The Effect of Patagial Tags on Breeding Success in American Kestrels

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INTRODUCTION

Patagial tags have been used widely in field studies of birds, particularly raptors (for review see Young and Kochert 1987). There are two common designs. The wrap-around tag is a piece of fabric that is folded across the leading edge of the wing and fastened to itself at the trailing edge; it is held in place by its snug fit between the tertials and scapulars. Alternatively, a tag may be attached directly to the patagium with a type of piercing fastener, such as cattle ear tags, aluminum fish fingerling tags (Hannon et al. 1990), miniature nylon machine screws (K. Meyer, pers. comm.), or nylon rod (Village 1990).

Although wrap-around tags did not appear to cause physiological stress, reduced mobility, or degradation of nutritional status in Golden Eagles (*Aquila chrysaetos*), Red-tailed Hawks (*Buteo jamaicensis*), or Common Ravens (*Corvus corax*; Kochert et al. 1983), fatal accidents have been reported, including a fledgling Bald Eagle (*Haliaeetus leucocephalus*) whose tag became tangled on a tree branch (Gerrard et al. 1978), and an adult American White Pelican (*Pelecanus erythrorhynchos*) whose bill was ensnared by its tag (Chapman and Chapman 1990).

Wrap-around tags also have a tendency to cause irritation, sometimes severe, and callousing on the leading edge of the patagium of birds that are small, have long and narrow wings, and/or have rapid wingbeats, such as Peregrine Falcons (*Falco peregrinus*; Sherrod et al. 1981), Prairie Falcons (*F. mexicanus*; Kochert et al. 1983), and American Kestrels (*F. sparverius*; Bolen and Derden 1980). Negative effects also were reported for Ring-billed Gulls (*Larus delawarensis*; Southern and Southern 1985, Kinkel 1989) and Willets (*Catoptrophorus semipalmatus*; Howe 1980), but not for Band-tailed Pigeons (*Columba fasciata*; Curtis et al. 1983).

As part of a study of the population dynamics of the Southeastern American Kestrel (*F. s. paulus*), one of us (JAS) developed a technique, similar to that of Village (1990), of attaching tags with monofilament rivets. We marked only nestlings, some with tags and others with colored bands. Although the tags enabled us to examine natal dispersal and philopatry (Miller and Smallwood 1997), we were not able to compare the possible negative effects that these two marking systems may have had on the birds, as measured by return or survival rates of banded versus tagged birds, because the tagged birds were much more likely to be detected.

In the present study, we tagged adult kestrels breeding in nest boxes in New Jersey. The objectives of this paper are to describe the method of tag attachment, and to report on a field test of the effect that placing such a tag on breeding female American Kestrels has on their reproductive success.

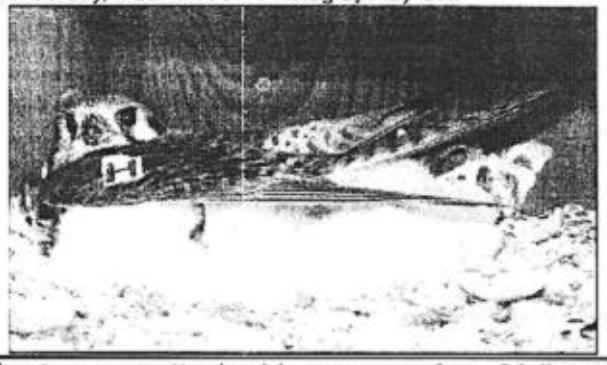
METHODS

Capture Technique - Adult kestrels were captured in the nest box with a modified butterfly net, whose 90-cm handle was extended by a 3-m piece of 2.54 cm (1") PVC pipe. The pipe was cut into three 1-m lengths, two of which had PVC slip couplings cemented to one end, allowing for easy transportation and assembly in the field. The rim of the net was reshaped into a square, approximately 20 x 20 cm, so that it did not extend beyond the front of a nest box. We placed a large rubber band around the 2-cm diameter net handle, which determined how far inside the PVC pipe the handle would slide, thus affecting the total length of the apparatus.

Some kestrels were prone to flush from the nest box, particularly those on roadside utility poles, at the sound of our arriving vehicle. Therefore, to capture an adult, we stopped the vehicle at least 25 m away, while one of us approached the nest box on foot as quietly as possible. Once the net was placed over the nest box entrance hole, the other team member erected and climbed a ladder, and carefully opened the nest box. The adult, if present, could either be grabbed by hand (this was usually possible if done very slowly) or allowed to exit into the net. A net containing a captured kestrel was slipped out of the end of the PVC pipe for easy handling.

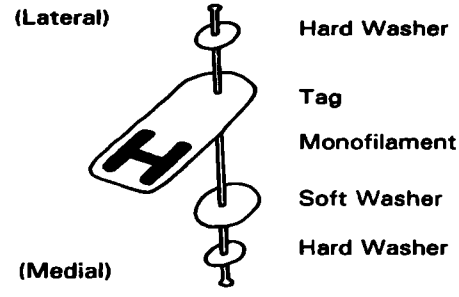
Patagial Tag and Attachment - The patagial tags were made from an inexpensive rip-stop, fiber-reinforced vinyl fabric (#20 Herculite©, available from Gulf Fabrics, 3709 N. Armenia Ave., Tampa, FL 33673-1303, and a similar fabric available from Safety Flag Co. of America, P.O. Box 1088, Pawtucket, RI 02862-1088). The tags were rectangular with rounded edges, measuring 16 x 40 mm. A permanent marking pen or paint stick was used to print a single alpha-numeric digit on the trailing half of the tag (Fig. 1).

Figure 1. Female American Kestrel (1443-81295) with patagial tag PTL-WH-H brooding chicks in nest box in northwestern New Jersey, 6 June 1997. Photograph by CN.



The tag was attached by means of an 80-lb test monofilament rivet (Fig. 2) which passed through a small puncture in the patagium. The widened tips of the rivet were made by heating the end of a piece of monofilament with a butane lighter until it melted into a bead, which was slightly flattened by touching it lightly with cold metal, such as a pair of banding pliers. Overheating the monofilament would denature the plastic and make the rivet brittle. A 7.5-mm diameter "hard" washer made of #2 recyclable plastic (i.e., from a milk jug) was used to keep the more elastic tag from slipping off the end of the rivet. A large number of hard washers were made very quickly with a standard (¼-inch) loose-leaf paper hole punch. We used a dissecting needle to make the hole in the center of the hard washer. To hold the hard washer while making this puncture, and later when tagging a bird, we used a small block of wood that had a shallow flat-bottomed hole (made with a ¼-inch Forstner drill bit) with a deeper 1/16th-inch hole at the center. The two hard washers did not contact the bird's wing; the tag was positioned between the patagium and the lateral hard washer while an 11-mm diameter vinyl fabric "soft" washer protected the bird's biceps from abrasion against the medial hard washer when the wing was folded.

Figure 2. Patagial tag attachment. Monofilament rivet is depicted longer for clarity; actual distance between hard washers is 4 mm.

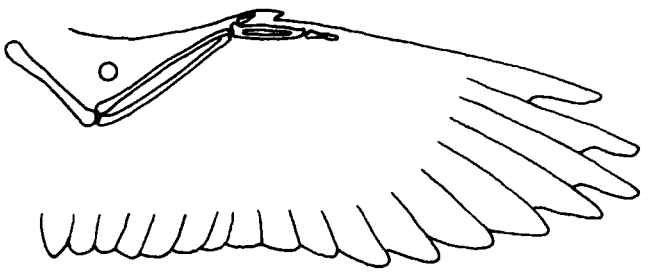


In order to minimize the length of time required to tag birds in the field, beforehand we cut out and marked a supply of tags, which were then stored on a safety pin. This kept them in proper sequence and provided the necessary hole for attachment. We also made a supply of monofilament rivets that were flattened on the medial side, and already had the medial hard and soft washers assembled.

To attach the tag to the bird, the wing was spread and the patagium near the elbow was swabbed with isopropyl alcohol. A puncture was made with a sterile dissecting needle through the patagium at a point approximately 1/3rd the distance from the biceps to the leading edge of the spread patagium (i.e., slightly closer to the biceps), about 5 mm distal from the elbow (Fig. 3). The puncture was made at least 4 mm from the distal bifurcation of the brachial vein. In good light, capillaries were clearly visible, and the puncture was made between

them; thus, there was no bleeding. The sharpened end of the monofilament (it was originally cut at an angle for this purpose) was passed through the patagial puncture and the tag and lateral hard washer were assembled. After making sure that the medial hard washer was snug against the medial monofilament bead, the lateral hard washer was positioned so that the two hard washers were 4 mm apart. The end of the monofilament was cut, leaving 3 mm extending laterally beyond the lateral hard washer. The 3-mm end was then melted with a butane lighter into a bead and flattened.

Figure 3. Location for attachment of patagial tag. See text for position relative to brachial vein and biceps.



Effect on Breeding Success - Study area. - The study area was located in rural northwestern New Jersey. This region is characterized by mixed agriculture, including corn, hay, and cattle production, and forestland in the ridge and valley physiographic region (Sauer et al. 1997). Sixty-six nest boxes were erected in open habitats in Sussex County (centered at approximately 41°11'N, 74°38'W) between 1 April 1995 and 15 February 1998, and 104 nest boxes in Warren County (approximately 40° 47'N, 75°04'W) between 5 August 1995 and 19 April 1998.

Monitoring nest boxes. - Each nest box was monitored at four-week intervals from 23 March through 13 July 1997 and 29 March through 15 July 1998 to determine occupancy status; a nest box was considered occupied by breeding kestrels if at least one egg was observed. Kestrels require 7-9 days to complete a clutch, usually four or five eggs, and incubation lasts 28-30 days (Bird and Palmer 1988); thus, all kestrel nesting attempts were discovered during egg laying or incubation.

Occupied nest boxes were visited several times as necessary to determine completed clutch size, hatching date, brood size, and to capture incubating and/or brooding adults. A final nest check was conducted when the chicks were 16-23 days old (88.2% were ≥ 20 days old), at which time they were banded and tagged. Nesting attempts were not disturbed by us after this time as the chicks in this study area are prone to premature fledging (pers. obs.). A nesting attempt was considered successful if at least one chick survived to banding age.

Statistical analyses. - Because only a few males were patagial tagged, those breeding attempts were excluded from statistical tests of significance. Also excluded, because of non-independence, were five second nesting attempts by pairs already observed (one in 1997 and four in 1998) and three attempts by females tagged as adults in 1997 that returned to breed again in 1998. Finally, we excluded from all analyses two nesting attempts that failed because the nest boxes were destroyed; i.e., the failure was not related to the presence or absence of patagial tags.

Control nesting attempts were those in which neither adult was tagged. The experimental group was limited to pairs in which the female only was tagged during incubation. Nesting attempts in which the female was tagged during the nestling stage were excluded from this comparison because those attempts had already survived past hatching, while control attempts could fail either before or after hatching.

We wanted to determine if tagging increases the risk of nest abandonment, i.e., if females are prone to leave after this treatment. Since control females had no equivalent starting point after which the breeding attempt could either continue or cease, we used the percent of nesting attempts that did not progress to hatching as an index of abandonment.

RESULTS

Forty adult kestrels from 39 breeding pairs were captured in nest boxes and marked with patagial tags, and another 23 pairs bred without being marked (Table 1). For all first attempts, breeding success was 76.0% (n = 25) in 1997 and 33.7% (n = 42) in 1998. Pairs in which the female was

marked during the nestling stage had success rates of 87.5% (n = 8) in 1997 and 33.3% (n = 3) in 1998. All attempts (n = 3) in which males were marked were successful.

The percentage of experimental attempts that progressed to hatching (53.8%) did not differ significantly from that of control attempts (47.8%; P = 0.78, two-tailed Fisher's exact test; Table 2). For all attempts in which at least one adult was banded (n = 39), there was only one instance in which both (1) the attempt failed and (2) the banded individual was not subsequently seen at the nest. There was no significant difference in breeding success for experimental (50.0%) and control breeding attempts (34.8%; P = 0.39, two-tailed Fisher's exact test; Table 2).

Table 1. Productivity of marked and unmarked adult American Kestrels breeding in nest boxes in northwestern New Jersey, 1997-1998. Values are mean ± SE (n) numbers of fledglings per breeding attempt. Marking consisted of a single patagial tag attached to either the left or right wing.

Treatment	1997	1998
Female only marked		
During incubation	3.00 ± 0.62 (7)	1.26 ± 0.46 (19)
During nesting period[a]	3.71 ± 0.68 (7)	0.33 ± 0.33 (3)
Male only marked[b]	- - -	4.50 ± 0.50 (2)
Both adults marked[c]	3.00 - (1)	- - -
Control (neither adult marked)	2.60 ± 0.73 (10)	0.69 ± 0.47 (13)

[a] 0-5 days post-hatching.
[b] During incubation.
[c] Male during incubation, female 2 days post-hatching.

Table 2. Effect of patagial tags on breeding success in American Kestrels using nest boxes in northwestern New Jersey, 1997-1998. All breeding attempts were detected during incubation. Females only were marked (during incubation) in experimental attempts (n = 26). Adults were not marked in control attempts (n = 23). Values are mean percent (95% binomial confidence interval).

Response	Experimental	Control
Percent of breeding attempts that progressed at least to hatching[a]	53.8 (34.7, 73.0)	47.8 (27.4, 68.2)
Percent of breeding attempts that produced at least one fledgling[b]	50.0 (30.8, 69.2)	34.8 (15.3, 54.2)

[a] Difference not significant (P = 0.78, two-tailed Fisher's exact test).
[b] Difference not significatn (P = 0.39, two-tailed Fisher's exact test).

DISCUSSION

We detected no evidence that marking kestrels with our patagial tags has any harmful effects on their reproductive performance. With only one exception, adults that were tagged were observed behaving normally in or near the nest box on subsequent visits. We did not observe any indication that the tags hindered their flying ability, foraging activity, or social behavior. The tag, lying flat against the top surface of the wing, did not disturb the aerodynamic properties of the wing, and the discomfort associated with attaching a tag was apparently minimal.

The principal advantage of this method of auxiliary marking, compared to colored bands, is the greater visibility of the tags. Color bands can be difficult to detect and read with a spotting scope at distances greater than 75-100 m, and the kestrel's habit of perching on roadside utility lines often results in the utility line blocking the view of the bird's tarsi. We routinely were able to read the patagial tags at distances of up to 250 m.

Determining the color of the tag is considerably easier than determining the color of a much smaller leg band. Also, the use of an alpha-numeric digit greatly increases the number of birds we can mark as individuals. In New Jersey, we use the 26 letters of the alphabet, uppercase (except "d"), and nine arabic numerals (excluding "1"). The availability of nine distinguishable fabric colors, and the placement on either the left or right wing allows us to mark 640 males and 640 females individually.

Using monofilament fishing line for the rivet has several advantages. The small diameter is sufficiently strong to hold the tag, but requires only a very small puncture in the patagium. The monofilament is smooth and circular in cross-section, so it should cause minimal irritation if it rotates. It is also very inexpensive.

The durability of the alpha-numeric marking is variable. In Florida, birds were observed with readable digits up to four years after banding (JAS unpubl. data). On the other hand, a female banded as a nestling in New Jersey in 1997 was observed overwintering in southern Georgia a few months later, and the digit had already worn off (J. Parrish, pers. comm.). One possible technique to ensure durability would be to sew the digit onto the tag with a monogramming sewing machine.

Finally, although we did not detect differences in reproductive success between tagged and unmarked kestrels, there was a substantial difference between the two years. Many of the failures in 1998 occurred early in the breeding season, a phenomenon also observed in Pennsylvania (S. Boyce, pers. comm.), and a large proportion of failures occurred post-hatching. Weather may have been a factor. An unusually rainy period coincided with hatching and the early nestling period; this occurred during a significant El Niño event.

SUMMARY AND CONCLUSIONS

In summary, the tagging system described here is an effective method of identifying a large number of kestrels individually, at distances far greater than that possible with colored bands. The tag and attachments apparently are not harmful to kestrels, nor was there evidence that the handling during tagging negatively affected the birds. This technique should be applicable to many other birds of similar size, for which patagial tagging has not been feasible previously.

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The First Prebasic Molt in Snow Buntings

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In a recent paper in *North American Bird Bander,* Pyle (1997a) described molt patterns in 288 species of North American passerines. Based on examination of 15 museum specimens he stated that in Snow Buntings (*Plectrophenax nivalis*), all 10 greater coverts were replaced in all individuals during the first prebasic molt. This conclusion differs from that of others who have studied molt of Snow Buntings.

I studied molt of Snow Buntings during four seasons of fieldwork on Devon Island, Northwest Territories, Canada, from 1966 to 1969 (Hussell 1972). I examined 51 juvenile Snow Buntings on dates ranging from 25 July to 23 August; 41 of them were undergoing their first prebasic molt. Thirty-three juveniles, of which 23 were in molt, were collected and are preserved in the University of Michigan Museum of Zoology.

I described the first prebasic molt by classifying it into seven stages from 0 (molt not started) to 6 (molt complete). None of the stages involved molt of the greater coverts or tertials because I never saw any molt of those feathers. I examined juveniles in all stages from 0 to 5. By molt stage 5 the new lesser and median wing coverts were fully grown and most of the feathers of the body plumage were at least three-quarters grown.