

# PARTIAL POSTJUVENILE WING MOULT OF THE SEMIPALMATED SANDPIPER *CALIDRIS PUSILLA*

by C.L. Gratto and R.I.G. Morrison

## Introduction

Shorebirds exhibit several patterns of flight feather moult during their first year of life. In most species, juveniles do not replace any remiges during the postjuvenile (first prebasic) moult. In others, all flight feathers are renewed. In a few species, however, juveniles exhibit a partial wing moult, which usually involves only the outer (distal) primaries and inner secondaries. Partial postjuvenile wing (PPW) moult appears to be most common in the genera *Tringa* and *Calidris* and has been noted for the following species: Semipalmated Sandpiper *Calidris pusilla* (Spaans 1979), Red-necked Stint *C. ruficollis* (Paton and Wykes 1978), Little Stint *C. minuta* (Pearson 1974), Least Sandpiper *C. minutilla* (Spaans 1979), Curlew Sandpiper *C. ferruginea* (Elliott et al. 1976, Waltner 1976), Stilt Sandpiper *Micropalama himantopus* (Spaans 1979), Ruff *Philomachus pugnax* (Pearson 1974), Marsh Sandpiper *Tringa stagnatilis* (Pearson 1974), Greater Yellowlegs *Tringa melanoleucos* (Spaans 1979), Lesser Yellowlegs *Tringa flavipes* (Spaans 1979), Solitary Sandpiper *T. solitaria* (Spaans 1979), Wood Sandpiper *T. glareola* (Pearson 1974), Common Sandpiper *Actitis hypoleucos* (Pearson 1974), Grey-rumped Sandpiper *Heteroscelus brevipes* (Prater and Marchant 1975) and Wandering Tattler *Heteroscelus incana* (Johnson 1979, Prater and Marchant 1975). Since most of these species winter in the southern hemisphere, it has been suggested that the moult functions to renew some of the most important flight feathers, which would otherwise become very worn if a bird were to attempt breeding in its first summer - a strategy which would involve three major migrations before the first replacement of these feathers during the second prebasic moult (Spaans 1976, Hale 1980). Plumage may also deteriorate more rapidly in the tropics (Pearson 1974).

The pattern of wing moult within juveniles of the species mentioned is also variable: some birds undergo partial moult of remiges, others renew all flight feathers, and others none. Reasons for this variation are, as yet, unclear.

Waltner (1976) noted that the pattern of feather replacement in the PPW moult of Curlew Sandpipers in South Africa is unlike that found during normal flight feather moult of adults. The direction of primary moult was the same as in adults, proceeding from a central locus to the outermost primary. Secondary moult, however, was different: the innermost secondary was the first to be renewed, with moult proceeding distally to the sixth or seventh secondary. The remiges not moulted were not replaced until the second prebasic moult, when all feathers were renewed.

The purpose of this paper is to examine the evidence for occurrence of PPW moult in populations of Semipalmated Sandpipers found at a northern stop-over during autumn migration. At this time of year, the moult is seen as differential wing wear - remiges which had been replaced during the postjuvenile moult the previous winter are clearly newer than those not moulted. Observance of the moult in birds of known age has indicated that it occurs only in yearlings (first-summer birds), and some indication of the percentage undergoing the partial moult has been obtained. Adaptive aspects of the moult will also be discussed briefly.

## Methods and Study Area

Since 1975, the Canadian Wildlife Service has carried out a large-scale shorebird banding operation at North Point (51°29'N 80°27'W), on the southwest coast of James Bay, 27 km northeast of Moosonee, Ontario. Birds were captured throughout the period of autumn migration during July and August. Between four and thirteen thousand shorebirds have been captured each year, the majority of which have been Semipalmated Sandpipers. Most birds were captured with mist nets, though rocket nets were also used. In addition to being banded, colour-banded, and dyed, birds were weighed and the lengths of bill (exposed culmen) and wing (maximum chord) measured.

Data on PPW moult have been collected since 1977. PPW moult was considered to have taken place only if some primaries had been replaced: partial moult of the secondaries only was not considered PPW moult. This definition was adopted for several reasons. Firstly, primaries appear more critical in affecting flight efficiency (see Discussion), and it was also sometimes difficult to determine reliably the age of new-looking inner secondaries which suffer less wear than outer feathers. PPW moult was recorded as follows:  $N^3O^7ON^4/N^5O^5ON^3$  - where "N" represents "new" feathers and "O" old feathers, and the superscript the number in each category. The notation reads across the bird's back from left to right wing with the slash at the body, so that the example represents: 3 new outer and 7 old primaries, 6 old outer and 4 new inner secondaries on the left wing; body; 5 new and 5 old secondaries, 7 old inner and 3 new outer primaries on the right wing. The PPW moult was scored by counting the total number of remiges (20 secondaries and 20 primaries) that had been replaced. Scores range from 1 to 39 (0 would mean no remiges had been moulted and 40 all).

## Results and Discussion

PPW moult in James Bay was noted regularly in Lesser Yellowlegs and Semipalmated Sandpipers, and occasionally in Least Sandpipers. Band returns for PPW moult juveniles have so far been obtained only for Semipalmated Sandpipers and results are presented for this species only.

Recaptures of previously-banded Semipalmated Sandpipers (Table 1) showed that only yearling (first summer) birds had undergone partial wing moult. The proportion of yearlings with PPW moult varied from half in 1977 (and 1980) to all in 1978. The number of feathers replaced in the 1978 birds ranged from 2 new primaries on the left wing only (moult score 2), to all new remiges except for the outermost secondary and innermost primary on the right wing (moult score 38). In 1980, the first summer bird without PPW moult had, however, replaced one new inner secondary on each wing. Four of the five 1977 birds without PPW moult had all old (abraded) primaries, although the condition of their secondaries is unknown. The remaining birds had all apparently new primaries.

It appears possible that the number of feathers replaced during PPW moult may vary from year to year. There is a significant difference between percent of PPW moult with a score greater than 6 (primaries only) in 1977 and 1978 (or 1980) (Table 2). This might indicate that PPW moult was less extensive in 1977, leading to the greater percentage of non-moulting first-summer birds in that year. Figures 1 and 2 show the distribution of primary and secondary moult scores, respectively. In all years, approximately 30% of all PPW moult birds had replaced the three outermost primaries on each wing. At least half of the PPW moulters replaced 1, 2, 3, 4 or 5 inner secondaries on each wing. The high values at even moult scores, especially in the primaries, result from a tendency for symmetrical replacement of remiges on each wing (Table 3).

Table 1. Presence of partial postjuvenile wing (PPW) moult in Semipalmated Sandpipers of known age recaptured during banding operations in southwestern James Bay.

Year of recapture	Number of yearlings*			Number 2 years or older		
	no PPW moult	PPW moult	total	no PPW moult	PPW moult	total
1977	5	5	10	216	0	216
1978	0	14	14	260	0	260
1979	-	-	-	252	0	252
1980	1	1	2	43	0	43

\* banded as juveniles, recaptured 1 year later and checked for PPW moult

Table 2. Distribution of primary moult scores among birds showing PPW moult. Figure are percentages, with number in each class in parentheses.

Year	Score 1-5	Score 6	Score 7-19	Total
1977	35.3 (53)	38.0 (57)	26.7* (40)	(150)
1978	27.8 (106)	30.9 (117)	41.3 (156)	(379)
1980	28.6 (57)	29.1 (58)	42.3 (84)	(199)

\* significant difference from 1978 and 1980 values (p less than 0.01)

Table 3. Symmetry of moult in primaries and secondaries during PPW moult in Semipalmated Sandpipers.

Year	Percent symmetrical		
	Primaries	Secondaries	Both
1977	82.7 (124/150)	72.7 (109/150) <sup>1</sup>	62.7 (94/150)
1978	78.2 (297/380)	67.1 (255/380) <sup>2</sup>	53.9 (205/380)
1980	81.9 (163/199)	66.8 (133/199) <sup>2</sup>	55.3 (110/199)

1. difference between primaries and secondaries significant, p less than 0.05.  
 2. difference between primaries and secondaries significant, p less than 0.001.

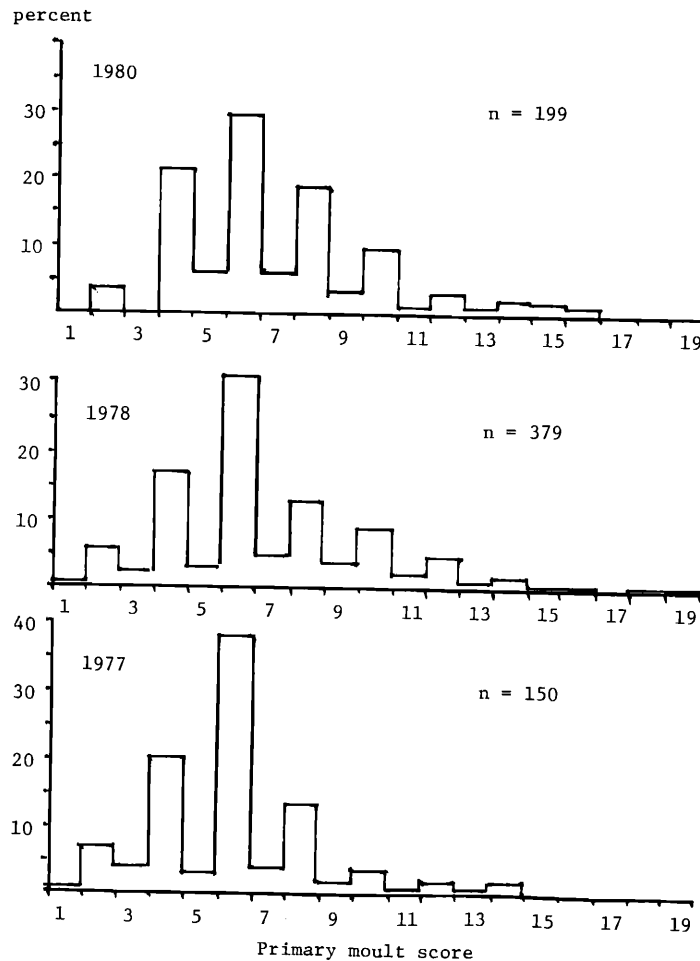


Figure 1. Distribution of primary moult scores in Semipalmated Sandpipers which had undergone partial postjuvenile wing moult.

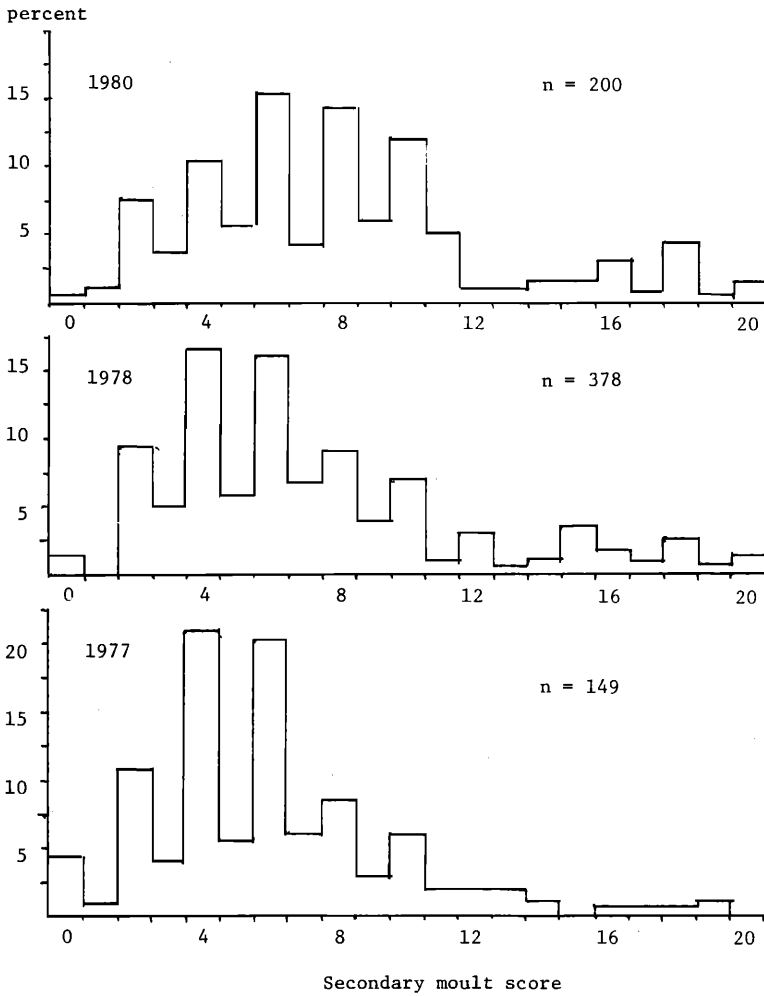


Figure 2. Distribution of secondary moult scores in Semipalmated Sandpipers which had undergone partial postjuvenile wing moult.

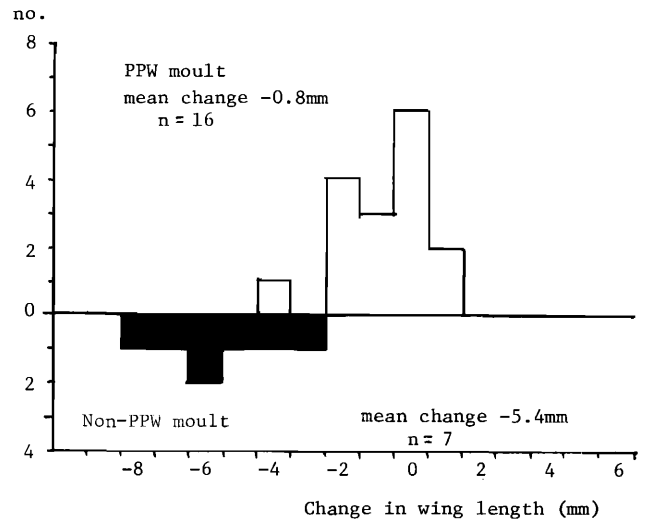


Figure 3. Changes in wing length of Semipalmated Sandpipers banded as juveniles and recaptured as yearlings, with and without PPW moult.

Table 4. A comparison of the percentage of yearlings in recaptured birds with the occurrence of PPW moult in samples of birds trapped during banding operations. Figures are percentages.

Year	Recaptured birds only		All birds captured PPW moult/all adults
	Known yearlings/older birds	Known yearlings with PPW moult/older birds	
1977	4.7 (11/234)	2.4 (4/167)	3.1 (149/4859)
1978	7.7 (13/168)	7.7 (13/168)	7.5 (380/5087)
1979	- (0/99)	- (0/99)	1.2 (29/2399)
1980	13.3 (2/15)	6.7 (1/15)	13.6 (199/1460)

Table 4 compares the percent yearlings from band returns, percent yearlings with PPW moult from band returns and percent PPW moult per all adults captured each year. These figures appear to indicate that the percent of PPW moult is a reasonable estimate of percent yearlings in the population. The percentage of first summer birds with PPW moult is clearly consistently high. The figures for 1979 in Table 4 are especially significant - 1978 was an extremely poor breeding year for Semipalmated Sandpipers throughout much of the Canadian arctic, or at least for those segments of the population migrating through the North Point area, and few juveniles were banded that year at North Point. This is reflected in the lack of known yearlings among the recaptures (captures of previously banded birds) in 1979, and in the very low percentage of birds with PPW moult.

Recaptures of banded birds show that a greater number of birds banded as juveniles return as two year olds than as yearlings (Table 5). Since it seems unlikely that the birds would take a different route from the breeding grounds as yearlings before reverting to their original path as two year olds, it would appear that a large number of first summer birds remain south of the breeding grounds. Spaans (1979) reported that yearling Semipalmated Sandpipers in Surinam overwinter in considerable numbers, and Loftkin (1962) noted regular reports of the species in Florida in June.

Table 5. Percentage recaptures of birds banded as juveniles during subsequent years.

1976 juveniles	Year of recapture	Age of bird at recapture	Percent juvenile recapture (No. 1976 juvenile/all 1976 recaptures)
	1977	1	4.7 (11/234)
	1978	2	18.6 (18/97)

1977 Juveniles	Year of recapture	Age of bird at recapture	Percent juvenile recapture (No. 1977 juvenile/all 1977 recaptures)
	1978	1	7.7 (13/168)
	1979	2	25.0 (32/128)
	1980	3	17.4 (4/23)

Table 6. The percentage occurrence of PPW moult in birds captured per 10 day period during autumn migration in southwestern James Bay.

Year	Percent (PPW moult/total adults caught)			
	12-21 July	22-31 July	1-10 August	11-20 August
1977	5.3 (56/1053)	2.6 (35/1362)	2.1 (31/1484)	0.8 (4/497)
1978	10.6 (43/404)	10.6 (223/2095)	4.8 (82/1708)	3.3 (29/880)
1980	14.5 (59/406)	15.9 (77/483)	11.5 (58/503)	4.4 (3/68)

Table 7. Percentage PPW moult in specimens of Semipalmated Sandpipers of known sex in the National Museum of Natural Sciences, Ottawa.

	Female	Male
Sex of specimens examined	42.7 (102/239)	57.3 (137/239)
Presence of PPW moult	38.5 (5/13)	61.5 (8/13)

The proportion of migrants with PPW moult is considerably higher during the early part of the fall migration than later in the season (Table 6). The disproportionately high number of one year old birds among early migrants could be related to their not attempting to breed, to a lower breeding success (and thus early departure), or to both factors. In 1980, 9 of 86 (10.5%) breeding Semipalmated Sandpipers captured at LaPerouse Bay near Churchill, Manitoba, had PPW moult (Gratto, Cooke and Morrison 1981), suggesting that a substantial proportion of the one year old birds which had migrated north attempted to breed. Their breeding success, however, was rather low, which could explain their early return. We do not know if the proportion of yearlings migrating to the breeding grounds varies from year to year or if the proportion of yearlings undergoing PPW moult varies with it. It is also not known whether there may be geographic variation in the extent of PPW moult in yearlings deriving from different breeding areas. Morphometric studies have indicated that later migrants in James Bay are from breeding areas further north and west of those of birds migrating earlier in the season (Harrington and Morrison 1979), and it is known that populations passing through the central U.S.A. have a different moult schedule (Martinez, E.F. pers. comm., see Harrington and Morrison 1979, Spaans 1979).

An examination of specimens of Semipalmated Sandpipers at the National Museum of Natural Sciences in Ottawa (Table 7) indicated that there was no difference between the sexes with respect to occurrence of PPW moult.

PPW moult has been considered an adaptation of yearlings for long migratory flights. Welty (1975) described an experiment undertaken by Chapeau in the early 1900's which demonstrates how important the outer primaries can be. Removal of only a small amount of the tips of the primaries of a dove rendered the bird flightless, while the elimination of enough of the secondaries to decrease the wing area by 55% did not prevent the bird from flying. Our data show that PPW moult may make a considerable difference to the length of the (flattened) wing. In four instances when no primaries had been replaced on one wing and at least the outermost feather on the other, the difference between the two wings was 6, 4, 3 and 1mm (mean 3.5mm). Figure 3 illustrates the changes in wing length between years in birds banded as juveniles and recaptured as yearlings. Those of birds that had undergone PPW moult remained almost the same, the mean change being -0.8mm (n=16), whereas those of the non-moulters decreased substantially, the mean decrease being 5.4mm (n=7).

If the condition of the primaries is more important for flight than that of the inner secondaries, one would expect the partial moult of primaries to be symmetrical more often than that of the secondaries. In all years this is so (Table 3), supporting the suggestion that the partial primary moult is an adaptation for long migratory flights of yearlings.

In summary, we know that birds with partial wing moult are yearlings, but not all yearlings have PPW moult (by our definition - the rest may have replaced some secondaries only). It appears that most yearlings can be identified by the moult, but that this percentage may vary between years. It would be interesting to determine if the percentage of yearlings without PPW moult is lower in non-migrant birds summering south of the breeding grounds, or in those undergoing partial migration. It is possible that the percentage of yearlings migrating northwards may vary yearly as well.

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## HATCHING SUCCESS OF YEARLING AND OLDER BREEDERS IN THE SEMIPALMATED SANDPIPER *CALIDRIS PUSILLA*

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### Introduction

A number of ornithological studies have attempted to determine the age of first breeding members of a population, and others have compared success of inexperienced versus experienced breeders. This information is necessary in calculating the reproductive potential of a population.

Studies of several small shorebird species have shown that at least some yearling (first year) birds may attempt to breed, e.g. Piping Plover *Charadrius melodus* (Wilcox 1959), Western Sandpiper *Calidris mauri* (Holmes 1973), Temminck's Stint *Calidris temminckii* (Hildén 1978), Least Sandpiper *Calidris minutilla* (Miller 1979), Dunlin *Calidris alpina* (Holmes 1966, Soikkeli 1967), and Northern Phalarope *Phalaropus lobatus* (Hildén & Vuolanto 1972). However, the percentage of birds breeding in their first year may vary. Soikkeli (1967), in Finland, estimated that one third of the Dunlin bred in their first year, and two thirds at 2 years; while in Alaska apparently all first year Dunlin nested (Holmes 1966).

The purpose of this paper is to document the presence of first year breeders in a population of Semipalmated Sandpipers *Calidris pusilla*, to compare their hatching success with that of more experienced nesters, and to discuss possible reasons for the observed difference in hatching success.

### Study Area and Methods

Studies were carried out at La Perouse Bay, 50 km east of Churchill, Manitoba, on the coast of Hudson Bay, during the summer of 1980. Semipalmated Sandpipers were studied in a 4 km<sup>2</sup> area in the Delta of the Mast River, where nesting occurred in drier, shrubby areas consisting mainly of *Salix brachycarpa* or *Betula glandulosa* and mixed sedges and grasses. Birds were captured on nests using walk-in or drop-door traps and measurements, including wing (maximum chord, flattened), exposed culmen, tarsus and bill width, and weight taken. Birds were also examined for evidence of partial post-juvenile wing (PPW) moult (see Gratto and Morrison 1981). A nest was considered successful if at least one egg hatched and eggs were considered to have hatched if they had been strongly pipped one to two days before finding an empty nest.