used by breeding ducks in the study areas with a high density of adjacent natural wetlands, but is only minimally used in Area V, which has few nearby wetlands. The amount and quality of pair and brood habitat in the canal channel will be reduced by future operational levels and velocity. However, the operation of the canal should

Table 29

WATERFOWL BROOD DENSITY[1/]

Control Route and McClusky Canal Route
27-29 June, 16-18 July, and 13-15 August 1979

Species	Control Route Total	Canal Route		
		Total	In[2/]	Off[3/]
Mallard	5	3	3	--
Pintail	2	1	1	--
Gadwall	1	13	12	1
Blue-winged teal	7	6	4	2
Green-winged teal	--	3	2	1
American wigeon	--	1	1	--
Northern shoveler	2	3	2	1
Total Dabbling Ducks	17	30	25	5
Redhead	--	1	1	--
Canvasback	1	3	3	--
Lesser scaup	--	1	1	--
Ruddy Duck	1	1	1	--
Total Diving Ducks	2	6	6	--
Unidentified ducks	4	19	12	7
Canada goose	--	2	--	2
TOTAL BROODS	23	57	43	14
TOTAL BROODS/KM OF ROUTE	0.6	1.4	1.1	0.3

1/Criteria for determining duck brood density was established using methods described by Hammond (1970. Waterfowl brood survey manual. Mimeo. 44 pages).

2/"In" denotes only those broods found in the canal channel.

3/"Off" denotes those broods found on wetlands within, and adjacent to, the canal right-of-way, but not in the canal channel.

not appreciably affect use of the upland right-of-way by nesting ducks provided the adjacent natural wetlands are not drained, and that the upland vegetation on the canal is maintained.

During this 3-year study, disturbance caused by construction, slump repairs, weed control, and wildlife investigations has been a regular occurrence in the study areas, but did not appear to discourage duck nesting provided the nesting vegetation was not disturbed.

The FWS predicted that canal construction would drain or fill 1,320 ha (3,262 acres) of natural wetland and adversely affect 598 ha (1,478 acres) of wetland. However, enough wetlands still remain adjacent to the canal route to attract nesting ducks to the area and provide pair and brood habitat. The amount of available nesting cover was increased when 86 percent of the canal area was converted from active crop and pastureland to idle grassland.

The upland nesting cover provided by the idle grasses on the right-of-way in conjunction with the natural wetland basins along the canal route are the primary attraction to nesting waterfowl. Griffith (1948) suggests that lack of nesting cover is the usual factor limiting nesting, and Cline (1965) concluded that cover adjacent to water areas is one of the most important factors in determining whether or not an area is attractive to dabbling ducks. Cultivation and heavy grazing around potholes restricts nesting to limited areas (Dwyer 1970). Evans and Black (1956) concluded that:

> "The only requirement for nesting was the proper type of cover at the nest site. Other factors, such as quality of the nearest pothole were secondary. It is desirable that nest cover be somewhere nearby, but it need not be adjacent to the wetlands. Furthermore, it can be a considerable distance from permanent brood water, since a brood can easily travel a mile or more to water."

Figure 12 compares successful duck nest densities on the McClusky Canal to densities and success found by other investigators in the Prairie Pothole Region. It demonstrates that the canal has higher successful

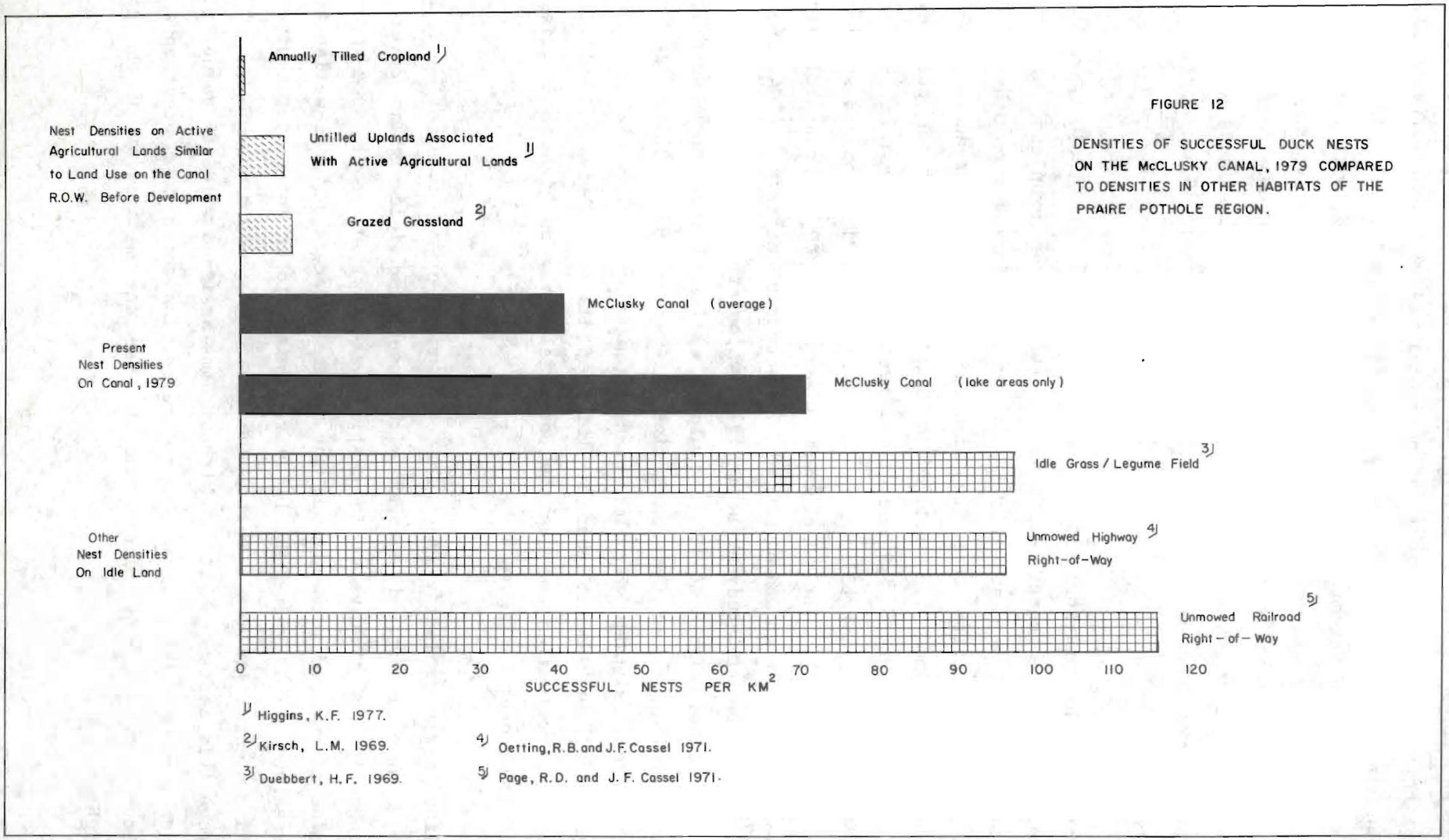


FIGURE 12

DENSITIES OF SUCCESSFUL DUCK NESTS ON THE McCLUSKY CANAL, 1979 COMPARED TO DENSITIES IN OTHER HABITATS OF THE PRAIRE POTHOLE REGION.

1/ Higgins, K.F. 1977.

2/ Kirsch, L.M. 1969.

3/ Duebbert, H.F. 1969.

4/ Oetting, R.B. and J.F. Cassel 1971.

5/ Page, R.D. and J.F. Cassel 1971.

nest densities than does cropland or pastureland. Although overall duck nesting success on the canal (50 percent in 1979) is not as high as that found in Duebbert's (1969) study area (79 percent), Keith (1961) states that an average hatching success of 39 percent would, with renesting, be "...more than adequate to maintain population levels of ducks." Figure 12 also illustrates that the canal right-of-way nest densities are still below what has been attained on idle grasslands along other rights-of-way in North Dakota (Page and Cassell 1971, Oetting and Cassell 1971).

Based on the previous land use on the 4,980 ha (12,305 acres) now occupied by the canal right-of-way (48 percent cropland, 42 percent pasture, and 10 percent wetland), it can be estimated from other studies in similar habitats that the cropland potentially produced 0.6 successful nests/km^2 (1.6 nests/mi^2) (Higgins 1977), and the pastureland potentially produced 5.9 successful nests/km^2 (15.3 nests/mi^2) (Kirsch 1969) for a total of 137 successful nests (14 in the cropland and 123 on the pastureland). The canal right-of-way is now 86 percent idle grassland. Based on an average of 40.2 successful nests/km^2 (104.3 nests/mi^2) found on our study areas in 1979 [which are similar to th remainder of the canal (Table 26)], it could be estimated that there were 1,724 successful nests on the canal right-of-way in 1979. These data show that canal right-of-way land can potentially produce 12 times more successful duck nests than it did when it was cultivated and grazed before construction and has the potential for even higher densities if managed properly (Figure 12).

Although the productivity of the canal right-of-way does not equal that of a natural wetland complex with associated idle upland cover, it presently has high value to nesting waterfowl and could have greater value if managed properly and the if the adjacent natural wetlands are preserved. This value should be recognized to insure proper management and to encourage (or require) the managing agency to maintain and improve this nesting habitat. Without some assigned wildlife value, other uses such as haying, grazing, and recreation could take precedence and become the deciding factors in the use and management of the canal right-of-way.

Roadside Bird Survey

A total of 9,929 birds of 85 species were recorded on the McClusky Canal right-of-way, and 3,629 birds of 76 species were recorded on the control route during four quarterly surveys (Table 30).

The frequency and abundance of the most commonly encountered species during the breeding season are compared in Tables 31 and 32.

More waterfowl (360 percent) were recorded on the canal route than on the control route during the breeding season survey. Fifteen percent of the waterfowl recorded on the canal route were in the channel. The other 85 percent were in adjacent natural wetlands.

Numbers of species and numbers of individual birds were consistently higher on the canal route than on the control route over a 3-year period (1977-1979) during the breeding season surveys (Table 33).

American bittern, eared grebe, mallard, and coot showed a noticeable increase in numbers from 1978 to 1979 on the breeding season canal survey. Blue-winged teal, northern shoveler, black tern, and common grackle decreased from 1978 to 1979 on the breeding season canal survey.

On the control route breeding season survey, common grackles and red-winged blackbirds decreased approximately 50 percent; while lark buntings, which totaled 83 individuals at 7 stops in 1978, did not occur at all in 1979.

The water in the channel provides some aquatic habitat, but use of the canal water by wildlife will probably change when the canal is in operation. This is suggested by the response of pied-billed grebes to the increase in water level in the canal to 5.3 m (17.4 ft) in the late summer of 1979. Pied-billed grebes increased from 2 birds in 1978 to 133 birds in 1979 in the canal channel during the fall surveys. Since a

Table 30

ROADSIDE BIRD SURVEY-1979

Number of Bird Species Observed

	McClusky Canal	Control
Spring	61	50
Summer	63	56
Fall	47	37
Winter	9	5
TOTAL	85	76

Number of Individual Birds Observed

	McClusky Canal	Control
Spring	3,305	1,793
Summer	1,781	862
Fall	4,217	923
Winter	626	51
TOTAL	9,929	3,629

Table 31

FIFTEEN MOST FREQUENTLY ENCOUNTERED SPECIES ON BREEDING SEASON SURVEY
(June 26-27, 1979)

Canal		Control	
Species	% of Stations	Species	% of Stations
Red-winged blackbird	96	Western meadowlark	86
Western meadowlark	92	Red-winged blackbird	80
Brown-headed cowbird	54	Horned lark	58
Mourning dove	50	Mourning dove	50
Bobolink	42	Brown-headed cowbird	48
Killdeer	32	Killdeer	30
Horned lark	32	Common grackle	24
Cliff swallow	30	Blue-winged teal	20
American coot	28	House sparrow	16
Blue-winged teal	28	American coot	16
Grasshopper sparrow	26	Chestnut-collared longspur	16
Yellow-headed blackbird	24	Yellow-headed blackbird	16
American bittern	24	Clay-colored sparrow	16
Common grackle	22	Upland sandpiper	16
Upland sandpiper	20	Gadwall	14

Table 32

FIFTEEN MOST NUMEROUS ENCOUNTERED SPECIES ON BREEDING SEASON SURVEY
(June 26-27, 1979)

Canal		Control	
Species	Number	Species	Number
Cliff swallow	280	Red-winged blackbird	133
Red-winged blackbird	207	Horned lark	79
American coot	169	Mourning dove	72
Mallard	166	Western meadowlark	68
Western meadowlark	114	Brown-headed cowbird	64
Brown-headed cowbird	84	Cliff swallow	50
Mourning dove	71	House sparrow	41
Lesser scaup	59	American coot	37
Yellow-headed blackbird	33	Common grackle	35
Bobolink	30	Blue-winged teal	30
Eared grebe	30	Chestnut-collared longspur	20
Blue-winged teal	27	Killdeer	19
Killdeer	22	Pintail	18
Common grackle	22	Gadwall	13
Canvasback	22	Yellow-headed blackbird	12

Table 33

NUMBER OF SPECIES AND INDIVIDUALS - ROADSIDE BIRD SURVEYS
1977 THROUGH 1979

	1977		1978		1979	
	Canal	Control	Canal	Control	Canal	Control
No. of Species	50	40	58	49	63	56
No. of Indiv.	1,401	793	2,086	1,388	1,781	862

similar increase in grebe numbers was not noted in the natural wetlands on the control route during the period, it is assumed that this species responded to the water level change in the canal channel.

The higher number of species and individuals recorded on the canal route compared to the control route is probably most related to the undisturbed grass cover provided along the right-of-way in contrast to the sparse vegetation along the control route where cropping, haying, and grazing limit the amount of cover available for feeding, nesting, and roosting.

Mourning Doves

Seventy-one doves were recorded on June 8 on the control route compared to 45 doves recorded on the canal route. The mean number of doves per mile on the control was significantly greater than the mean of the canal ($t=2.35$, $p < .05$).

The significantly higher numbers of doves on the control route compared to the canal route may be related to the greater percent of trees and farmsteads along the control route (4.6 percent) compared to the canal route (1.4 percent). Although considerable ground nesting occurs in the Plains States, shelterbelts planted in this area have increased nesting habitat for doves (Keeler 1977). Although portions of shelterbelts along the canal alinement were removed during construction, 46,000 trees and shrubs have been planted on the canal right-of-way. Repeating these surveys after these plantings become established would determine the response of dove populations to this new habitat.

Mammalian Predators

Table 34 summarizes the results of the 1979 survey. Since the data collected in 1978 was limited by rain, it is not comparable to this year's data.

Table 34

McCLUSKY CANAL PREDATOR SCENT STATION SURVEY ABUNDANCE INDEX
SEPTEMBER 11-19, 1979

	Control Route		Canal Route	
Number of Operable Station-Nights (of possible 100)	71		98	
Species	No. of Visits	Index*	No. of Visits	Index*
Skunk	8	112.7	17	173.5
Fox	12	169.0	7	71.4
Badger	0	0.0	6	61.2
Raccoon	0	0.0	2	20.4
Weasel	1	14.1	1	10.2
Mink	0	0.0	1	10.2
Domestic cat	4	56.3	4	40.8
Domestic dog	5	70.4	3	30.6
Unidentified canine (possibly coyote)	0	0.0	2	20.4
Unidentified Predator	6	84.5	13	132.7
Total Predator Visits	36	507.0	58	591.8

*Index = $\frac{\text{Total Number of Visits}}{\text{Total Number of Operable Station-Nights}} \times 1{,}000$

The higher number of fox on the control routes compared to the canal routes was statistically significant based on the scent station results (x^2=3.929, $p < .05$). However, spotlighting data (see Deer Study, Table 35) showed no significant difference in fox occurrences between the two routes (x^2=0.802, $p \geq .05$). Both surveys show no significant difference in the occurrence of skunks on the canal and the control routes (scent survey x^2=1.207, $p \geq .05$; spotlight survey x^2=2.701, $p \geq .05$).

It must be emphasized that in this limited analysis, only 1 year's data is used. Several years' data will be needed before predator population trends can be determined.

Deer

The winter aerial survey resulted in a total of 75 deer (0.63/km or 1.0/mi) observed along the canal compared to 6 deer (0.04/km or 0.07/mi) along the control route (Table 35). The late-summer spotlight survey resulted in a total of 13 deer (0.21/km or 0.34/mi) observed along the canal route compared to 4 deer (0.10/km or 0.17/mi) along the control route (Table 36).

The surveys demonstrate the importance of the idle grassland along the canal as a source of food and cover for wildlife, especially during the winter. Sixty-five of the deer (over 85 percent) observed along the canal route during the aerial survey were on the canal right-of-way. Although snow cover was well above average throughout the entire area, the banks of the canal were one of the few areas where grasses were still available as food and cover for deer and grouse. The agricultural land outside of the canal right-of-way, including the control route, had very little vegetation above the snow cover with the exception of unmowed wetland vegetation and planted treebelts.

Table 35

McCLUSKY CANAL AERIAL SURVEY - MARCH 1979

Species	McClusky Canal		Control Route	
	No. Observed	Mean No./Km	No. Observed	Mean No./Km
White-tailed deer	75	0.630	6	0.040
Red fox	5	0.040	3	0.020
White-tailed jackrabbit	2	0.020	3	0.020
Sharp-tailed grouse	78	0.660	1	0.007
Gray partridge	--	--	9	0.070

Table 36

SPOTLIGHT SURVEY - AUGUST 29-30, 1979

Species	McClusky Canal (61 km)		Control Route (38.6 km)	
	No. Observed	No./10 km	No. Observed	No./10 km
White-tailed deer	13	2.13	4	1.04
White-tailed jackrabbit	30	4.92	13	3.37
Red fox	8	1.31	1	0.26
Muskrat	3	0.49	2	0.52
Striped skunk	4	0.66	0	0.00
Badger	1	0.02	1	0.26
Raccoon	1	0.02	0	0.00
House cat	4	0.66	3	0.78
Short-eared owl	3	0.49	5	1.31
Burrowing owl	2	0.33	0	0.00

Small Mammals

Five species (127 individuals) were trapped during 1,126 trap nights (112.8 per 1,000 trap nights) on the McClusky Canal right-of-way. In comparison, 30 small mammals of 4 species were trapped during 1,140 trap nights (26.3 per 1,000 trap nights) on the control transects in agricultural areas (Table 37).

All canal transects had higher average vegetation densities than did the control transects (Figure 13).

Highest numbers of small mammals were found on the idle smooth brome canal transect which also had the highest vegetation density reading of all plots. The lowest number of small mammals was trapped on the black-tilled soil off-canal transect with a vegetation density reading of zero.

Voles were the dominant species on the canal while deer mice were the most frequently captured species on the agricultural transects.

Approximately four times more small mammals were trapped on the canal right-of-way than on adjacent agricultural lands in both 1978 and 1979. The relative abundance of species trapped generally remained the same in both years. Franklin's ground squirrel, jumping mouse, and house mouse were trapped in 1978 but not in 1979. This species difference is possibly due to the different trapping methods employed in 1978. The high number of rodents trapped on the stubble field transect may be related to the idle grassland adjacent to this plot.

Table 37

SMALL MAMMAL TRAPPING RESULTS BY SPECIES AND HABITAT - 1979
(Animals Trapped Per 1,000 Trap Nights)*

Species	McClusky Canal					Control				
	Idle Dom. Grass	Idle Smooth Bromegrass	Idle Green Needlegrass	Idle Nat. Prairie	All Habitats	Hayed Nat. Prairie	Stubble Field	Black-Tilled Soil	Grazed Nat. Prairie	All Habitats
Masked Shrew	—	3.7	3.4	—	1.8	--	--	--	—	--
Thirteen-lined Ground Squirrel	—	--	--	3.5	0.9	—	3.5	--	--	0.9
Franklin's Ground Squirrel	--	--	—	--	--	--	--	--	—	--
Pocket Mouse	3.5	--	--	--	0.9	--	--	--	--	—
Deer Mouse	14.1	—	48.4	--	16.0	17.8	42.4	10.1	3.6	18.4
Grasshopper Mouse	--	--	--	--	--	--	3.5	--	--	0.9
Vole	42.4	212.7	31.1	94.0	93.2	10.7	7.1	—	7.2	6.1
Meadow Jumping Mouse	--	--	--	--	--	--	—	--	--	--
House Mouse	--	--	--	--	--	--	--	--	--	--
TOTAL	60.0	216.4	82.9	97.5	112.8	28.5	56.5	10.1	10.8	26.3

*Includes day capture.

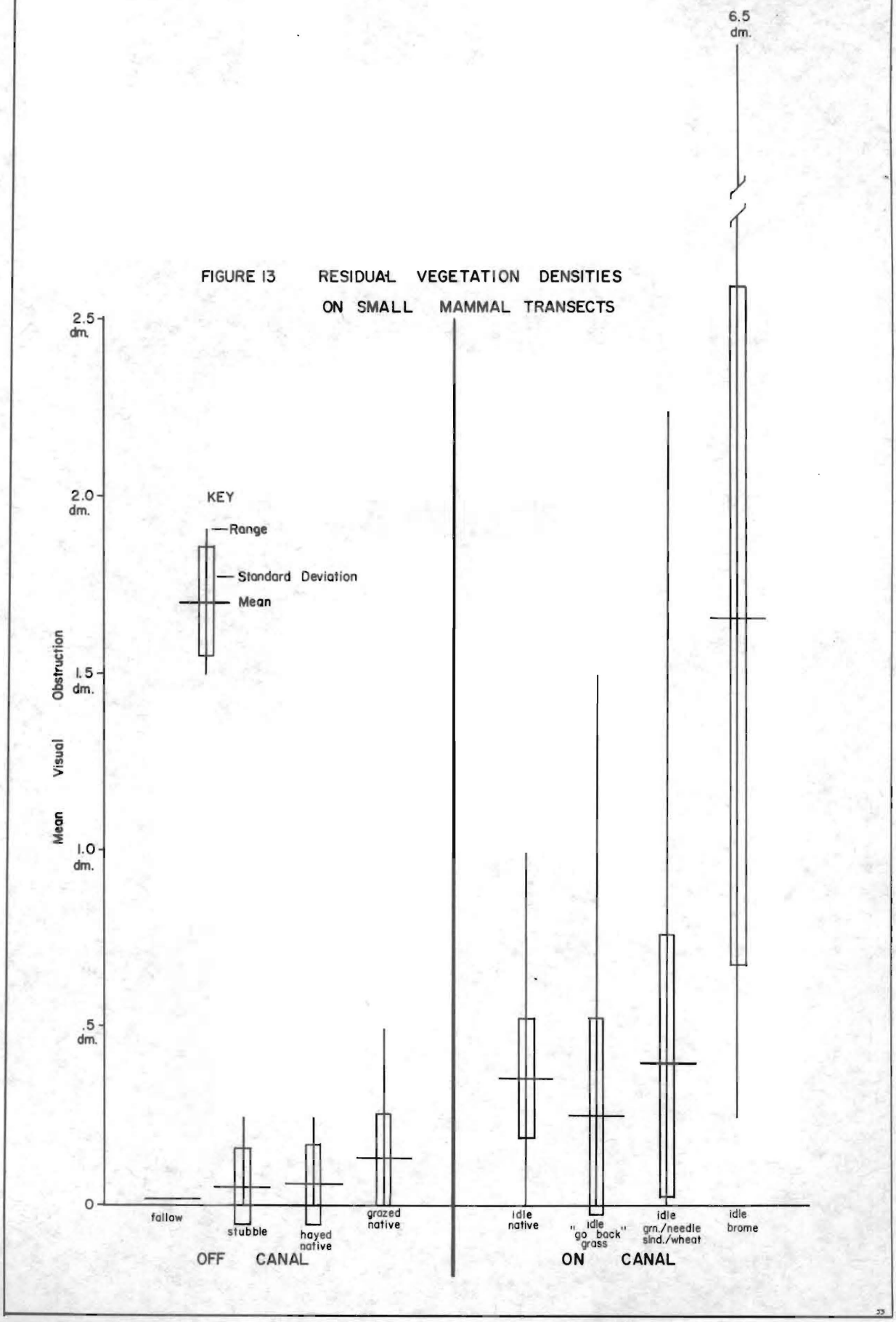


FIGURE 13 RESIDUAL VEGETATION DENSITIES ON SMALL MAMMAL TRANSECTS