

SHORT COMMUNICATIONS

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SURVIVAL RATES OF ARTIFICIAL PIPING PLOVER NESTS IN AMERICAN AVOCET COLONIES¹

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Communal mobbing reduces nest depredation within the mobbing birds' breeding colonies (Göransson et al. 1975, Andersson and Wiklund 1978, Wiklund and Andersson 1980, Götmark and Andersson 1984, Elliot 1985). Mobbing also may increase reproductive success of non-mobbing bird species nesting nearby. Wiklund (1979) reported that Merlins (*Falco columbarius*) nesting within Fieldfare (*Turdus pilarus*) colonies had higher reproductive success than when nesting alone. Reproductive success of nesting grebes (*Podiceps occipitalis* and *Rollandia rolland*) seemed to be improved as a result of anti-predator behavior of nearby nesting Brown-hooded Gulls (*Larus maculipennis*) (Burger 1984). Black-bellied Plovers (*Pluvialis squatarola*) seemed to provide Buff-breasted Sandpipers (*Tryngites subruficollis*) with a "protective umbrella" by mobbing jaegers (*Stercorarius longicaudus*, *S. pomarinus*, and *S. parasiticus*) and Glaucous Gulls (*Larus hyperboreus*) (Paulson and Erckmann 1985). Piping Plovers (*Charadrius melodus*) nesting within colonies of mobbing Least Terns (*Sterna antillarum*) were more successful than plovers nesting outside colonies (Burger 1987).

American Avocets (*Recurvirostra americana*) nest colonially or semi-colonially (Gibson 1971, Hamilton 1975) and mob terrestrial and avian predators near their nesting sites (Gibson 1971; Hamilton 1975; Sordahl 1981, 1986). In the northern Great Plains, Piping Plovers and American Avocets nest in proximity on saline wetland beaches. Piping Plovers in this region were listed as Threatened under the Endangered Species Act in 1985 (U.S. Fish and Wildlife Service 1985).

In 1986 and 1987 we tested the hypotheses that survival rates of non-avocet nests within American Avocet colonies were greater than at non-colony sites, and that survival of neighboring nests increased as a func-

tion of avocet colony size. Our goal was to assess if a potential commensalistic relationship between American Avocets and Piping Plovers could be exploited as a plover conservation tool.

STUDY SITE AND METHODS

Our study site was a complex of seven alkali wetlands in The Nature Conservancy's John E. Williams Memorial Nature Preserve (JWMNP), McLean County, North Dakota. The wetlands ranged in size from 3.5-353.6 ha. American Avocets nested on salt-encrusted mud or gravel shoreline interspersed with saltwort (*Salicornia rubra*), saltgrass (*Distichlis stricta*), seepweed (*Suaeda depressa*), and alkaligrass (*Puccinellia airoides*). Piping Plovers, Killdeer (*Charadrius vociferus*), and Common Terns (*Sterna hirundo*) often nested within American Avocet colonies at JWMNP. Potential predators of ground-nesting birds at JWMNP included red fox (*Vulpes vulpes*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), badger (*Taxidea taxus*), mink (*Mustela vison*), long-tailed weasel (*M. frenata*), Franklin's ground squirrel (*Spermophilus franklinii*), thirteen-lined ground squirrel (*S. tridecemlineatus*), California Gull (*Larus californicus*), and Ring-billed Gull (*L. delawarensis*). We observed gulls depredating Piping Plover and artificial nests, and skunks destroying American Avocet nests. We also have circumstantial evidence implicating red fox and an unknown mustelid as predators of artificial and natural ground nests, respectively. Of 26 depredated Piping Plover nests for which evidence existed to identify the predators, 65% were depredated by mammals and 35% by avian species (Mayer 1990).

To improve experimental design and to obtain adequate sample sizes, we used artificial nests to simulate Piping Plover nests in tests of our hypotheses. Each nest consisted of a shallow scrape containing four Japanese Quail (*Coturnix japonica*) eggs similar in size, shape, and color to Piping Plover eggs. Nests were placed in a zig-zag pattern within a site, an average of 15 m apart (range = 8-21 m) in locations similar to those chosen by nesting Piping Plovers (Prindiville Gaines and Ryan 1988). Artificial nest spacing was based on Piping Plover inter-nest distances we observed at JWMNP. The number of artificial nests at an avocet

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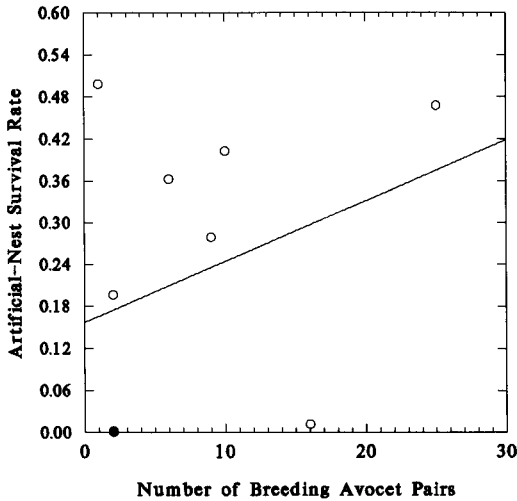


FIGURE 1. Relationship between American Avocet colony size and survival rates of artificial Piping Plover nests at the John E. Williams Memorial Preserve. The darkened circle indicates two hidden data.

colony was a function of the colony area. At noncolony sites the number of artificial nests was dictated by beach area. No nests were placed closer than 15 m from beach boundaries.

To test the effects of avocet presence/absence and of avocet colony size on survival rates of artificial nests, we placed nests at six sites without nesting American Avocets, and at 10 sites covering the range of avocet colony sizes at JWMNP (mean no. pairs = 7.5, range = 1–25). We placed from 7–18 artificial nests ($\bar{x} = 10.3$) at each site. Substrate, vegetation, and beach size were similar at sites with and without nesting avocets.

Sites were observed in June of each year during peak avocet nesting activity. We checked artificial nests every 6–12 days until the number of breeding avocet pairs at a site decreased by $\geq 50\%$ or until artificial eggs became bleached by the sun thereby reducing nest crypticity (Martin 1987). Artificial nests were exposed for a range of 16–25 days. Artificial nests were considered depredated if one or more eggs were damaged or eaten by predators. We estimated daily nest survival probabilities for each site based on nest exposure methods (Mayfield 1961) using the MICROMORT computer program (Heisey and Fuller 1985). Nest survival probabilities were then calculated for 28-day intervals, the mean incubation length for Piping Plovers at JWMNP (Prindiville Gaines and Ryan 1988). Mean survival rates of artificial nests between years and between beaches with and without breeding avocets were compared using *t*-tests. The possible relationship between colony size and survival rate was assessed using linear regression.

RESULTS

Mean survival rates of artificial nests within American Avocet colonies did not differ between years (1986: \bar{x}

= 0.17, SD = 0.22; 1987: $\bar{x} = 0.26$, SD = 0.21; $t = 0.640$, 8 df, $P = 0.54$). Mean survival rates at sites without nesting avocets also did not differ between years (1986: $\bar{x} = 0.39$, SD = 0.36; 1987: $\bar{x} = 0.47$, SD = 0.07; $t = 0.274$, 4 df, $P = 0.80$); therefore, we combined data from 1986 and 1987.

Mean survival rates of artificial nests did not differ between sites with nesting American Avocets ($\bar{x} = 0.22$, SD = 0.21, $n = 10$) and those without avocets ($\bar{x} = 0.42$, SD = 0.28, $n = 6$; $t = 1.586$, 14 df, $P = 0.14$). Additionally, American Avocet colony size did not affect survival rates of artificial nests ($Y = 0.009X + 0.157$, $r^2 = 0.110$, $P = 0.35$, $n = 10$) (Fig. 1).

DISCUSSION

Our data do not support the hypotheses that nest survival of non-mobbing birds breeding within avocet colonies is improved by the mobbing behavior of American Avocets or that larger avocet colonies would effect increased artificial nest survival rates.

The absence of an increased nest survival rate within American Avocet colonies may be a function of predator attraction to prey activity and prey ability to drive predators from colonies. Rodgers (1987) observed substantial nest predation in colonial waterbirds and believed that auditory, olfactory, and visual cues produced by the colony could attract predators. At JWMNP, predators may be attracted to American Avocet colonies where these large, conspicuous shorebirds indicate a potential food source. However, the small numbers of avocets per site at JWMNP were ineffective at driving out predators. Perhaps colonies must reach a critical size and density before avocets can successfully repel nest predators. Additionally, American Avocets may be less effective at driving off mammalian than avian predators (T. Sordahl, pers. comm.; Ryan, pers. observ.). Mammals are responsible for most Piping Plover nest losses at JWMNP (Mayer 1990).

Conversely, at sites without nesting avocets, the lack of prey activity provided no impetus for predators to initiate a search. At these sites, predators may discover artificial nests randomly. This may explain the marginally higher survival rates of artificial nests at sites unoccupied by avocets.

American Avocet nesting colonies did not increase the survival rate of associated nests. Hence, management to increase the number of or size of avocet colonies does not seem to be a useful strategy for enhancing reproductive success of Piping Plovers.

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OBSERVATIONS OF RAVENS PREYING ON ADULT KITTIWAKES¹

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Key words: Predator-prey interaction; Common Raven; *Corvus corax*; Black-legged Kittiwake; *Rissa tridactyla*.

From 9 May-15 August 1990 we participated in ongoing U.S. Fish and Wildlife Service research at Cape Peirce (58°35'N, 161°45'W), Togiak National Wildlife Refuge, in the northern Bristol Bay region of south-

western Alaska. Within the area of heaviest seabird nesting densities at Cape Peirce (ca. 3 km of linear cliff face), four Common Raven (*Corvus corax*) pairs were known to be nesting and an additional nesting pair was suspected. Due to this high density of breeding ravens, walking along the cliff-top perimeter for any distance without observing ravens patrolling (Birkhead 1974) for seabird eggs was unusual. As a result, numerous opportunities were available to observe interactions between ravens and Black-legged Kittiwakes (*Rissa tridactyla*). Here we report individual Common Ravens exploiting adult Black-legged Kittiwakes as a food

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