

Effects of Coots on duck densities in Saskatchewan parkland

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Introduction

American Coots *Fulica americana* aggressively defend interspecific territories against many avian species; even mammals may be attacked if they enter Coot territories (Ryder 1959). There is disagreement, however, about the effect of agonistic interactions between Coots and ducks. Brooks (1941), Sooter (1945), Harris (1954), A. G. Smith (1955), and R. I. Smith (1956) thought that Coot populations at high densities could limit nesting, feeding, and loafing sites available to breeding ducks. Munro (1939), Low (1940, 1941), Hochbaum (1944), and Stevens (1947) thought that Coot aggression did not seriously impair duck nesting and brood-rearing. Later work described the biology of Coots in detail (Guillion 1953, 1954; Miller & Collins 1954; Hunt & Naylor 1955; Kiel 1955; Ryder 1959, 1961; Fredrickson 1970), but did not resolve whether Coots were, in fact, a "problem".

The inability adequately to test for a depression of duck productivity in the presence of dense Coot populations was, firstly, because most studies were short-term and thus few data were collected. For example, duckling mortality might arise from Coot-inflicted injuries, but Munro (1939) was unable to relate small brood size to dense Coot populations. Secondly, environment influences on duck population density could not be separated from the influence of dense Coot populations. It is generally accepted that breeding population size in ducks depends on available breeding habitat, measured by pond abundance (e.g., Stoudt 1969). Weller and Fredrickson (1973) and Ryder (1961) noted that Coot population size also depends on breeding habitat availability. Thus, environmental variation may obscure relative changes in duck and Coot population sizes. Ryder (1961) manipulated Coot densities and studied duck productivity, but his experiment still had this restraint and was of short duration.

This paper tests two hypotheses. First, if Coots adversely affect some duck species, then these should show population densi-

ties inversely related to Coot density. Second, because there is greater potential for overlap in nesting habitat (emergent vegetation) and perhaps diet between diving ducks *Aythya* spp. and Coot, than between dabbling ducks *Anas* spp. and Coot (primarily in loafing and feeding sites; Ryder 1959), the intensity of negative relationships between diving duck densities and Coot density should be the greater.

Methods

I used 26 years (1952–1977) of duck and Coot census data and pond abundance data from the 12.9 km² (64.4 km transect, 0.2 km wide) Redvers Waterfowl Study Area in southeastern Saskatchewan. The bulk of the data were collected by J. H. Stoudt. I collected the 1977 census data. General information about the area can be found in Stoudt (1969, 1971, 1973).

Dzubin (1969) described the potential biases in census data collected on transects. However, as absolute population densities are not involved in this paper, but indices of population size, the data are suitable for the analyses. Duck and Coot populations at Redvers were censused in early May, early June, early July and late July from 1952 to 1964. Censuses usually took 3 to 5 days to complete and commencement dates varied from 1 to 11 May, 1 to 4 June, 29 June to 13 July, and 22 to 26 July, respectively. Eight and 6 censuses were conducted in the drought years of 1961 and 1962, respectively. Only 1 July census (between 11 and 23 July) was carried out each year from 1965 to 1977; dates of the May and June censuses varied as in previous years. Observed pairs, lone drakes and females, flocks, and females with broods, were counted in each census.

Since indicated breeding pairs (calculated from sex ratio information in Dzubin [1969]) was highly correlated with observed breeding pairs ($p < 0.01$) for all species, I used observed breeding pairs of each species as an index to population size in the nesting period. The observed number of females with broods of each species

was used to index brood density during the brood-rearing period.

Seven species of dabbling ducks (Mallard *Anas platyrhynchos*; Gadwall *A. strepera*; Pintail *A. acuta*; Green-winged Teal *A. crecca*; Blue-winged Teal *A. discors*; Wigeon *A. americana*; and Shoveler *A. clypeata*) and four species of diving ducks (Redhead *Aythya americana*; Canvasback *A. valisineria*; Lesser Scaup *A. affinis*; and Ruddy Duck *Oxyura jamaicensis*) were examined. Coot effects on breeding population density were assessed in the appropriate census period. Hence, May census data were used in the analyses of Mallard, Pintail and Canvasback and June censuses were used for all other species except Ruddy Duck. Ruddy Ducks generally nest later than other ducks (see Weller & Spatcher 1965) and so July census data were used. All species' brood densities were examined using July census data; however, insufficient data were available to test Coot effects on brood density of Ruddy Ducks.

To control statistically the variation in pond abundance, to which ducks and coots respond in a similar fashion, I used partial correlation analysis (Nie *et al.* 1970) and searched for negative correlation coefficients between the densities of each duck species and Coot density as these might indicate competitive interaction (Pianka 1976). For each correlation, the densities of all other species were used as indicators of environmental conditions because, first, all species respond positively to increased pond abundance, and second, all duck

species potentially interact with each other ('diffuse competition'). Thus these analyses overcome the two pitfalls of earlier attempts to assess the effects of dense Coot populations on densities of breeding waterfowl (i.e., small samples and uncontrolled environmental variability). These advantages outweigh disadvantages imposed by the manner of data collection and allow an 'assay' for competitive interactions in duck-Coot associations. Dean & Ricklefs (1979) used a similar approach to investigate competition among parasites of Lepidopteran larvae for hosts.

Results and discussion

Tenth-order partial correlation coefficients of population sizes of ducks and population size of Coots in both the nesting and brood-rearing periods are shown in Table 1. Eleventh-order partial correlation coefficients, found by 'partially out' pond abundance in addition to all other species in a given correlation, were not appreciably different from those obtained by removing the effects of all other species alone (Table 1). Thus, fluctuations in the densities of all other species were sufficient indicators of fluctuations in the environment and the influences of diffuse competition and environmental variation are controlled in a given duck species-Coot correlation.

No clear pattern of competition emerged. Only 5 of 11 coefficients describing the correlation between nesting-pair density and Coot density were negative,

Table 1. Partial correlation coefficients of duck species' densities with Coot density at Redvers, Saskatchewan holding all other species and densities constant. Coefficients from analyses in which pond abundance was also controlled appear in brackets.

Species	Partial correlation with Coot density		
	May	June	July
Mallard	-0.13 (-0.13)		0.01
Gadwall		0.26 (0.28)	-0.25
Pintail	0.47 (0.51)		-0.40*
Green-winged Teal		0.11 (0.03)	-0.25
Blue-winged Teal		0.15 (0.12)	0.36
Wigeon		0.26 (0.38)	-0.26
Shoveler		0.60 (0.67)	0.25
Redhead		-0.30 (-0.41)	-0.27
Canvasback	-0.32 (-0.39)		0.59
Lesser Scaup		-0.02 (-0.06)	0.21
Ruddy Duck			-0.14 ^a

* $p < 0.05$ (one-tailed test of significance).

^a Breeding pairs.

but none were significant. Thus, the hypothesis that dense Coot populations limit breeding populations of ducks (by limiting nesting, feeding, and loafing sites) is not supported. It follows that the hypothesis that dense Coot populations suppress diving duck populations to a greater extent than dabbling duck populations cannot be supported either. However, it is interesting to note that all 4 diving duck species had a negative sign in the correlation with Coot density, and only 1 of 7 dabbling duck species showed a negative sign.

Five of 10 coefficients relating brood densities to Coot density were negative. Only Pintail brood density was significantly lower in the presence of high Coot densities, but I have no biological explanation for this. The result is probably a statistical artifact (Type I error). The relationship was significant for the species for which it was least expected (e.g., none of 3 diving-duck brood densities were significantly depressed).

The patterns observed at Redvers may not be representative of other duck-Coot associations and duck numbers might actually be suppressed where the density of Coots is greater. That seems unlikely, however, because the data used in these analyses encompass a wide range of coot and duck densities. Coot population size ranged from zero to 223 pairs; data for waterfowl can be found in Stoult (1969, 1971, 1973).

Coots therefore are not an important factor affecting duck densities in either the nesting or brood-rearing periods in Saskatchewan parkland. It has been 40 years since Brooks (1941) wrote of the detri-

mental nature of Coots on duck productivity, but a test of his hypothesis had to await the accumulation of sufficient data.

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Summary

The hypothesis that high nesting densities of American Coots *Fulica americana* might impair breeding duck productivity by suppressing duck population densities was investigated using 26 years of duck and Coot census data and pond abundance data collected at Redvers, Saskatchewan. Using partial correlation to hold environmental variation and effects of interactions with other species constant, each duck species' density was correlated with Coot density in both the nesting and brood-rearing periods. No patterns emerged which were consistent with the hypothesis that Coots detrimentally affect breeding duck densities.

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