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HABITAT USE BY NESTING AMERICAN COOTS IN SASKATCHEWAN PARKLANDS

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American Coots (*Fulica americana*) are the most abundant marsh species using prairie pothole habitat (Stewart and Kantrud 1972), but apart from Kiel's (1955) paper, little has been published on the factors that affect nesting densities and how nesting pairs are distributed throughout such habitat. Discussing research and management needs of the American Coot, Fredrickson (1977) stressed the need to document relationships between populations and habitat. Data for the present paper were collected during a study of Canvasbacks (*Aythya valisineria*) and Redheads (*A. americana*) from 1973–1975.

STUDY AREA AND METHODS

The study area (52°N, 106°W) is a 31.1-km² block, 4.83 × 6.44 km, 48 km east of Saskatoon, Saskatchewan. It is divided by roads and fence lines into 12 sections, each 259 ha. The area has been described elsewhere (Sugden 1977, 1978). Pond density averaged 17.6/km² in 1973, 23.6/km² in 1974, and 26.2/km² in 1975; size ranged from <0.04 ha–8.1 ha. Most ponds were partly, or wholly bordered with trees, mainly willows (*Salix* spp.) and trembling aspen (*Populus tremuloides*). The most common emergent species occurring in ponds used by coots were whitetop (*Scolochloa festucacea*), cattail (*Typha latifolia*), and sedge (*Carex atherodes*). *Scirpus* spp. was scarce.

Each year maximum depth of ponds was measured in early May and again in July. Ponds were assigned to 4 permanency categories (Sugden 1977, 1978) similar to those described by Martin et al. (1953) and Evans and Black (1956). Types 1 and 3 ponds are least permanent, whereas types 4 and 5 are most permanent. Pond areas were measured from maps prepared from aerial photographs. For data analysis, ponds were placed in 5 size classes (see Table 2). Ponds were assigned to 3 categories of estimated woody shore growth: open, 0–33%; half-open, 34–66%; and closed, 67–100% (Smith 1971). Land use around ponds was recorded in late May as summer fallow, seeded to grain, seeded to oilseed, or as pasture.

Three coot counts were made on all 12 sections in 1974 during 9–13 May and 4 additional counts were made on 8 sections during 14–23 May. In 1975, 3 counts were made on the 12 sections during 8–15 May. Counts were made in conjunction with duck counts and not all coots were seen. Therefore, assuming the same percentage was seen each time, the results represented an index to numbers of coots present (Kiel 1955:192).

Emergent cover on all ponds was systematically searched twice for nests, the first search commencing in late May and the last ending in late July. The average interval between searches was about 35 days. With few exceptions, only active nests with eggs were recorded. The exceptions involved nests with clutches that had hatched recently or had been destroyed, and when, in the latter case, there was no nest on the pond that could be considered a renest resulting from the one destroyed. Total nests for a given pond were recorded as the largest number found during either search. The maximum number was recorded during the first search on a majority of ponds. In 1974 and 1975, nest locations were plotted on maps,

permitting calculation of all new nests, including those that were likely renests based on evidence of destroyed nests.

In 1975, water depth at nest-sites, kind of support, and nest material were recorded. Distances between nests within ponds were also measured in 1975 on all ponds with more than 1 nest on 6 of the sections. To increase sample size for ponds with over 4 nests, such ponds from the remaining 6 sections were included. Nest locations were marked with a stake or a ribbon on a nearby willow. In November, distances between marked nests were measured by pacing between them on the ice and plotting their locations with the aid of a compass.

RESULTS AND DISCUSSION

Excluding type 1 ponds which were not used by nesting coots, the numbers of types 3, 4, and 5 ponds on the block were, respectively, in 1973: 187, 140, 74 (total = 401); 1974: 180, 250, 205 (635); 1975: 248, 279, 174 (701). Proportions of ponds in the 3 categories of woody shore growth were similar in all years and averaged 49% open, 13% half-open, and 38% closed. On the average, large ponds tended to be more open than small ponds ($\chi^2 = 56.2$, df = 8, $P < 0.001$). High water levels prevailed in 1974 and 1975 and much of the peripheral willow growth was inundated throughout those breeding seasons.

Although new nests were found on some ponds during the second search in each year, total nests for such ponds seldom exceeded totals for the first search. In 1973, 410 nests were found on ponds that yielded equal or higher totals during the first search. Thirteen (3.1%) were on ponds that had higher totals during the second search. In 1974, 56 new nests were found during the second search and of these, 26 (4.7%) of the grand total resulted from higher totals for ponds searched a second time. The remaining 30 were probably renests. During the second search in 1975, 159 new nests were found and 52 (5.1%) were on ponds having higher totals during that search. The others (107) were believed to represent renests. In addition to the small proportion of new nests located by second searches, 2 observations helped to justify the method for calculating the total nesting population. Many of the ponds having fewer nests during the first search were among those that were searched earliest (late May). Thus, a pair of coots and perhaps a nest structure would be seen, but the clutch was not present until the second search. On the other hand, when new nests were found but the total for the pond did not increase, there was usually evidence that the original nest(s) had been lost.

Habitat use.—Based on nest counts, there were 423 nesting pairs on the study block in 1973, 555 in 1974, and 1013 in 1975 for respective densities of 13.6, 17.8, and 32.6 pairs/km^2. Nests were not found on type 1 ponds and an average of only 5% occurred on type 3 ponds (Table 1). A similar relationship was shown by Kiel (1955:193) who found only 2.3% of

TABLE 1
COMPARISON OF POND USE BY NESTING COOTS FOR 3 PERMANENCY TYPES AND 3 YEARS

Year	Pond type	Percent of all nests	Percent ponds used	Mean pond area (na)/nest			
				All ponds	All nest ponds	>1-nest ponds	1-nest ponds
1973	3	7	12	2.11	0.45	0.49	0.42
	4	43	67	0.38	0.32	0.30	0.38
	5	50	80	0.35	0.32	0.30	0.55
	Total	100	44	0.48	0.33	0.31	0.42
1974	3	5	12	1.55	0.36	0.55	0.29
	4	30	46	0.69	0.45	0.49	0.41
	5	65	80	0.54	0.50	0.46	0.61
	Total	100	48	0.63	0.48	0.47	0.49
1975	3	5	19	0.75	0.27	0.29	0.27
	4	35	77	0.32	0.29	0.29	0.28
	5	60	93	0.33	0.33	0.30	0.57
	Total	100	60	0.35	0.31	0.30	0.35
All years	3	5	15	1.32	0.34	0.47	0.31
	4	36	63	0.42	0.33	0.33	0.34
	5	59	85	0.40	0.38	0.35	0.59
	Total	100	52	0.46	0.36	0.34	0.41

the nests on "temporary" ponds, which were roughly equivalent to my type 3. Many of the unused type 3 ponds became dry during the breeding season. Those that were occupied had average nest densities similar to those on types 4 and 5 ponds. A majority of the coots nested on types 4 and 5 ponds in all years. Nest densities on these 2 types (Table 1) were similar. This is contrary to Fredrickson's (1977:125) statement that highest densities occur on type 4 wetlands.

The ability of American Coots to select nest ponds that maintain water throughout the breeding season has been noted by Kiel (1955:194) and Smith (1971:28). In my study, only 2 nests were found on ponds that became dry. Both ponds dried up after the eggs hatched but before the young fledged. The birds may have moved to nearby ponds. The relationship of both pond permanency and size to use by nesting coots in illustrated by mean densities for the 3 years (Table 2). Nest densities on the 12 sections were directly related to the total area of types 4 and 5 ponds. Regression equations for the 3 years are as follows (Y = coot nests, X = ha of types 4 and 5 ponds per 259-ha section): 1973, $Y = 3.23X - 3.61$,

TABLE 2
THREE-YEAR AVERAGES FOR COOT NESTS/POND[a] BY 3 PERMANENCY TYPES AND 5 SIZE CLASSES

	Size class (ha)					
Type	<0.21	0.21–0.40	0.41–0.81	0.82–1.62	>1.62[b]	Average
3	<0.01	0.22	0.55	0.11	1.20	0.17
4	0.45	0.80	1.30	2.29	5.10	1.06
5	0.38	1.01	1.62	3.08	6.92	2.61
Average	0.24	0.67	1.29	2.53	6.28	1.15

[a] Three-year pooled nests/3-year pooled ponds.
[b] Mean size was 2.92 ha.

$r = 0.90$, $P < 0.001$; 1974, $Y = 5.85 + 1.54X$, $r = 0.72$, $P < 0.01$; 1975, $Y = 11.77 + 2.74X$, $r = 0.87$, $P < 0.001$.

Within any of the 5 size classes of ponds, nest densities were unrelated to the amount of tree growth around ponds ($\chi^2 < 5.0$, df = 2, $P > 0.05$). This was also true for the kind of land use around ponds ($\chi^2 = 0.3$, df = 2, $P > 0.80$).

Nesting chronology.—Seven counts on 8 sections during 9–23 May 1974 indicated that the coot population on the area was stable by mid-May. Most, if not all, of the birds apparently nested. Flocks of obviously non-breeding birds were not observed. Notwithstanding the limitations of the coot counts, the low numbers seen compared with the numbers known to nest, also suggested a high incidence of nesting. In 1974, the maximum count yielded but 62% of the number known to nest. In 1975 it was 43%.

Shortage of nesting cover during mid- to late May at the peak of nest initiation, apparently caused some pairs to delay nesting—a phenomenon described for coots in Iowa by Fredrickson (1970:450). Emergent cover became available last on the deepest parts of a few large ponds and the latest nesting occurred here. Some pairs, unable to secure a territory early in the season, did so later when new cover became available. Coots were present on some ponds that lacked cover and nests during the first search (late May); nests were established later when new plants emerged. Fjeldså (1973), in a study of breeding European Coots (*Fulica atra*) on a 140-ha complex of marshes in Denmark, described territorial regulation that involved both space and time. All available nesting areas of the marsh were occupied and egg-laying was underway in mid-April by 1 group of European Coots while non-breeders remained on the open parts of the marsh. As clutches of the first group hatched and the parents with downy young moved into denser cover, pairs from the second group established nests

in the vacated territories. The first group comprised 62 pairs and the second group, 40 pairs; the later believed to be mostly first-year breeders, based on nest and egg measurements (Fjeldså 1973:124). In Saskatchewan, the breeding season is at least a month shorter, so is probably too short to allow such protracted use of nesting habitat. Moreover, few marshes would be large enough to accommodate nesting and non-breeding birds simultaneously. Any delayed nesting on my area was caused mainly by late growth of nesting cover, not the vacating of space by early nesting pairs.

Nest distribution.—The distance from 1 nest to the nearest nest within a pond was measured for 577 nests on 121 ponds in 1975. Distances ranged from 22 to 145 m ($\bar{x} = 54 \pm 20$ m). Mean distance did not differ among pond size classes or with numbers of nests per pond ($P > 0.05$, Duncan's new multiple-range test). Only 22% of the nests were closer than 40 m. Some of the closest nests were separated by dense cover, particularly willows and cattails, which would reduce interpair contact (Fjeldså 1973:119). However, a few had no such barriers; these usually occurred on small ponds with the longest axis equal to the nest-to-nest distance.

Gullion (1953:181) showed that the distribution of coot nests on 2 California wetlands, 1.1 and 4.9 ha, was governed mainly by territorial spacing and the distribution of nesting cover. This was also true for the pothole habitat in my study where total amount of emergent nesting cover was unimportant. Small patches of cover (often isolated willow or cattail clumps), well distributed throughout a pond, were used as efficiently by coots for nesting as were extensive stands of cover. Few ponds were without some cover near shore and on many ponds cover occurred only here; nest distribution (Fig. 1) reflected these cover patterns. On large ponds the complete lack of cover in the interior portions probably limited the number of nesting pairs that the pond could otherwise have supported (Fig. 1). However, on large ponds with well-dispersed cover, coots tended to nest farther from shore. Therefore, lack of interior cover would, in part, be compensated for by the relatively high use of peripheral areas dictated by cover distribution. In 1975, 6 ponds over 3 ha with only peripheral cover had a mean density of 2.8 nests/ha compared with 3.7 nests/ha on 4 ponds having well-distributed cover. The difference was not significant ($t = 2.03$, df = 8, $P > 0.05$).

These results cannot be considered conclusive because no 2 ponds were alike in size and shape, both of which interact with cover dispersion. As ponds become smaller and/or depart from a circular shape, lack of interior cover would become less important and be replaced by territorial spacing as the key factor limiting nest densities on ponds having only shore cover. Available space would limit the number of nests regardless of their loca-

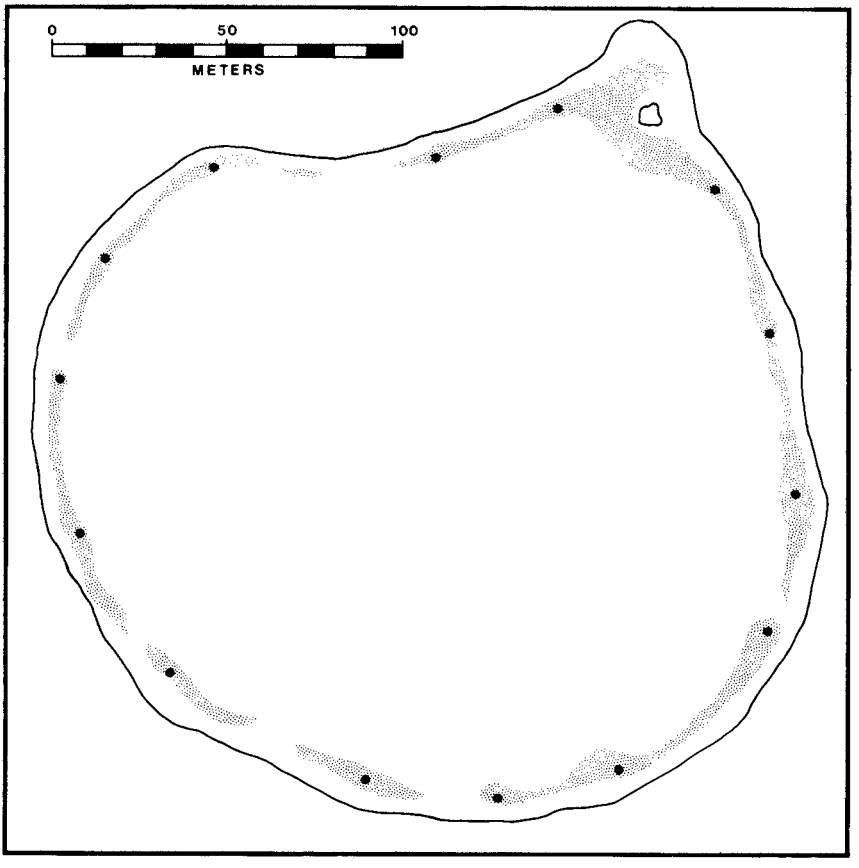

FIG. 1. Distribution of 14 coot nests on a 3.75-ha pond having only peripheral *Scolochloa festucacea* cover (shaded), 2 June 1975.

tions. On many ponds under 2 ha with more than 1 nest, the fact that nesting coots were restricted to shore cover probably permitted higher nesting densities than would have been possible where pairs could occupy interior cover. Within the spacing mechanism characteristic of coots, maximum possible nest densities occur on ponds under 2 ha when nests are located near shore.

Weller and Fredrickson (1973:287) showed that highest densities of coot nests on a 162-ha marsh in Iowa occurred when open water occupied about 50% of the area. Less open water resulted in fewer nests. Ponds on my area normally provided more than 50% open water in May when most nests were started. A few nest ponds became completely overgrown with

TABLE 3
AVAILABLE AREA FOR NESTING COOTS ON OCCUPIED PONDS

Available area per pair (ha)[a]	Percent of nesting pairs					
	>1 nest per pond			1 nest per pond		
	1973 (330)[b]	1974 (371)	1975 (773)	1973 (93)	1974 (184)	1975 (240)
to 0.10	0	0	2	5	8	15
0.11–0.20	23	8	16	26	17	27
0.21–0.30	46	24	43	12	13	13
0.31–0.40	8	14	21	16	15	22
0.41–0.50	12	16	13	10	11	6
0.51–0.60	6	12	3	9	7	4
0.61–0.70	3	10	t[c]	9	3	4
0.71–0.80	1	4	t	3	5	4
0.81–0.90	0	6	0	5	9	3
0.91–1.00	0	5	1	1	2	*t*
>1.00	1	1	t	4	10	2

[a] Pond area/number of nests.
[b] Number of nests.
[c] t = <0.5%.

whitetop later in the season and it is possible that this discouraged unsuccessful coots from renesting; data on this aspect are lacking.

Territory size was not measured, but data on maximum size were obtained. Considering ponds with 2 or more nesting pairs, over 60% of the pairs must have had territories under 0.3 ha in 1973 and 1975 (Table 3). This is supported by nest-to-nest distances. Circular territories with nests 50 m apart would have provided about 0.2 ha per pair—less when nests were near shore. The greater space available per pair in 1974 suggested that territories were larger then; however, distances between nests were not measured. Kornowski (1957) compared the sizes of 91 European Coot territories on 2 large wetlands—one rich in food resources and the other apparently not rich—and concluded that territory size was inversely related to food yield. On the other hand, Gullion (1953:180), who found that areas defended by 5 marked coot pairs on 2 California wetlands ranged from 0.22 to 0.56 ha and averaged 0.43 ha, believed that the main function of the territory was undisturbed reproduction.

On ponds with 1 nesting pair, the area available to a pair would not be influenced by other pairs. Thus, proportionately more solitary pairs were able to use areas under 0.2 ha than those pairs that shared ponds (Table 3).

Nesting cover.—Coots used emergent plants and other objects for nest support. In 1975, the main support materials for 1013 nests were: whitetop

(37%), willow (24%), cattail (21%), and sedge (9%). Earliest nests were started about mid-May and these usually were supported by dead cattails or flooded willows, the principal materials available then. When new growth of whitetop and sedge became available in late May and early June, these plants—particularly whitetop—were used more often. At this time they appeared to be preferred over flooded willows for nest support, perhaps because they allowed the coots to nest farther from shore.

Floating nests (7%) occurred in relatively deep water and were most often anchored to whitetop plants. Fewer than 1% of the nests were supported by the pond bottom. Such nests were in shallow water, usually near shore, so likely these would have comparatively low success due to predation and disturbance (Fjeldså 1973:122). There was 1 exceptional condition under which coots readily built bottom-supported nests in the absence of cover. On 26 June 1975, strong winds and rising water levels from heavy rain destroyed both coot nests and cover (mainly whitetop) on a few large ponds. Two days later, coots on these ponds were building structures near shore in shallow water; some eventually became nests. Apparently the territorial bond was so strong that, despite lack of cover, they remained to renest.

In nests supported by whitetop, cattail and sedge, 78% were constructed of the same material as comprised their support, a proportion similar to one given by Fredrickson (1970:448). Dead cattail was used in 29% of nests supported by whitetop and sedge. The latter were used in only 2% of cattail-supported nests. Cattail was the main material in 19% of the willow-supported nests, whitetop in 39%, and sedge in 40%.

Nearby nest material was not essential to nest-site selection; coots evidently carried components several meters to some nests, particularly those supported by willows. Vegetation was usually obtained from the pond but, on a few occasions, coots obtained it (including wheat straw) from dry land.

At 930 nests supported by plants, water depth averaged 70 cm (range = 8–152), and did not differ among plant species ($P > 0.05$, Duncan's new multiple-range test). However, depth at floating nests ($\bar{x} = 100$ cm, range = 34–142, N = 72, $P < 0.01$) was greater, and depth at bottom-supported nests ($\bar{x} = 19$ cm, range = 10–28, N = 6, $P < 0.01$) was less. These measurements were made in a year of high water levels, so are probably higher than would prevail in most years.

SUMMARY

American Coot nest densities on a 31.1-km² block during 1973, 1974, and 1975 were, respectively, 13.6, 17.8, and 32.6 nests/km². Consistent with territoriality in this species, nest numbers increased directly with pond size. Occupancy rate also increased with pond permanency, however, nest density on occupied ponds was independent of permanency type.

Only 2 of 1991 nests occurred on ponds that became dry before the young could have fledged. Close to one-half of the pairs occupied territories of less than 0.3 ha. There was some indication that territory size was influenced by available space, but this was not verified. In 1975, the distance to the nearest nest on the same pond ranged from 22 to 145 m ($\bar{x}$ = 54 ± 20 m, N = 577).

Most, if not all, coots attracted to the area apparently nested, though a small proportion of pairs delayed nesting until additional nest cover became available through new emergent plant growth. Territorial spacing and the distribution of nesting cover were the main factors governing nest distribution. Most ponds had sufficient cover to accommodate all the coot nests possible under the spacing behavior of this species.

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