

in post-breeding pairing behavior on the Eastern Headland failed completely whereas nearly all gulls on Mugg's Island had fledged at least one chick so it is notable that aggressive post-breeding pairing behavior was more frequent at the former site than at the latter.

Coulson (1972) suggested that divorce was caused by asynchronous arrival of previous mates at the breeding colony in the year following the premature breakup of the pair due to nesting failure. He thus implied that a delay in pair formation and perhaps the additional time required to pair with a new individual were responsible for lower breeding success. Such an explanation does not account for the lower success of widowed than divorced individuals. Mills (1973) suggested that birds that changed mates for either reason began egg-laying later and laid smaller clutches because they had less foraging time resulting from more time spent pairing than gulls that did not change mates. One way for birds to overcome some of the disadvantage associated with changing breeding partners would be to form new pairs before the upcoming breeding season. I do not know whether the pair dissolutions I observed lasted to the next breeding season, but some Ring-billed Gulls may have ameliorated the disadvantages by obtaining a new mate immediately after breeding. In contrast, if widowed birds discover the loss of their previous mate only when they return to the breeding colony, breeding may be delayed and therefore comparatively less successful than for other pairs. Then some of the difference in breeding success between widowed and divorced individuals in kittiwakes and fulmars may be explained by pair dissolution and pairing with a new mate immediately after breeding.

The non-aggressive post-breeding pairing behavior I observed may strengthen pairbonds and the bond to the site thus facilitating reacquisition of the previous mate in the following breeding season. Returning to the same site in subsequent years is thought to play a major role in the reformation of pairs of colonial nesting birds (Hunt, pp. 113–151 in *Behavior of Marine Animals*, Vol. 4: *Marine Birds*, J. Burger, B. L. Olla and H. E. Winn, eds., Plenum, New York, New York, 1980).

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Consequences of mate loss to incubating Ring-billed and California gulls.—Recently, attention has been focused on the strategies that gulls, which have lost their mates, may employ to raise their offspring. It had been assumed that the only option for these gulls was to raise the young themselves. However, Pierotti (*Am. Nat.* 115:290–300, 1981) observed male Western Gulls (*Larus occidentalis*), which had lost their mates during the incubation period, recruiting new female mates who helped them raise their young. Pierotti (1981) argued that this seemingly altruistic behavior on the part of the female helpers would benefit them if breeding males were in short supply and if the female helpers were able to pair with these males in subsequent years.

Likewise a widowed female may be able to recruit a male to form a heterosexual pair or another female to form a female-female pair (Ryder, *Proc. Colonial Waterbird Group*

2:138–145, 1978). In the latter case, the second female could lay her eggs in the mutual nest, resulting in the supernormal clutch found in many nests attended by female-female pairs. Hence, each female would have a chance to raise her own offspring. Alternatively, female-female pairs may form at the beginning of the breeding season in the same manner as a heterosexual pair (Hunt and Hunt, *Science* 196:1466–1467, 1977).

Unfortunately, there are insufficient data to determine which mechanism accounts for most female-female pairings. Some female-female pairs show mate fidelity from one year to the next (Hunt and Hunt 1977; Kovacs and Ryder, *Auk* 98:625–627, 1981); consequently, once established, female-female pairs may re-mate in subsequent years in the same manner as heterosexual pairs, but this leaves unanswered the question of how these pairs are initially formed.

I had an opportunity in 1981 to study the consequences of mate loss in Ring-billed Gulls (*Larus delawarensis*) and California Gulls (*L. californicus*) when someone shot several color-banded birds early in the incubation period in the Potholes Reservoir colony near Moses Lake, Grant Co., Washington. As the nest-sites of these birds were known, I was able to observe the effect of this loss on the mate's behavior and breeding success. Additional subjects were added when I trapped and held their mates in captivity for a 2-week period before releasing the mates unharmed.

Among California Gulls, I identified five females and five males which had lost their mates early in the incubation period. On the first day after losing their mates, all of them left their territories for part of the day. This absence apparently resulted in egg predation because, by the following day, four of the females and three of the males had lost their clutches. One female retained her clutch for 1 week, possibly because her nest was located in heavy vegetation and was inconspicuous. After 2 weeks, only one of her three eggs remained and she had abandoned the nest. The two males still caring for their nests after the second day also were unsuccessful; one clutch was destroyed and the other was abandoned during the first week.

I also watched five female and three male Ring-billed Gulls which had lost their mates early in the incubation period. On the first day after losing their mates, three of the females and two of the males began leaving their territories, and within 24 h one male and one female had lost their clutches. By the end of the second day, all clutches were destroyed except for one cared for by a female and one by a male. The eggs in these two nests, however, were also destroyed or the nest abandoned within 1 week.

None of the Ring-billed or California gulls that lost mates was observed courting other birds. When other gulls landed on their territories, the birds drove them away. I did not observe any of these subjects setting up new territories elsewhere or re-nesting with new mates. Of course, this possibility cannot be excluded because some re-nesters could have escaped detection during my searches.

These observations contrast with those Pierotti (1981) made for male Western Gulls. All five males he observed recruited a female nest helper within 2 days. Within a similar period, most of the Ring-billed and California gulls which I watched had already lost their clutches. Possibly, this difference occurred because unattended eggs are more likely to be destroyed by neighboring gulls in Ring-billed and California gull colonies due to their smaller territories and nearness to neighbors. Additionally, Western Gull territories may be large enough for an unmated female to remain on the territory of an incubating, widowed male without provoking an attack. Thus, acceptance of a female helper could be accomplished gradually.

In this study, none of the female Ring-billed and California gulls which lost her mate attracted another female and formed a female-female pair. Hence, these results fail to support the hypothesis that most female-female pairings occur when a female loses her mate during the incubation period. I did not ascertain whether female-female pairings could form

when a female is widowed after being fertilized but before beginning to incubate. Nonetheless, given the short time involved, it is likely that too few females find themselves in that predicament to account for most of the female-female pairs.

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Intra- and extrapair copulatory behavior of American Crows.—The copulatory behavior of American Crows (*Corvus brachyrhynchos*) has not been described. The present observations on intrapair copulations (N = 28) and extrapair copulatory behavior were made at the Hendrie Ranch, 24 km S, Lake Placid, Highlands Co., Florida, January–April 1982, 1983, and 1984. The crows at the ranch were relatively tame as described earlier (Kilham, in press). Birds on nests, 6–8 m above ground, were viewed at distances of 10–20 m without the use of blinds.

Identification of sexes of breeding pairs.—My observations are based on two groups (7–9 crows each) of cooperatively breeding crows occupying territories with a common boundary. During the period of greatest copulatory activity, i.e., between the end of nest-building and the third day of incubation, the behavior of the sexes of breeding pairs were clearly distinguishable. The males, the dominant members of groups, devoted much time (unpubl.) to driving away or attempting to drive away some of the adult auxiliaries as well as mate-guarding, in which they either watched the nest when the female was on it or followed her closely wherever she flew. The males frequently held an upright stance and did more wing-tail flicking and “cawing” than other members of their group. One male, identified sexually at times of copulations, had a missing right rectrix in 3 successive years. The breeding females, in addition to egg-laying and doing all of the incubating, were distinguishable at times by their never attacking other crows of their own group and, when perched by their mates and elsewhere, in having hunched postures with wings hanging loosely, which gave them a relaxed appearance. One female, identified at times of copulation, had a forked tail due to a breaking off of central rectrices. Criteria distinguishing adult from yearling crows are described by Emlen (*Condor* 38:99–102, 1936).

Intrapair behavior.—Twenty-eight copulations were observed both on nests and on the ground. A female was giving slow *caw-caw-caws* on her nest on 13 January when her mate came to the rim and mounted. I heard a single *cu-koo*. The male settled, waving his outspread wings which came to hang over the edge of the nest. The female stood up beneath him, her tail vibrating up and down as he worked his tail under hers. On the next day, the second of egg-laying, he again came to the rim, placing a foot on her neck before mounting. This time her body sank low as her head tilted way back. The crows vocalized (bills open) so loudly that they were audible at 250 m. Similar loud cries were heard in 11 of the 28 copulations.

I watched a crow fly over a pasture on 2 February when it abruptly alighted on a female that was crouching in the grass in a pre-copulatory pose. In the copulation that followed, she put her head back. This was 70 m from the nest. I watched the same female feeding in a pasture later when her mate alighted 5 m away in the same pre-copulatory pose that she had exhibited earlier. She flew to him immediately, also taking a pre-copulatory pose. He