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EVALUATION OF A COLORED LEG TAG FOR STARLINGS AND BLACKBIRDS

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Bird damage control studies conducted since 1960 at Sand Lake National Wildlife Refuge, South Dakota, and in a sector of the South Platte River Valley north of Denver, Colorado, require basic movement data for starlings (*Sturnus vulgaris*), red-winged blackbirds (*Agelaius phoeniceus*), and yellow-headed blackbirds (*Xanthocephalus xanthocephalus*). Consequently, a method of marking thousands of birds was needed to increase the recovery rates of banded birds and to facilitate field identification of specific depre-dating populations. Recovery rates of banded blackbirds and starlings have customarily been very low. For example, Neff and Meanley (1957:23) reported only 137 recoveries from 22,241 red-wings banded during an 11-year period in eastern Arkansas, and Mitchell (1963:7) reported only 9 recoveries from 6,512 redwings and 407 recoveries from 23,365 starlings banded during a 6-year period in seven eastern and midwestern states.

Numerous marking techniques have been successful in field identification of individual birds. The advent of brightly colored, durable plastic material provided a suitable marker for many

species. In early trials, Trippensee (1941), Taber (1949), and Nelson (1955) reported use of plastic marking devices. Blank and Ash (1956) and Craighead and Stockstad (1956) simultaneously reported on a durable plasticized polyvinyl chloride material which was tested on partridges (*Perdix p. perdix*) and Canada geese (*Branta canadensis*). Recently, Downing and Marshall (1959) conducted durability tests with plasticized polyvinyl chloride material on boat-tailed grackles (*Cassidix mexicanus*), black-necked stilts (*Himantopus mexicanus*), and green herons (*Butorides virescens*). Since initiation of the present study, the stronger plastics have been used in movement studies of marked starlings, common grackles (*Quiscalus versicolor*), robins (*Turdus migratorius*), and blue jays (*Cyanocitta cristata*) (Hester, 1963), and plastic adhesive tape has been used to color-mark redwings and herring gulls (*Larus argentatus*) (Fankhauser, 1964), and house sparrows (*Passer domesticus*) (Gullion, 1965).

These studies used different materials, marker configurations, and methods of attachment. The attachment techniques, however, were too cumbersome and time consuming for marking large numbers of birds in the field. As an improvement, Campbell (1960) described a procedure for marking redwings with a plasticized polyvinyl chloride strip threaded on a U. S. Fish and Wildlife Service aluminum band. Thomas and Marburger (1964) modified and successfully used Campbell's attachment technique on wild turkeys (*Meleagris gallopavo*) in Texas. The Campbell technique was used in this study, but with different material and a larger band and marker.

MATERIALS AND METHODS

A nylon-impregnated, polyvinyl chloride plastic was used for marking birds in this study. It is available, under the trade name Facilon*, from the Facile Division, Sun Chemical Corporation, Paterson, New Jersey, and costs \$1.50 per linear yard, 54 inches wide. It is strong, durable, lightweight, and waterproof. Although the material comes in various weights, the 10-ounce-per-square-yard weight was used for starlings and blackbirds. White, orange, yellow, and blue were the most visible of the several colors tested and were chosen because they could be seen up to 75 yards with the unaided eye.

Tags used on starlings, redwings, and yellowheads in 1962 and 1963 were 1 inch wide, 4 inches long, and 12 mils thick with a 1/4 inch hole centered 1/2 inch from one end. Average weight of the tags was 0.8 g. In 1964, tag length was reduced to 2-1/2 inches for use on starlings in Colorado. Figure 1 illustrates a 4-inch tag properly attached to the tarsus of an adult male redwing; the free end is toward the bird's body to enable the bird to walk and perch without stepping on the tag. Tags were cut and drilled for approximately \$2.75 per thousand.

*Use of trade names does not imply endorsement of commercial products by the Federal Government.

Fig. 1. Red-winged blackbird with a 1- x 4-inch color-tag attached to its legband.



Bands one size larger than recommended by the Bird-Banding Office were used so that the tag material could be placed between the band and the bird's tarsus without causing discomfort to the bird. Size 2 bands were used on female redwings and yellowheads, and size 3 bands on starlings and male redwings and yellowheads. Bands were butted tightly to prevent the tags from slipping out.

Tags were color-coded to identify specific populations, not individual birds. Sand Lake yellowheads were marked with white tags in 1962 and yellow in 1963, and Colorado starlings and redwings were marked with orange in 1962 and white in 1963. Starlings trapped in 1964 at a Colorado site were marked with numbered blue tags. The numerals, printed with a fast-drying indelible ink from a commercial felt-tip dispenser, identified the week of the year the starling was banded. Hester (1963:214-215) used a vinyl plastic finish (Ram Cote Products) for marking patagial tags. I

found this to be more durable than ink, but its application required too much time and effort. Numerals on the tags were about 3/4 inch in height and were easily readable up to 40 yards with the aid of 7 x 50 binoculars. This method thus would lend itself to studies requiring the field identification of limited numbers of individual birds that have been marked by coding tags with combinations of numerals, letters, and symbols in various colored inks.

Articles describing the tagging program appeared in the *Farm Journal* (Anonymous 1963:A-2) and *Inland Bird Banding News* (Guarino 1963:65-66). These articles alerted the public to the importance of the program and encouraged reporting of tagged birds.

A questionnaire designed to determine the influence of color tags on the recovery of starlings and blackbirds was mailed to all persons reporting recoveries of tagged and untagged birds from January 1962 through November 1963.

RESULTS AND DISCUSSIONS

Recovery Rate

Only those recoveries reported to the Bird-Banding Office were used in calculating recovery rates (Table 1). There were 55 recoveries of 9,491 banded birds and 220 recoveries of 18,363 color-tagged and banded (hereafter referred to as tagged) birds through October 1965. Recovery rates of tagged starlings, redwings, and yellowheads were 1.7 (1962-64), 3.0, and 3.1 times greater, respectively, than of banded birds. A t-test showed that this difference was significant ($P \leq 0.01$) for all species.

Increases in the recovery rates for tagged redwings and yellowheads were in close agreement, although different numbers of the two species were banded and only four recoveries of banded yellowheads were recorded. This may be indicative of a true increase to be expected when color tags are used on these species. The lower rate of increase for tagged starlings is perhaps related to the higher recovery rate of banded starlings. Mitchell (1963:6) also reported a much higher recovery rate of banded starlings (1.74 per cent) than of redwings (0.14 per cent) in the eastern United States. Starlings are notorious city dwellers, prime targets for many local and wide-scale control campaigns, and are not protected by Federal laws. These factors increase the recovery rate of banded starlings, which apparently reduces the benefits of color tags.

The slightly lower starling recovery rate from the 1964 portion of the study (Table 1) is an effect of time and not the change from 4-inch to 2-1/2-inch tags. This is confirmed by the close agreement in per cent increase from tagged birds during the two periods, 57 per cent in 1962-63 and 58 per cent in 1964. The starling recovery rate from 1964 bandings should increase with time.

Sight records for tagged birds in Table 1 include valid sightings from all sources except those less than 20 miles from capture and release locations during marking seasons. There were 41 starlings and 7 redwings sighted during marking seasons, and 10 starlings and 15 redwings at later times. Of the latter, six starlings and four

TABLE 1. RECOVERY RATES OF BANDED VERSUS COLOR-TAGGED BLACKBIRDS AND STARLINGS

Species	Year	Number Banded	Number Tagged	Number of Recoveries Banded	Number of Recoveries Tagged	Recovery Rate (Per cent) Banded	Recovery Rate (Per cent) Tagged	Per cent Increase in Recovery from Tagging	Number of Sight Records Tagged Birds	Per cent Increase in "Total Recovery" from Tagging (Sight Records Included)
Redwings	1962	3,426	3,141	11	30	0.32	0.96	200	22	419
Yellowheads	1962-63	2,078	5,683	4	33	0.19	0.58	205	0	205
Starlings	1962-63	1,044	4,601	12	83	1.15	1.80	57	20	95
	1964	2,943	4,938	28	74	0.95	1.50	58	31	123
All species	1962-64	9,491	18,363	55	220	0.58	1.20	107	73	176

TABLE 2. COLOR-TAG RETENTION BY STARLINGS AND BLACKBIRDS

Months After Release	Redwings		Yellowheads		Starlings		All Species	
	Number Recaptured	Number Retaining Tags	Number Recaptured	Number Retaining Tags	Number Recaptured	Number Retaining Tags	Number Recaptured	Per cent Retaining Tags
1-4	477	472	215	204	168	168	860	98.1
5-8	1	1	0	0	8	4	9	55.6
9-12	4	3	26	6	1	1	31	32.3
13-16	17	1	13	2	0	0	30	10.0

redwings were sighted more than 6 months after tagging, and three redwings after more than 1 year. Three of the redwings marked in Colorado were reported in Wyoming from 75 to 100 miles from the release site, and two of the Colorado starlings were reported in south-central Colorado approximately 150 miles distant.

Including valid sight records as recoveries increased the 1962-1964 "total recovery rate" of tagged redwings and starlings 5.2 and 2.2 times, respectively, over banded redwings and starlings, and 1.7 and 1.3 times over tagged redwings and starlings (Table 2).

An additional 388 observations of tagged starlings and redwings wintering north of Denver provided valuable data on feeding, movement, and roosting patterns. Such observations during the winter of 1963-64 showed that problem birds at one cattle feedlot ranged over approximately 1,000 square miles and roosted in 14 cattail marshes, some as far as 27 miles from the feedlot. These data were useful in guiding damage control studies.

Questionnaires

There were 77 replies from persons who recovered tagged birds; 68 per cent stated that they would not have collected the bird had it not been marked (although only 64 percent reported noticing the tag before collecting the bird, not after). Many persons associated the marker with an information-gathering program, and others collected the birds because of curiosity.

Tag Retention

There were 930 recaptures of birds within 16 months after tagging, including several of trap-susceptible individuals of each species (Table 2). Marking programs were dependent upon seasonal bird populations, which explains the sharp decrease in recaptures 5 to 8 months after release. Birds recaptured 9 to 16 months later had survived either migration or a breeding season, or both. An adult male yellowhead, marked at Sand Lake Refuge August 16, 1962, and shot 3 months later in Morelia, Michoacan, Mexico, had traveled about 1,800 miles with the tag. From band recovery data (Guarino, unpublished), I suspect that other tagged yellowheads, recaptured 9 or more months later at Sand Lake Refuge, made a round trip of at least 3,600 miles to south-central Mexico.

For all species, 98.1 per cent of 860 recaptures retained their tags up to 4 months, but after that, tag loss increased steadily so that at 13-16 months only 3 of 30 tags were retained. Thomas and Marburger (1964:554) experienced similar results using leg tags on wild turkeys, but showed the initial high tag retention for a longer period.

High initial tag retention provided information on continental movements of starling and blackbird populations, particularly when birds were tagged before and during migration. In other studies, redwings tagged at Sand Lake Refuge were sighted in Minnesota, North Dakota, and Louisiana, and recovered in North Dakota, Nebraska, Kansas, and Texas.

Tag loss that occurred within 1 month after tagging was attributed

to improperly-butted bands. This was noted when handling recently-tagged birds. Tag wear was evident in the 1- to 4-month period, but was not critical until about 6 months. Most wear and subsequent loss of tags was due to weathering, which caused tags to become brittle through loss of the plasticizing agent. The bird's activity apparently had very little effect on the tag, and conversely, the tag seemed to have little effect on the bird's activity after an initial adjustment period.

Marked birds were observed while feeding, loafing, or in flight, singly or in flocks of 5 to 4,000 birds, and in staging and roosting flocks of as many as 600,000 birds. Their behavior was notably different from that of unmarked birds only when they encountered winds greater than 20 mph. At such times, tags seemed to create an excessive drag, and marked birds tended to lag behind and below the main flock.

It was not possible to determine whether color tags affected natural mortality. Analysis of starling recoveries showed that 1 of 57 untagged and 6 of 146 tagged birds were killed by predators, but this does not necessarily indicate that birds wearing tags were more susceptible to predation. It may simply show that people are more likely to recover marked birds killed by predators because their attention is attracted to the tag. Because of this bias due to the tag itself, an assessment of natural mortality could not be made.

However, there is some evidence that the tag increased mortality because of shooting by man. Of 119 untagged and 239 tagged starling and redwing recoveries, 21.8 and 31.0 per cent were shot, respectively. Although this increased mortality occurred with these problem species, I doubt if it would occur if the method were used on fully protected species because man would not be so inclined to shoot them.

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SUMMARY

Colored, nylon-impregnated, polyvinyl chloride plastic leg tags were used successfully to increase the band recovery rates of starlings and blackbirds banded from 1962 through 1964 in Colorado and South Dakota. Recovery rates of color-tagged yellow-headed blackbirds, red-winged blackbirds, and starlings were 205, 200, and 65 per cent greater, respectively, than those of banded birds. Including valid sight records increased recovery rates of redwings and starlings 5.2 and 2.2 times, respectively. For all species, 98.1 per cent of 860 recaptured birds retained their tags up to 4 months, but thereafter tag loss increased steadily. Tags helped in identi-

fying local and migrating birds, particularly those marked before and during migration seasons.

CONCLUSION

The sizable increase in recovery rates of tagged birds affords a considerable saving in labor costs for trapping and banding; to achieve the same results with banding alone would have required the banding of about 24,000 more birds. However, since 90 per cent of the tags are lost by the 16th month and the recovery rate falls in proportion, tagging could introduce bias into certain types of research, especially mortality rate studies.

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