

# SOME EFFECTS OF WING TAGS ON BREEDING RING-BILLED GULLS

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**ABSTRACT.**—We examined the effects of wing tags on breeding Ring-billed Gulls (*Larus delawarensis*) by comparing the performance of tagged birds with that of color-banded birds. During the year of marking, effects seemed minimal. The following year, however, substantial differences were observed between the two groups. Fewer tagged birds returned to the colony and those that did were six days later, on average, than banded birds. About 60% of the tagged females were unable to acquire mates in the year after marking, but tagged males paired without apparent problems. Mean hatching date of tagged birds was three days later than banded birds. A large proportion of this group failed to raise any young, principally because tags seemed to interfere with pairing. Wing tags also may have affected birds at later stages of the reproductive cycle, but brood sizes for successful tagged and banded birds were similar in the year after marking. *Received 14 March 1984, accepted 9 June 1984.*

LONG-TERM studies of long-lived avian species often require that individuals be readily identifiable for a period of some years. In the last two decades, the patagial tag has been one of the more popular marking techniques used on birds (reviews in Marion and Shamis 1977, Kochert et al. 1983).

The use of plastic wing tags on Ring-billed Gulls (*Larus delawarensis*) was pioneered in 1967 at the Calcite colony in northern Michigan (Southern 1971). We continued to wing-mark gulls at this site intermittently through 1982. Many marked birds returned to the colony year after year; many apparently bred normally. On the basis of such casual observations, we considered the effects of tags to be negligible. Burley et al. (1982), however, recently found that color marking may have significant effects on bird behavior.

To evaluate the potential impact of tags on ring-bills, in 1982 we marked a second sample of birds with conspicuous color bands. Color-banded Ring-billed Gulls may not represent a true control group; however, we suggest that meaningful comparisons can be made between tagged and color-banded ring-bills to demonstrate some of the effects of tags. This paper summarizes our comparative observations on breeding performance of tagged and banded birds, primarily in the year after they were marked.

## METHODS

Our study was conducted at the Calcite colony near Rogers City, Michigan (Presque Isle Co., 45°N, 83°W). On 19 and 24 May 1982, during the late incubation stage, we cannon-netted 279 nesting Ring-billed Gulls in study plots semipermanently marked with surveyor stakes. We wrapped a yellow, disc-shaped Saflag wing marker around the patagium of 150 birds, fastening the ends with an aluminum eyelet and 1 or 2 heavy-duty staples. We marked 53 other individuals with 1 or 2 Darvic color bands (J. E. Warner, Durham, England). Color bands were yellow, orange, white, black, blue, and green. All marked birds were in non-edge, traditionally used areas of the colony. Nests of color-banded birds were intermingled with those of some wing-marked birds. We have no reason to suspect that age structure or other potentially biasing factors differed between the banded and tagged samples.

In 1982 one of us (LKS) spent 163 h after cannon-netting observing newly marked birds from a car or truck that served as a blind. Between 6 April and 6 July 1983, LKS observed marked birds for 317 h, recording dates of first sighting and hatching and number of young reared to 21 days of age. When hatching was not observed firsthand, the date of hatching was determined by estimating the age of the oldest chick. The accuracy of this method was tested with known-age chicks unfamiliar to LKS, and 9 of the 10 estimates were within 1 day of the actual hatching date. None of the study plots was entered by any person once chicks were more than 2 days old.

TABLE 1. Rates of return of tagged and banded samples to the Rogers City colony site in 1983, and mean return dates in April.

	Tagged	Banded	P
Returning birds			
Number	92	48	0.0001 <sup>a</sup>
Proportion	61.3%	90.6%	
Dates of return <sup>b</sup>			
All birds (122)	18.0 ± 11.4	12.0 ± 7.7	<0.001 <sup>c</sup>
Females (73)	17.5 ± 9.2	10.7 ± 6.9	<0.001 <sup>c</sup>
Males (45)	18.8 ± 14.7	12.2 ± 8.3	<0.05 <sup>c</sup>

<sup>a</sup>  $\chi^2$  test.<sup>b</sup> Numbers represent dates in the month of April.<sup>c</sup> Mann-Whitney *U*-test.

Rates of return to the colony site were determined by persistent searches for marked birds. Ring-bills at this colony show very strong nest-site fidelity, with between-year movements averaging about 1.1 m (pers. obs.), thus facilitating searches for marked individuals. Because of the probability that some tags had been lost, whenever possible we read band numbers of birds within the study plots. Three birds tagged in 1982 had lost their tags in 1983 but were identified by bands.

## RESULTS

The year after they were color marked, 61.3% of the tagged sample and 90.6% of the color-banded sample were observed at the Calcite colony (Table 1).

Wing-tagged birds arrived at the colony site, on average, 6 days later than color-banded birds (Table 1). When categorized by sex, this difference still holds in the mean values. Because it appeared that tagged birds arrived later than banded birds, the alternate hypotheses for statistical testing indicated one-tailed tests were appropriate. The difference between the highly variable male samples was barely statistically significant, while females were highly significantly different (Table 1).

In the year of capture all tagged (35) and banded (11) males for which breeding status was determined were paired and held territories. For females for which breeding status was determined, 60 of 61 tagged birds were known to be paired, and all color-banded (18) birds were mated.

The year after marking, 37.1% of the tagged

TABLE 2. Breeding status of marked birds in 1983, the year following marking.

	Paired		Unpaired
Females			
Tagged	13 (37.1%)	** <sub>a</sub>	22 (62.9%)
Banded	24 (92.3%)		2 (7.7%)
Males			
Tagged	33 (94.3%)		2 (5.7%)
Banded	18 (100.0%)		0

<sup>a</sup> \*\*  $\chi^2 = 16.78$ , *df* = 1, *P* < 0.0001.

females that returned still wearing their tags acquired mates, while 92.3% of returning color-banded ones did so (Table 2). Of the 22 tagged females without mates, at least 13 (59.1%) were paired the previous year. In contrast to females, males successfully acquired mates in 1983 whether they were tagged or color-banded (Table 2). All but 1 of these males, a tagged individual, also held territories in the year after marking.

In 1983 greater proportions of banded birds reached egg, chick, and fledgling stages than did tagged birds. Almost all returning banded birds reached the egg stage (44 of 46 cases, 95.7%), whereas 62.9% of tagged birds did so (44 of 70 cases,  $\chi^2 = 16.30$ , *df* = 1, *P* = 0.0001). For birds that reached the egg stage, the chance of progressing through subsequent stages was similar for tagged and banded individuals ( $\chi^2 = 1.05$ , *df* = 2, *P* = 0.59).

Hatching dates were determined for the eggs of 31 tagged birds and 34 color-banded ones in the year after marking. On average, tagged birds hatched eggs 3 days later than banded birds (*t* = 2.62, *df* = 1, *P* = 0.0056).

Successful tagged and banded birds reared statistically similar numbers of young in both 1982 and 1983 (Table 3). If one considers reproductive success of all birds, i.e. including failures, 1982 mean brood sizes again did not differ for the two groups. The following year, however, each color-banded bird raised an average of 0.95 young and each tagged bird 0.36 young. The number of young fledged dropped significantly in the year after marking for tagged birds but showed no significant difference for banded birds (Table 3).

The principal cause of reproductive failure for tagged females in 1983 was the inability to form pair bonds (Table 4). Some tagged males

TABLE 3. Mean brood sizes of marked birds. The category of "All birds" includes those known to have raised no young.

	1982	1983	
Successful birds			
Tagged (48)	1.45 ± 0.57	1.59 ± 0.71	$P(\chi^2) = 0.51$
Banded (39)	1.71 ± 0.73	1.56 ± 0.51	$P(\chi^2) = 0.14$
	$P(\chi^2) = 0.33$	$P(\chi^2) = 0.13$	
All birds			
Tagged (112)	1.22 ± 0.75	0.36 ± 0.75	$P(\chi^2) < 0.0001$
Banded (58)	1.41 ± 0.94	0.95 ± 0.87	$P(\chi^2) = 0.08$
	$P(\chi^2) = 0.53$	$P(\chi^2) = 0.0001$	

failed at each stage of the reproductive cycle (Table 4). All pairs with both members tagged laid and incubated eggs, but 8 later failed (Table 4); only 1 such pair fledged young. There were 5 pairs with both members color-banded, and all fledged young in the year after marking.

About one month after most birds had returned to the colony site (20 May 1983), we captured, weighed, and measured 22 tagged and 30 unmarked birds for which sex was known from behavioral observations. Birds with wing tags were not significantly different from unmarked birds in bill length and depth (Table 5). The 7 tagged females weighed slightly more, on average, than unmarked females, but the difference was not significant and may be due to slight differences in stages of the reproductive cycle. Tagged males averaged about 25 g less than unmarked males, a difference of borderline statistical significance ( $t = 1.68$ ,  $df = 30$ ,  $P = 0.05$ ).

#### DISCUSSION

A significantly lower proportion of wing-marked Ring-billed Gulls returned to the colony site in the year after marking than did color-banded birds. Some tagged birds might have moved to other colony sites. However, in the many years we have tagged ring-bills, reports of these birds at other Great Lakes colonies have been extremely rare (3 in the last 5 yr, for example). A more likely explanation for the lower return rate of tagged birds is that the markers interfered with migration, as Howe (1980) proposed for Willets (*Catoptrophorus semipalmatus*). This explanation is supported by the fact

that tagged birds returned to the Rogers City site about 6 days later than color-banded birds.

Tagged males were able to acquire territories and mates as readily as color-banded males. About 60% of the tagged females did not pair in the year after they were marked, although not for lack of trying. Many of these females approached and solicited males even after the time chicks had hatched. For years we have noticed the presence of outcast tagged females, and we now consider this to be caused by the markers.

In the year of marking no obvious differences were noted in breeding performance of tagged and banded birds. In an earlier study, however, we observed slightly lower brood sizes during the year of marking for successful, tagged gulls as compared to successful, un-

TABLE 4. Stage of reproductive failure in 1983 for birds marked in 1982. Unless otherwise noted, birds had mates that were unmarked or carried only an aluminum band. Only those failures whose mates and status were known at all stages are included.

	Stage of failure <sup>a</sup>			
	Pair- ing	Egg- laying	Hatch- ing	Fledg- ing
Tagged ♀♀	22	0	1	0
Banded ♀♀	2	0	2	0
Tagged ♂♂	2	2	4	2
Banded ♂♂	0	0	3	1
Tagged ♀♀ with tagged ♂♂	—	0	5	3
Banded ♀♀ with tagged ♂♂	—	0	0	3

<sup>a</sup> Pairing = failed to form pair bond; egg-laying = paired, but no eggs laid; hatching = eggs lost or not hatched; fledging = chicks died before 21 days old.

TABLE 5. Bill measurements and weights of tagged and unmarked birds captured on 20 May 1983. In this case, tagged birds were ones that had carried markers for 1-5 yr.

	Bill length (mm)	Bill depth (mm)	Weight (g)
Females			
Tagged (7)	55.1 ± 3.4	12.6 ± 1.0	480.7 ± 49.3
Unmarked (13)	55.8 ± 2.3	12.7 ± 0.7	476.5 ± 27.3
P(t)	0.50	0.49	0.40
Males			
Tagged (15)	60.9 ± 2.6	13.9 ± 0.7	525.0 ± 48.6
Unmarked (17)	61.4 ± 2.1	14.2 ± 0.7	550.9 ± 38.6
P(t)	0.28	0.14	0.05

marked birds (Southern and Southern 1983). Sample sizes were larger in that study, and the potential for immediate impacts on reproduction must be acknowledged.

In the year following marking, 61.0% of banded birds and 25.4% of tagged birds raised young ( $\chi^2 = 13.56$ ,  $df = 1$ ,  $P = 0.0002$ ). Brood sizes were similar for successful tagged and banded birds. However, a large proportion of tagged birds failed to breed at all, principally because tags seemed to interfere with pair bonding. The delayed arrival of tagged females may have contributed to their difficulty in establishing pair bonds, but it probably was not the most important factor. Some very early females failed to pair, while some later ones succeeded. There also were indications that tags affected birds at later stages of the reproductive cycle. Eight of 9 tagged pairs (88.9%), for example, failed to raise young, while 100% of 5 banded pairs succeeded. At least 7, and possibly all 9, of the tagged pairs had been mated to each other the previous year. Although their pair bonds were maintained following marking, their reproductive success was extremely low.

Taking into account the weight of a tag and band, tagged males weighed about 4% less than unmarked males. Impacts of tags on flight or foraging efficiency would not be surprising, but this possibility remains to be investigated.

In most studies of wing-marked birds, investigators have assumed that if *some* tagged birds appeared to behave normally, then any marker effect must be negligible (e.g. Hewitt and Austin-Smith 1966, Rowley and Saunders 1980). Only a comparison of the sort discussed in this paper, however, can accurately determine whether or not tags have a detrimental

effect. In addition, some impacts of tags will be observed only during long-term studies, and other effects may be noticeable primarily in the nonbreeding season.

As others have suggested previously (e.g. Kochert et al. 1983), marking techniques must be tailored to the species and should be carefully evaluated whenever possible. This is particularly important for sensitive and rare species; in our view, patagial tags should be used on such forms only with the utmost caution. For other species or for some purposes, patagial markers may be the only viable alternative. To ensure accurate representation of natural phenomena, we urge further scrutiny of the effects of color marking.

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