Five pairs had separate feeding territories but fed to varying degrees on their breeding territories. Pair 1 fed regularly on Mole Crabs Emerita talpoida on the beach near their nest while maintaining a feeding territory in the marshes. Pairs 2, 10 and 15 were first noted making feeding trips to distinct feeding territories during their incubation period. Their feeding up to this time had been restricted to salt marsh on the breeding territory. Pair 14 fed entirely on salt marsh on their breeding territory until the hatching of the young, when the female of the pair began making feeding trips to Wallops Island and returning with exceptionally large Ribbed Mussels Geukensia demissa.

Among the 16 pairs on the study area only three pairs (20, 22 and 14) raised young. Pairs 20 and 22 fed and raised their young (up to four weeks of age when the study ended) entirely on the breeding territory while pair 14 fed entirely on salt marsh on the breeding territory until the hatching of the young (see above). It would appear that having feeding habitat near the nest so that both parents are available when needed is advantageous in the raising of a brood.

I shall be on the study area next year in time to establish if these territories are the first chosen by the returning birds. (Editor's note: this was the case, pers. comm. from Dr. A. Baker).

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(See also a comparable study in Wales: Safriel, U. 1966. Food and Survival of Oystercatcher chicks on Skokholm in 1965. Ibis 108: 455; Harris, M.P. 1970. Territory limiting the size of the breeding population of the oystercatcher (Haematopus ostralegus) - a removal experiment. J.Anim. Ecol. 39: 707-713. -Eds.)

DISPERSAL AND PREDATION RATES OF WING-TAGGED SEMIPALMATED SANDPIPERS Calidris pusilla AND AN EVALUATION OF THE TECHNIQUE

by David Lank

During the southward migrations of 1977 and 1978, I studied the effects of weather, fat stores and migratory route on the daily variations in migration rates of shorebirds. The study required the individual identification of hundreds of small sandpipers during daily censuses at feeding and roosting areas. I developed a highly visible sandpiper wing tag, and in two seasons tagged 2935 Semipalmated Sandpipers Calidris pusilla. This report deals with the tagging technique itself, with reports of marked birds from distant locations and with predation rates relative to untagged birds.

The Tags

Figure 1a shows a wing-tagged sandpiper. The tag is illustrated in Figure 1b. In passerines and larids, similar tags have been attached around the humerus between the wing and the body ("patagial tags"). Morgenwick and Marshall (1977) reported excellent success with patagial tags on American Woodcock Philohela minor. Kelly and Cogswell (1979) used patagial tags on Willet Catoptrophorus semipalmatus and Marbled Godwit Limosa fedoa, but reported that the tags were sometimes hidden by the scapulars. When I tested patagial tags on captive sandpipers, I found that the birds invariably rotated them under the wing, where they completely disappeared.

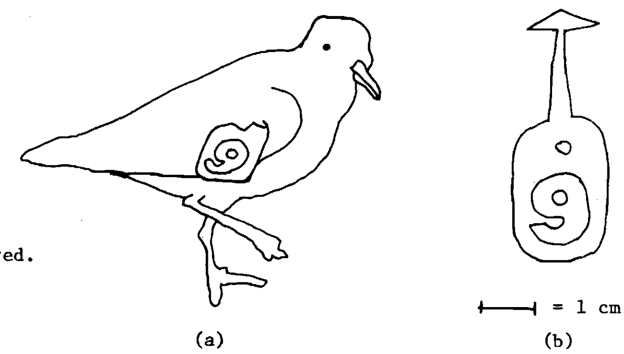

Figure 1. (a) Wing-tagged sandpiper
(b) Wing tag

As an alternative, the tag was tucked into the diastataxic gap between the 4th and 5th secondaries, looped around the radius and ulna, and pulled through the hole in the body of the tag to secure it to the wing. Care was taken not to catch coverts inside the loop of the tag. The loop was then flattened against the wing with the fingers, and its width checked where it passed between the secondaries. With practice, a bird can be tagged by one deterous individual in about a minute, if no adjustment to the tag is necessary. These tags sit vertically while the wings are folded (Figure 1a) and lie flat above the secondaries while the bird is in flight. They are almost never covered by feathers and are highly visible.

The tags were made from a variety of materials. Since my primary interest was short-term, less permanent tags were preferable. In 1977, most tags were made of nylon-impregnated vinyl, such as SAFLAG, but some were made from plain 8-10 mil vinyl sheets. Only one bird appeared to have lost its tag (it remained banded), which suggests that simple vinyl tags were adequate for determination of stopover times, which ranged up to 60 days. In 1978, most tags were made from unreinforced vinyl to lessen long-term interference with the birds. All tags were made from materials stiff enough to lie flat along the wing, and they did not flap in the wind.

The characters on the tags were self-sticking ½ inch gothic vinyl letters, available at hardware stores. These provide crisp, alpha-numeric symbols which can be read with a 15-60x spotting scope at distances up to 70-80m. Potentially confusing characters, such as '5' and 'S' were rotated 90^{o} or eliminated to prevent confusion. In 1977, when I tagged birds on the New Brunswick coast, I saw no tag which had lost its character. In 1978, when tagging was done in North Dakota, the hot prairie sun loosened the black letters on one set of yellow tags. Different colours of vinyl varied in the firmness of letter attachment, but all except the yellow-black combination proved to be satisfactory in the field. For a longer term study, enamel paint might be preferable.

Upon release, a bird's first wing flap usually caused it to bank sharply. Following this, birds appeared able to compensate for the aerodynamic changes produced by the tag. Tagged birds did not tend to lag behind others when flying in flocks, and some individuals performed well under the high performance demands of aerial pursuit by a falcon or trans-oceanic flight.

On the ground, with folded wings, birds also appeared to adjust to the tags. With few exceptions, no obvious increase in preening of the tagged vs untagged wing was seen after the first few days. Of 158 tagged birds recaptured during the study, only 6 showed callusing or swelling of the skin at the attachment site. There was no indication that likelihood of irritation increased with length of time the tag had been worn (Mann-Whitney U test, $p > 0.10$, 1-tail test). With care, the tags have almost no direct effect on the birds' skin and plumage.

In addition to the tagging, birds were measured, weighed, checked for moult, and given standard aluminum bands above the tarsal joint. In 1978, birds were also breast-dyed with a variety of alcohol-soluble green and blue dyes, all of which washed off within 2-4 weeks.

Sightings and Recoveries

Kent Island In 1977, 1161 adults and 295 juveniles were wing-tagged at Kent Island, New Brunswick (45°35'N, 66°45'W). An additional 182 Semipalmated Sandpipers and 161 Least Sandpipers Calidris minutilla were banded but not tagged. Sightings and recoveries of these birds are shown in Figure 2 and listed in Table 1. The geographical recovery pattern is similar to that documented by Mc Neil and Burton (1973, 1977) during their shorebird marking on the Magdalen Islands and Sable Island. Birds were recovered to the southeast, along the Atlantic coast, in the West Indies and on the northwestern coast of South America.

Especially exciting was the documentation of an overnight flight. A bird last seen on Kent Island around noon of 22 August was reported the next day at Salisbury Beach, Massachusetts, between 1300 and 1400. Three other birds were reported the first fall: one was seen at Kitty Hawk, North Carolina, and two were recovered in Guyana. Subsequent sightings of birds banded in 1977 include one in New Jersey during the northward migration, two birds seen on the Atlantic coast the next fall, and one bird shot in Guadeloupe in September 1978.

Five of the ten reports of 1977-banded birds - all but one of the North American ones - resulted from sight records of tags. All observers obtained the character and colour combination which enabled individual identification. The four Latin American reports resulted from band returns.

North Dakota Large numbers of shorebirds migrate through the interior of North America. Despite long-term banding efforts (e.g. Martinez 1979), direct evidence on the origins and destinations of these birds is meagre. No colour marking had previously been done, and in 1978, 641 adults and 838 juveniles were wing-tagged at Sibley Lake, North Dakota (46°57'N, 99°44'W). In addition, 565 Semipalmated Sandpipers and 67 Least Sandpipers were banded and breast-dyed, but not tagged. Figure 2 and Table 1 present returns from these birds to date. The distribution is southeasterly, rather than southerly: although one bird was reported from Cheyenne Bottoms, Kansas, nearly due south, it is on the extreme western edge of the distribution. The large numbers of Semipalmated Sandpipers seen in the central and southern Great Plains, and possibly those seen along the western Gulf Coast, probably do not come from areas directly to the north, but likely derive from areas in the western arctic (Harrington and Morrison 1979). Sightings from Minnesota, Wisconsin, Kansas and Tennessee indicate that some Semipalmated Sandpipers from western populations make shorter flights than the trans-oceanic ones of their east-coast conspecifics. Three birds were sighted in Latin America: one on Aruba, one from the Chichirivichi marshes of Venezuela, and one from the Panama Canal Zone. These locations are considerably west of the major target areas of eastern migrants (see Figure 2; McNeil and Burton 1973, 1977, Morrison 1978b). All encounters with the 1978-banded birds were due to sightings of the tags. All observers reporting birds at sites outside North Dakota were able to provide the information needed to identify the bird individually.

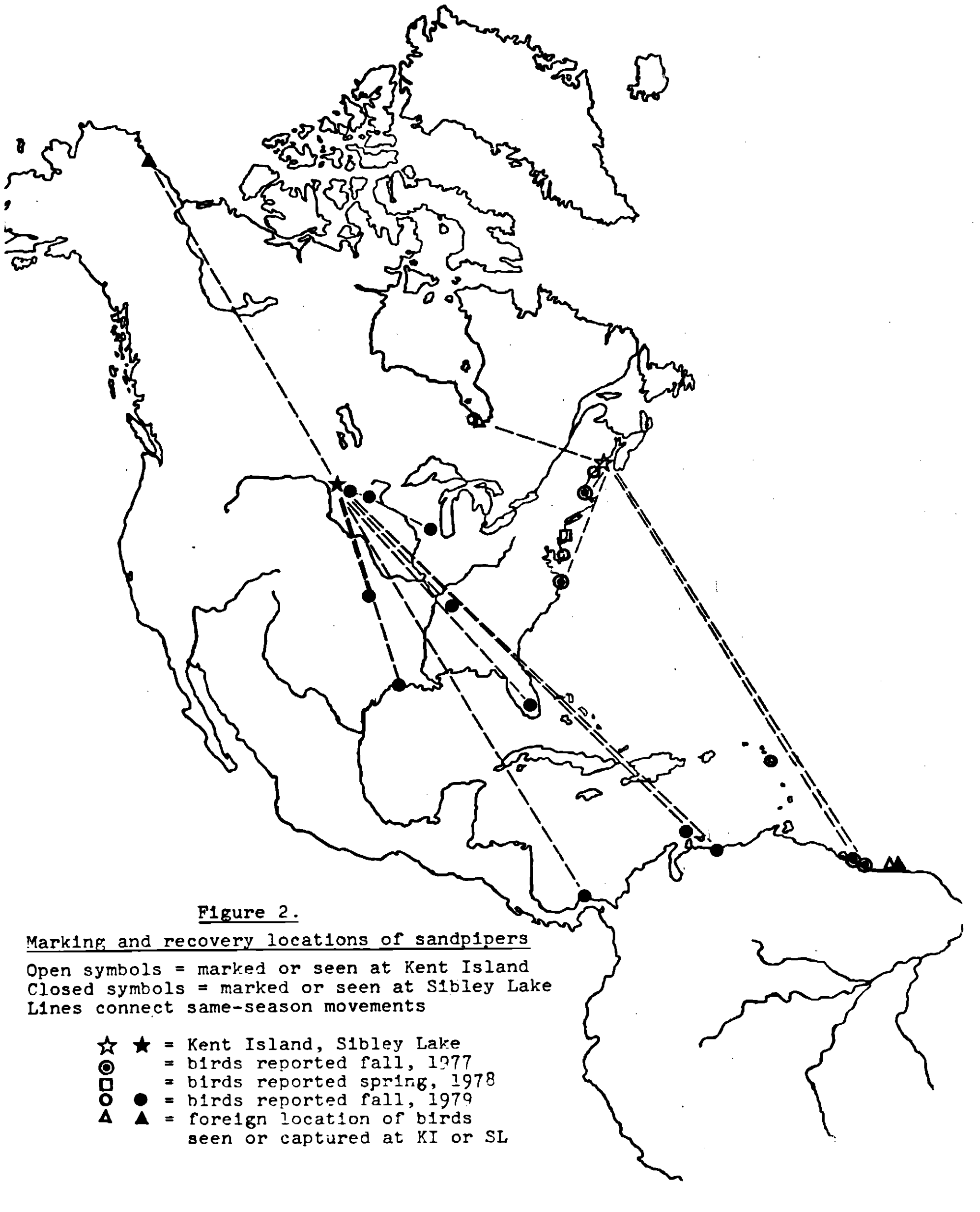

Figure 2.

Marking and recovery locations of sandpipers

Open symbols = marked or seen at Kent Island
Closed symbols = marked or seen at Sibley Lake
Lines connect same-season movements

☆ ★ = Kent Island, Sibley Lake
◉ = birds reported fall, 1977
□ = birds reported spring, 1978
○ ● = birds reported fall, 1979
△ ▲ = foreign location of birds seen or captured at KI or SL

Table 1. Foreign recoveries and sightings of birds marked at Kent Island, N.B., and Sibley Lake, N.D.

Semipalmated Sandpipers

Recovery Data			Marking Data			
Location	Date	ID Method	Date Marked	Last seen	Age	Band Number
Birds marked at Kent Island, 1977						
Salisbury Beach, MA	23 Aug 77	tag	16 July 77	22 Aug 77	A	1211-15129
Alness Village, Berbice, Guyana	03 Sept 77	band	16 July 77	----	A	1211-15104
Kitty Hawk, NC	05 Sept 77	tag	01 Aug 77	16 Aug 77	A	1211-02362
Nigg, Berbice, Guyana	10 Sept 77	band	09 Aug 77	25 Aug 77	A	1211-02607
Stone Harbor, NJ	16 June 78	tag	21 July 77	24 July 77	A	1211-15323
North Point, Ont.	22 July 78	band	16 July 77	----	A	1211-15137
Pt. Louis, Guadeloupe	06 Aug 78	band	08 Aug 77	23 Aug 77	A	1211-02799
Lubec, ME	18 Aug 78	tag	01 Aug 77	21 Aug 77	A	1211-02374
Assateague Is., MD	18 Sept 78	tag	07 Aug 77	07 Aug 77	A	1211-02745
?? - Guyana	? Feb 79	band	24 July 77	----	A	1211-02164
Birds marked at Sibley Lake, 1978						
Breckenridge, MN	19 Aug 78	tag	21 July 78	12 Aug 78	A	1241-30955
Gallatin, TN	19 Aug 78	tag*	15 July 78	27 July 78	A	1241-30856
Madison, WI	20 Aug 78	tag	05 Aug 78	14 Aug 78	I	1241-31363
Crystal Springs, ND	29 Aug 78	tag	------78	----	-	-------
Johnsons Bayou, LA	04 Sept 78	tag	06 Aug 78	19 Aug 78	A	1241-31276
Bubali, Aruba,	06 Sept 78	tag				
Neth. Antilles	08 Sept 78	tag	27 July 78	03 Aug 78	A	1241-31050
Lake Williams, ND	19 Sept 78	tag	------78	----	-	--------
Chichirivichi, Venezuela	23 Sept 78	tag	31 July 78	15 Aug 78	A	1241-31200
Coco Solo, Panama Canal Zone	13 Oct 78	tag	27 July 78	27 July 78	A	1241-31075
Cheyenne Bottoms, KA	20 Oct 78	tag	------78	----	-	--------
Okeechobee, FL	27 Oct 78	tag	11 Aug 78	17 Aug 78	A	1241-31495

* tag reported to be bothering this bird

Table 2. Controls of Semipalmated Sandpipers banded by others

Banding data				Recovery Data	
Location	Date	Age	Band Number	Location	Date
North Point, Ont.	29 July 75	A	110-153964	Kent Island	26 July 77
Kent Island, N.B.	26 July 70	U	1031-74223	Kent Island	07 Aug 77
Kent Island, N.B.	? July 74	U	63-718?5	Kent Island	07 Aug 77
Beechy Point, Alaska	09 July 78	I	880-55151	Sibley Lake	23 Aug 78

Controls and Sightings of Marked Birds

Four previously banded Semipalmated Sandpipers were captured during the course of the study, three at Kent Island and one in North Dakota (Table 2). Two of the Kent Island controls were banded at the same site in earlier years, one in 1970 and one in 1974. Although it was not aged at capture, the 27 July banding date suggests that the first bird was an adult, which would make it at least eight years old at recapture. The third Kent Island control had been banded the previous year by the Canadian Wildlife Service on the coast of James Bay (Morrison 1978b).

The single control in North Dakota was a colour-banded immature which had been marked by W.C. Hanson near Prudhoe Bay, Alaska. Dr. Hanson informed me that the bird had left the area in the first or second week of August. It was found in North Dakota in a walk-in trap on 23 August. Alaskan birds have previously been recovered in Florida, Cuba and Surinam Martinez 1974, Hanson and Eberhardt 1978, US F & WS files).

Sightings were made of Semipalmated Sandpipers from two colour-marking projects. Twenty-seven sightings of orange-breasted sandpipers from James Bay were made on Kent Island, probably representing 22 different individuals. One double-orange banded bird marked by Arie Spaans in Surinam was sighted. Birds from Surinam were also seen in North Dakota: sightings on three successive days at the same location probably represented a single individual (24-26 July 1978), while sightings of birds on 6 August and 16 August may have been different birds. Although the Canadian Wildlife Service continued its operation in James Bay in 1978, no orange-breasted birds were seen in North Dakota, providing strong evidence of the lack of westward dispersal from that area.

Predation

Kent Island Kent Island supports a large population (40,000 plus pairs) of Herring Gulls *Larus argentatus* . Until their dispersal at the end of the season, the gulls keep raptors away from the island. One female nesting adjacent to my release site successfully attacked at least three tagged birds. The first attack occurred when a freshly released bird carrying a bright orange tag banked into tall vegetation on the gull's territory, and pinned its wings open on the stalks. The gull quickly flew over to the spot, hovered above the helpless sandpiper, and swallowed it whole. We immediately stopped using bright orange and red tags, and moved our release site. The gull was later seen chasing both tagged and untagged sandpipers, and it caught at least two other tagged birds. No other gull was seen to attack sandpipers during the season, although they regularly prey on the island's breeding population of Leach's Petrels *Oceanodroma* leucorhoa (Gross 1935). This gull's location and the particular chance it had to catch a tagged bird probably enabled it to learn of the vulnerable condition of freshly released birds: I found no other evidence of predation on sandpipers on Kent Island.

North Dakota A well developed set of avian predators was present in North Dakota. Most important to small shorebirds were locally breeding Short-eared Owls Asio flammeus and post-breeding Prairie Falcons Falco mexicanus. An adult female Peregrine Falcon Falco peregrinus was seen on one occasion. Three categories of remains of predated sandpipers were found during daily censuses of the study area: remains of tagged birds (11), remains of untagged, unbanded birds (5), and loose tags (9). The loose tags probably represent predated tagged birds.

To test for a differential probability of predation between tagged and untagged birds, I first estimated the predation date of each of the 16 remains from the state of deterioration of the carcass (data from loose tags were not used). I then checked daily census records for the total number of tagged and untagged sandpipers present on those dates. The data were set into a 2x2 contingency table (Table 3), with census numbers providing the 'not predated' totals. A Mann-Whitney U comparison of my estimates of the number of days between death and discovery does not support the idea that tagged remains were more readily discovered - that is, found sooner or in better condition - than untagged remains ($p > 0.1$). Most were found within a day or two of death. Assuming then equal probability of finding tagged and untagged remains, a chi-square test may be applied to the table, and the result suggests that tagged birds were selectively taken by predators ($p < 0.005$).

Table 3. Predation rates of tagged and untagged Semipalmated Sandpipers at Sibley Lake

	tagged	not tagged		
predated	11	5	16	$\chi^2 = 15.00$
not predated	874	2501	3375	$p < 0.005$ 1 D.F.
	885	2506	3391	

Discussion

Sandpipers were marked to facilitate individual identification at the staging areas, and the tags served this purpose well. Hundreds of birds were identified in the field, more rapidly and at greater distances than would have been possible with other methods. The method also produced valuable dispersal information. The tags thus met the study's requirements and, with careful fitting, appear to have directly interfered little with the birds' normal functions. However, predators on the study site appear to have taken marked birds more frequently than expected from their occurrence in the total population. I wish to discuss possible reasons for the increased predation in relation to use of the tags for such studies, where a need for individual identification and a conspicuous marker may suggest consideration of the method.

Predation Rate

The higher predation rate of marked birds could result from a higher attack rate by predators or a higher success rate per attack, or both. I have little direct evidence on this point, since I saw no successful predation in North Dakota. Four aerial falcon-sandpiper chases were observed, two of marked and two of unmarked birds. All ended with the sandpiper's escape.

Page and Whiteacre (1975) describe the hunting success of the Merlin (Falco columbarius) on small shorebirds. They report a zero success rate for aerial chases, and a 16.5% rate when birds were attacked on the ground. Ground hunts outnumbered aerial chases 3.2 to 1. Hunt et al. (1975) report similar tactics for Peregrine Falcons attacking shorebirds. If surprise is a primary determinant of raptor success in ground attacks, there might be little difference in the success rate on tagged and untagged birds, unless the tags significantly hindered take-off.

I believe that an increased attack rate accounts for most of the differential predation. The tags are designed to be conspicuous. Unlike other marking methods, they change the bird's dorsal appearance, thus disrupting its camouflage towards aerial predators. This may have increased the attack rate on tagged birds by Short-eared Owls, although for falcons, individual conspicuousness rather than camouflage loss per se might be more important. Mueller (1975) reported that American Kestrels Falco sparverius tended to select "odd" prey in the laboratory, and this may be true for other falcons in the field. Furthermore, if flocking serves to confuse a predator's concentration on a single quarry, its value will be diminished by the tagging of a bird.

Return Rates in Dispersal Studies: a Comparison of Marking Techniques

For shorebirds in the Americas, the scarcity of foreign returns of banded birds has meant that data on migratory routes has accumulated only very slowly. For instance, of 978 encounters with Semipalmated Sandpipers listed in the Banding Laboratory's files, birds marked with metal bands only (status 300) document only 24 same season movements greater than 100km. Several groups have tried using more conspicuous markers on shorebirds to increase the return rate, and to assess the value of wing tags and other methods for dispersal studies, I have brought together information on the return rates from most of the colour-marking projects in the Americas (Table 4).

Metal bands

Metal bands produce the lowest return rate for the methods compared in Table 4. There are a number of difficulties in comparing the return rates from different projects in the Table. Metal bands placed below the tarsal joint have a shorter lifetime than bands placed above it (Martinez unpubl. data, Morrison unpubl. data). Most of the pre-1970's banding was done below the tarsal joint, while later workers adopted the higher position. Improved band longevity, whether from changes in metals* or band locations, would increase the long-term return rate for "aluminum only" birds, although the rate of same-season recoveries would be little affected. Burton and McNeil (1975) reported for Semipalmated Sandpipers that 16 of 23 Latin American encounters were band returns, while 33 of 34 North American encounters were sightings of marked birds. My more limited experience with the Kent Island birds was similar (Table 1).

Leg streamers

It is difficult to evaluate the success of Burton and McNeil's techniques using leg streamers, since they do not provide a breakdown of numbers of birds marked in different ways. The calculated return rate includes band returns plus sightings of streamers and tags. They do report that leg streamers became tangled on the birds, and that this was not an effective marking method (McNeil and Burton 1973).

* Several European ringing schemes use hard alloy ('Monel' and 'Incoloy') or stainless steel rings. These are resistant to wear and corrosion but the duller alloys may lead to lower chance of notice by the public. Bias in relation to the age of the ring is, however, reduced -Eds.

Table 4. Encounter rates of Semipalmated and Western (C. mauri) Sandpipers.
All numbers refer to Semipalmated Sandpipers except where noted. Numbers in () are same season returns.

Marking Method and Project	Location	Number marked	Reports	Percent	Source
Aluminum Only					
Martinez, 1966-78	Kansas	28,906	28	0.10	Martinez 1979
Martinez, 1966-78 (C. mauri)	Kansas	7,038	6	0.09	Martinez 1979
Spaans, 1970-77	Surinam	5,494	6	0.11	Spaans 1979 and pers. comm.
Manomet, 1969-77	Massachusetts	4,572[1]	10	0.22	Harrington 1978
USF&WS Files, status 300[2]	N. & S. America	50,000[3]	52(24)	0.10[4]	USF&WS Files, July 1979
Double-orange Colour Bands					
Spaans, 1976-77	Surinam	7,043	106[5]	1.51	Spaans 1979 and pers. comm.
Breast-dyeing with Picric Acid plus Colour Band					
Gill, 1977-78 (C. mauri)	Alaska	1,609	(34)[6]	2.11	Gill 1979
C.W.S., 1975-78	James Bay, Canada	31,324	(1,626)[6] [7]	5.19	Morrison 1975-1979
Breast-dye and Leg Streamers					
Burton and McNeil, 1969-72	Maritime Provinces	8,966	59	0.66	McNeil and Burton 1977
Wing Tags					
Lank, 1977	New Brunswick	1,456	10(4)	0.69	This paper
Lank, 1978	North Dakota	1,479	(9)	0.61	This paper

[1] Some proportion of these were colour-banded, primarily for local identification. [2] Status 300 birds are ones marked with metal bands only. [3] This figure is an estimate. The file contains 102,415 Semipalmated Sandpiper bandings, but I do not know the exact number of status 300 records. [4] Since these files include the bandings of the three groups listed above, this is not an independent estimate of return rates. [5] I have included only reports due directly to the colour bands. Multiple sightings thought to be the same bird have been counted as one, making these figures comparable to band returns. An additional 31 reports of aluminum bands were received, some proportion of which were probably obtained because of the colour bands. Inclusions of all returns increases the percentage to 1.95. [6] These figures are 'bird days' which include multiple sightings and are therefore not directly comparable to band return rates. [7] Some 1975 birds were marked with other dyes, and the return rate for that year is lower than those of subsequent years.

Colour Bands and Metal Bands

Any comparison of marking methods faces problems of variations in banding site, ages of birds marked, observer densities in target areas, and so on. Arie Spaans' data from Surinam provide one of the best controlled situations for evaluating the effectiveness of several banding methods. Spaans used three different methods: aluminum only below the tarsal joint, aluminum only above the tarsal joint and double-orange colour bands above the joint (Spaans 1979 and pers. comm.)(see Table 5). Chi-square tests performed on the data, with the null hypothesis of equal reporting probabilities, suggest that the four-fold difference in reporting rate with regard to location of aluminum bands is marginally significant, while the colour bands clearly resulted in a better return.

One complication interpreting these results is that observer density increased in the later years of the study, when the colour bands were in use. The Maritimes and International Shorebird Survey schemes have increased the reporting rate on all marking programs in recent years. The survey involved observers rather than collectors, however, and it is clear that colour bands were responsible for the 10-fold increase in return rate.

Table 5. Return Rates of Birds Banded in Surinam (1970-1977)

(a) Differential encounter rates of aluminum bands placed below the 'knee' joint (on the tarso-metatarsus) in 1970-73, vs those placed above the joint (on the tibiotarsus) in 1975-77.

	Not recovered	Recovered	Totals	%
Below Knee	3621	2	3623	0.06
Above Knee	1867	4	1871	0.21
Totals	5488	6	5494	0.11

$\chi^2 = 2.84$
$(0.10 < p > 0.05)$ (1 d.f.)

(b) Differential encounter rates of aluminum bands vs double-orange bands, both placed above the joint, in 1975-77 and 1976-77, respectively.

	Not recovered	Recovered	Totals	%
Aluminum Bands	1867	4	1871	0.21
Orange Bands	6906	137	7043	1.95
Totals	8773	141	8914	1.58

$\chi^2 = 28.47$
$(p < 0.001)$ (1 d.f.)

Data from Arie Spaans (1979, pers. comm.)

Colour-dyeing

Colour-dyeing produced by far the highest return rate. One difficulty in comparing this method with those using individually marked birds is the use of 'bird days' in reporting numbers of sightings obtained. On Kent Island, I judge from colour bands and location information that my 27 'bird days' represented 22 individuals. If generally applicable, this would lower the 'bird days' figures about 20%. Breast-dyeing would still remain easily the most effective method, and the widespread geographical range of sightings confirms its effectiveness. Used in combination with a colour-banding scheme, it is without doubt the method of choice for dispersal studies.* Unfortunately, picric acid remains the only known effective, long-lasting dye for birds: other dyes that have been tried on shorebirds have all faded rapidly (McNeil and Burton 1973, Morrison 1975, Summers 1978, Gurstenberg pers. comm.).

* See note on next page

Use of Wing Tags

Long distance return rates for the wing tags are higher than aluminum bands alone, but lower than those of picric acid-dyed or orange-banded birds. I believe this properly reflects the relative conspicuousness of the methods. While the dispersal information obtained in the study from North Dakota birds is a contribution to our knowledge of mid-western populations of Semipalmated Sandpipers, more returns would have been obtained through use of an effective breast dye. The useful additional information that might be obtained from individual identification using wing tags does not outweigh the advantages of breast-dyeing with regard to return rate.

Wing tags would not be the method of choice in studies of local breeding populations. They would disrupt the camouflage of incubating birds and would be an invitation to predation. The tags might be profitably used in studies of foraging strategy or feeding territories (e.g. Kelly and Cogswell 1979). However, colour bands have been successfully used in such studies in the past and probably do not have the predation liability demonstrated during the present study for wing tags.

In summary, I feel the tagging method described here can be used to mark clearly small, and probably also large, shorebirds with a minimal amount of disruption of normal functioning. The tags provide individual identification and may be read at greater distances than colour bands. Naive observers can successfully identify the tags. This very conspicuousness, however, increases the bird's chances of being taken by avian predators, limiting the applicability of the method. I recommend use of the tags only after careful and creative consideration of the requirements of the study and the use of less disruptive marking methods.

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*Note from previous page: The use of temporary leg flags (Goodyer, Symonds & Evans 1979, WSG Bull 25:12) is generally preferable to colour-bands for this type of study, because of both greater conspicuousness and prevention of long term conflict between marking schemes -Eds.