Nesting success of yearling and older breeders in the Semipalmated Sandpiper, *Calidris pusilla*

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Approximately 100 pairs of Semipalmated Sandpipers (*Calidris pusilla*) nested in a 2-km^2 area at La Pérouse Bay, Manitoba, each year from 1980 to 1982. The proportion of nesting yearlings in the population varied from 3 to 10% in different years. Some aspects of the breeding biology of pairs containing at least one yearling were compared with those without yearlings. In 1980, a significantly lower proportion of nests of yearlings were successful (hatched at least one chick) compared with older pairs. In 1981 and 1982 no difference was observed. Nest failure was primarily caused by egg predation. No differences in clutch size or nest distribution were found between the two age groups, but eggs were significantly smaller in nests of yearling females and mean hatch date at yearling nests was later.

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Environ 100 couples de bécasseaux semi-palmés (*Calidris pusilla*) sont venus construire leur nid chaque année de 1980 à 1982 dans une aire de 2 km^2 de La Pérouse Bay, au Manitoba. La proportion d'oiseaux de l'année qui sont venus faire leur nid a varié de 3 à 10% durant les 3 années. La nidation chez les couples comptant au moins un oiseau de l'année a été comparée à la nidation des couples où les deux partenaires étaient plus âgés. En 1980, le succès de la nidation (éclosion d'au moins un oisillon dans le nid) a été significativement plus faible chez les couples de jeunes de l'année que chez les couples plus âgés. En 1981 et 1982, il ne semble pas y avoir eu de différence. L'insuccès de la nidation semble avoir été dû surtout à la prédation sur les œufs. Le nombre d'œufs par portée et la répartition des œufs étaient semblables chez les deux groupes d'âge, mais les œufs des femelles de l'année se sont avérés plus petits et la date d'éclosion des œufs des parents de l'année, plus tardive.

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Introduction

To estimate the reproductive potential of a population, it is necessary to know age of first breeding and success (young produced) of experienced and inexperienced breeders. Deferred breeding is common in large, long-lived bird species but more unusual in small, short-lived birds (Western and Ssemakula 1982). In most small shorebird species, some individuals breed in their first year: e.g. Western Sandpiper, *Calidris mauri* (Holmes 1971); Temminck's Stint, *C. temminckii* (Hildén 1978); Dunlin, *C. alpina* (Holmes 1966; Soikkeli 1967), Least Sandpiper, *C. minutilla* (Miller 1979); and Red-necked Phalarope, *Phalaropus lobatus* (Hildén and Vuolanto 1972). However, according to Safriel (1971, and in Myers 1981), Semipalmated Sandpipers (*C. pusilla*) at Barrow, Alaska, do not breed as yearlings.

The purpose of this paper is to document the presence of 1st year breeders in a population of Semipalmated Sandpipers (Semis) and to compare aspects of their breeding biology with more experienced nesters.

Study area and methods

The study was carried out at La Pérouse Bay, 50 km east of Churchill, Manitoba, in the summers of 1980, 1981, and 1982. Semis were observed in a 2-km^2 area in the delta of the Mast River, where nests occurred in dry, shrubby areas consisting mainly of *Salix brachycarpa* or *Betula glandulosa* and mixed sedges and grasses. Density was estimated at 23 pairs per 10 ha dry land area. Approximately 100 pairs nested in the study area. Birds were captured on nests using passive walk-in traps of chicken wire, with a circular (35 cm in diameter and 25 cm high) keyhole design. The birds were marked with individual colour band combinations. Measurements, including wing (maximum chord to nearest millimetre), exposed culmen (0.1 mm), and tarsus (0.1 mm) were taken (as described in Prater *et al.* 1977). Birds were weighed with a 50-g Pesola balance to the nearest 0.5 g. Birds were also examined for evidence of partial postjuvenal wing (PPW) moult. All birds with PPW moult are yearlings, and most yearlings have PPW moult (Gratto and Morrison 1981). We defined yearling nests as those with at least one PPW moult parent, and adult nests as those without any PPW moulters.

Length (0.1 mm) and maximum breadth (0.1 mm) of most eggs were measured in 1981 and 1982. Eggs were weighed with a Pesola balance (0.5 g). An index of egg volume was calculated by length × breadth^2 (Davis 1975), and shape by 100 × length/breadth (Coulson 1963). Nests were checked every 1–3 days. We considered a nest successful if at least one egg hatched or if eggs had been strongly pipped 1–2 days before we subsequently found an empty nest.

Results

Three birds banded as nestlings were captured as breeding yearlings the following summer. All had PPW moult.

Yearlings constituted between 3 and 10% of all Semis caught on nest in the 3 years (Table 1). Altogether there were 13 female and 9 male yearlings captured.

Nesting success was significantly lower in yearling than adult nests in 1980 but not in 1981 or 1982 (Table 2). Yearling nests were those with at least one yearling parent. Only nests at which both parents had been captured were considered. Although some studies have found that members of a pair are usually the same age (e.g., Arctic Terns, *Sterna paradisaea*; Coulson and Horobin 1976), this may not be so in our Semipalmated Sandpiper population. In the 19 yearling pairs where both mates were known, only 1 pair contained two PPW moulters. In four instances a PPW moult female was mated to a known experienced (previously banded) male. The remaining seven males and seven females were mated to unbanded non-PPW moulters.

Nest failure in all years was primarily due to predation. At 213 nests with known fates, 207 (97.2%) were destroyed by predation of eggs. Potential predators in the area included Parasitic Jaegers (*Stercorarius parasiticus*), Marsh Hawks (*Circus cyaneus*), Herring Gulls (*Larus argentatus*), Arctic Foxes (*Alopex lagopus*), Red Foxes (*Vulpes vulpes*), and Short-tailed Weasels (*Mustela erminea*). The only instance of predation on shorebird nests that we observed was a Marsh Hawk removing eggs from a Red-necked Phalarope nest in 1982. The remainder of nest loss was due to desertion, which was observed at only 6 of 213 nests (2.8%). The only two cases of desertion early in incubation were at yearling nests in 1980, when in each instance one parent deserted after the other was killed (by a predator) at the nest. Yearling nests were spread throughout the entire study area.

Shorebirds do not normally vary their clutch size from four (MacLean 1972), and in this study clutch size did not differ between age groups (Table 3). Since eggs occasionally disappeared from nests during incubation, we were never certain that less than four eggs had been laid. Many nests were found during incubation, and not all nests were checked daily.

Eggs in nests of yearling females were significantly smaller in length and "volume" than those in adult nests (Table 4). Yearling female nests were those with a PPW moult female, and yearling male nests those with a PPW moult male. Due to small sample sizes, each egg was considered an independent measurement, disregarding possible intra-clutch similarities. Egg weight was not considered because few incubation times were known, and egg weight decreased throughout incubation (n = 132, r = −0.51, $p \ll 0.001$). Length was significantly less in nests of yearling females, but breadth was not different. This resulted in a significant difference in shape and "volume" between the two age groups. Overall, the reduction in "volume" of eggs of yearling females was about 5%. Eggs in nests of yearling males were not significantly different from those of adults (Table 4).

TABLE 1. Percentages of yearlings (PPW moult) for 1980 to 1982

Year	No. of birds identified on nest	% yearlings (PPW moult)
1980	87	10.3 (9)
1981	101	8.9 (9)
1982	140	2.9 (4)

TABLE 2. The effect of age on nesting success for 1980 to 1982. Only nests with known fates are included

Year	% nest success			
	All nests[a]	Yearlings[b]		Adults[b]
1980	69.8 (30/43)	25.0 (2/8)	*	80.0 (28/35)
1981	24.4 (21/86)	50.0 (2/4)	NS	33.3 (7/21)
1982	60.7 (51/84)	75.0 (3/4)	NS	73.8 (45/61)

NOTE: *, $p < 0.01$ (Fisher's exact test); NS, not significant.
[a]Includes nests where no or only one adult was captured.
[b]Nests at which both adults were captured only.

Measurements of all PPW moulters were compared with those of all adults. Data from all years were combined as there were no significant differences in measurements between years (ANOVA). Wing was significantly shorter (n = 290, $p < 0.05$) in yearlings, but bill length, tarsus, and weight were not significantly different (ANOVA). Weights were taken throughout incubation, but weight remained constant for both sexes during this time (C. L. Gratto, unpublished data).

Arrival dates could not be determined, but mean hatch date was 2–3 days later at yearling than at adult nests each year (Table 5). Sample sizes for each year were low, and mean hatch date varied between years. Therefore, hatch dates were corrected in relation to the mean hatch date of their year, and all data combined. Mean hatch date over all years was significantly later for yearlings than adults (Table 5).

To obtain an estimate of mortality and (or) philopatry of each age group, the percentage of returning breeders (PPW moult and non-PPW moult birds) was calculated. This refers to the number of nesting birds of each age class which were found back at La Pérouse Bay the following year (Table 6). In 1981, there was a significantly lower proportion of 1980 yearlings seen in the

TABLE 3. The effect of age on clutch size for 1980 to 1982. Nests destroyed before incubation were excluded

	Yearlings				Adults		
Year	n	Mean	SD		n	Mean	SD
1980	7	4.0	0.0	NS[a]	35	4.0	0.2
1981	9	3.8	0.7	NS	28	4.0	0.0
1982	4	3.5	0.6	NS	61	3.8	0.4
All	20	3.8	0.5	NS	124	3.9	0.3

[a]NS, not significant (ANOVA).

TABLE 4. The effect of age and sex on egg size. Data from 1981 and 1982 were combined

Age	No. of eggs	Length (mm)	Breadth (mm)	Shape[a]	"Volume"[b]
Yearling female	22	28.9 (1.1)	21.1 (0.4)	136.6 (4.7)	12.9 (8.3)
		*	NS	*	*
Adult	310	30.0 (0.9)	21.3 (0.5)	141.2 (5.2)	13.6 (7.5)
		NS	NS	NS	NS
Yearling male	24	29.8 (1.0)	21.2 (0.5)	140.7 (4.2)	13.4 (8.8)

NOTE: Values in parentheses are standard deviations. *, $p \ll 0.001$ (ANOVA); NS, not significant.
[a]Shape = 100 (length/breadth).
[b]"Volume" = length × breadth^2.

TABLE 5. The effect of age on date of hatch for 1980 to 1982 (day 1 = 1 July)

	Yearlings				Adults		
Year	n	Mean hatch	SD		n	Mean hatch	SD
1980	2	10.5	0.7		33	7.4	1.7
1981	3	13.0	4.0		17	11.2	3.3
1982	3	18.0	1.7		43	16.4	2.7
All[a]	8	7.4	2.4	*	93	5.4	2.5

[a]Hatch dates were corrected with respect to the mean hatch date of their year.
$*p < 0.05$ (ANOVA).

study area, or at a nest, compared with 1980 adult birds. However, in 1982 there was no difference in return rate of 1981 yearlings and older birds.

Discussion

Some yearling Semis attempted to breed in the La Pérouse Bay population. The percentage of yearlings in this population appeared to be related to the nesting success of the previous year (Tables 1 and 2).

Blus and Keahey (1978) summarized the major theories that attempt to explain the low reproductive success of inexperienced breeders. Clutch size is normally reduced in young birds, either because they cannot produce more eggs, or the number of eggs laid is adapted to the number of young they can fledge. Inexperienced breeders are often found at the periphery of colonies or in unsuitable habitats and often nest later than adults, either because they arrive later or are less able to recognize, obtain, and defend suitable nest sites.

In this study, yearling nests were distributed throughout the study area, and we noticed no obvious differences in habitat between nest sites of the two age groups. Although sample sizes are small, mean hatch date was two days later for yearling than adult pairs (Table 5). Since nestling survival was not examined, the effect of a slightly later hatch is unknown.

Clutch size did not vary between older and younger birds (Table 3). Although egg size may be reduced in first-time breeders of some species (e.g., Tree Swallow *Iridoprocne bicolor*, DeSteven 1978; Herring Gull, Davis 1975), Vaisanen *et al.* (1972) stated that in shorebirds and other birds with precocial young, egg size would be expected to depend less on the age of the female than it would in birds with altricial young. Here eggs were significantly smaller at nests of yearling females (Table 4). Egg "volume" was only decreased by about 5%, but smaller eggs may produce smaller chicks, as shown for Dunlin (Soikkeli 1967). It is unknown whether the small difference in size would lead to greater chick mortality. Although egg size was not the same, there was no difference in body size or weight between yearling and adult females.

Several authors have measured differences in behavior (e.g., nest attentiveness, distraction displays)

TABLE 6. Return rate to the nesting area of birds banded as yearlings and adults the previous year

	% from previous year seen in area		% from previous year found at nest	
	1980[a], 1981[b]	1981[a], 1982[b]	1980,[a] 1981[b]	1981[a], 1982[b]
Yearlings	12.5 (1/8) **	55.5 (5/9) NS	0.0 (0/8) *	44.4 (4/9) NS
Adults	55.8 (43/77)	56.5 (52/92)	40.3 (31/77)	48.9 (45/92)

NOTE: *, $p < 0.05$ (Fisher's exact test); **, $p < 0.01$; NS, not significant.
[a]Year banded.
[b]Year recovered.

between yearling and older birds. For example, Ryder (1975) noted that young Ring-billed Gulls (*Larus delawarensis*) were less persistent incubators and experienced higher egg loss than older pairs. In 1980 at La Pérouse Bay, at 2 (of 8) yearling nests the remaining parents deserted after their mates were killed by a predator, while predation or desertion of the parents was not observed at any of the 35 adult nests. The only nest found with more than four eggs (two Red-necked Phalarope and four Semi eggs) was incubated by a yearling pair. However, no such behavioral differences were observed in 1981 or 1982, just as there was no difference in nesting success between yearlings and older breeders in these years.

In conclusion, a substantially lower nesting success for yearling breeders was evident in this population of Semipalmated Sandpipers in 1980, followed by a low return of these yearlings in 1981. Sample sizes were low for 1981 and 1982, but no significant difference in nesting success between the two age groups was evident in either year, and there was also no difference between return rates in 1982 of 1981 yearlings and older birds. Eggs at nests of yearling females were significantly smaller, and mean hatch date at yearling nests slightly later, than at adult nests. It is not known whether either would affect nestling survival. Causes of inconsistencies between years in nesting success and yearling return rate are unknown. Low breeding success of yearlings might be a fairly common occurrence, or years like 1980 might be unusual. A long-term study of this population would be necessary to resolve these questions.

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