

DISAPPEARANCE OF BREEDING SEMIPALMATED SANDPIPERS FROM CHURCHILL, MANITOBA: MORE THAN A LOCAL PHENOMENON

JOSEPH R. JEHL, JR.¹

Smithsonian Ornithology, U.S. National Museum of Natural History, Smithsonian Institution,
Washington, DC 20560

Abstract. As late as the 1940s the Semipalmated Sandpiper (*Calidris pusilla*) was the most abundant sandpiper breeding at Churchill, Manitoba. By the 1960s it had undergone a sharp decline, and by the mid-1990s the local population consisted of 11 pairs in a single colony. Nesting was last documented in 2001. Declines had also become evident at several other breeding sites along the Hudson Bay coast of Manitoba and Ontario, as well as in the number of migrants detected on the Atlantic coast of Canada and the northern United States. Information on the biology of the Churchill population in 1993–2004 largely agreed with that gathered at La Pérouse Bay, Manitoba, in the 1980s: reproductive success was good and new birds continued to join the colony; however, the number of breeding attempts by individuals was low and decreasing. As there is no evidence that the decline was related to local factors (e.g., altered habitats, climate change), it is probably attributable to mortality in the nonbreeding season, which leaves fewer birds available to return north. Whether causality can be fully resolved is problematic. Monitoring migrants can reveal population trends and studies on the breeding grounds can help frame hypotheses, but both approaches are time-consuming and provide only partial answers. In such cases, restoration of declining species may be best served by fostering habitat conservation throughout a species' range.

Key words: breeding biology, *Calidris pusilla*, Churchill, Manitoba, monitoring, population dynamics, Semipalmated Sandpiper.

Desaparición de Individuos Reproductivos de *Calidris pusilla* de Churchill, Manitoba: Más que un Fenómeno Local

Resumen. Hasta los años 40 *Calidris pusilla* fue el chorlo más abundante que criaba en Churchill, Manitoba. Para los años 60, esta especie ya había sufrido una marcada disminución y para la mitad de los 90 la población local estaba integrada por 11 parejas que se encontraban en una única colonia. La nidificación fue documentada por última vez en el 2001. La disminución se había vuelto evidente también en varios otros sitios de cría a lo largo de la costa de la Bahía Hudson de Manitoba y Ontario, y en el número de migrantes detectados en la costa atlántica de Canadá y el norte de Estados Unidos. La información sobre la biología de las poblaciones de Churchill obtenida entre 1993 y 2004 coincidió en gran medida con la obtenida en la Bahía La Pérouse, Manitoba, en los años 80: el éxito reproductivo fue bueno y nuevas aves siguieron integrándose a la colonia. Sin embargo, el número de intentos reproductivos de los individuos fue bajo y decreciente. Como no hay evidencia de que la disminución se relacionó con factores locales (e.g., alteración del hábitat, cambio climático), se puede atribuir probablemente a la mortalidad en la estación no reproductiva, lo que conduce a que menos individuos regresan al norte; sin embargo, identificar de modo concluyente las causas es problemático. El monitoreo de las aves migratorias puede revelar las tendencias poblacionales y los estudios en las áreas reproductivas pueden ayudar a proponer hipótesis, pero ambos enfoques requieren mucho tiempo y sólo brindan respuestas parciales. En estos casos, la restauración de especies en declive podría beneficiarse en mayor medida impulsando la conservación del hábitat a lo largo de la totalidad de sus rangos de distribución.

INTRODUCTION

The lowlands bordering Hudson Bay near Churchill, Manitoba, have been known for the

abundance and diversity of breeding shorebirds since the early 1930s (Taverner and Sutton 1934). In the intervening decades the impressiveness of that fauna has diminished and the status of many species has changed appreciably (Jehl and Smith 1970, Jehl and Lin 2001, Jehl 2004). The change is best exemplified by the Semipalmated Sandpiper (*Calidris pusilla*),

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¹ E-mail: grebe5k@cs.com



FIGURE 1. The breeding range of the Semipalmated Sandpiper in Canada. 1 denotes the Churchill, Manitoba area, 2 denotes Cape Henrietta Maria, Ontario. Adapted from Godfrey (1986).

which was the most abundant shorebird in the area as late as the mid-1940s (Allen 1945). Here, the species reached the southern boundary of its breeding range, which extended along the coast from the west side of the Churchill River, east to Cape Churchill, and about 800 km south-eastward to Cape Henrietta Maria, Ontario (Fig. 1; Cadman et al. 1987, American Ornithologists' Union 1998).

Historically, the Semipalmated Sandpiper was widespread near Churchill (Fig. 2), occurring in a variety of habitats including wet meadows to fairly dry hillsides between Churchill and the former rocket launch site (now the Churchill Northern Studies Centre), tundra habitat bordering the coast at Bird Cove, and sedge meadows inland south at least to Twin Lakes (Jehl and Smith 1970, Jehl 2004; JRJ, pers. obs.; J. A. Hagar, pers. comm.). By the 1960s, though still fairly common to uncommon in a few localities, it had declined greatly, and by the early 1990s breeding adults could be found in only a single meadow 15 km east of the townsite. The decline was also evident at the handful of breeding localities remaining along the Manitoba coast of Hudson Bay. In 1991 the next-nearest nesting location was 10 km farther east on the cold and nearly barren outermost beach at Gordon Point, where in a one-hour search I found five pairs and three nests. More thorough fieldwork in

2003 revealed no more than two pairs (one nest found); in 2005 the species was absent (R. M. Alison, pers. comm.). La Pérouse Bay, some 18 km southeast of Gordon Point, was a major and well-studied breeding locality in the early 1980s. There the number of breeding pairs dropped from about 122 in 1983 to 10 in 1998 (Hitchcock and Gratto-Trevor 1997, Gratto-Trevor and Vacek 2001; C. Gratto-Trevor, Canadian Wildlife Service, pers. comm.). Only a few birds remain (R. L. Jefferies, University of Toronto, pers. comm.). The only other nesting site between Churchill and La Pérouse Bay is Fox Island, 9 km east of Gordon Point, where I estimated 3–4 pairs in 1994; there is no current information. Further historical information is given in Jehl (2004).

In addition to having been the most abundant breeding shorebird in the Churchill region, the Semipalmated Sandpiper was historically the most abundant migrant on the Atlantic coast of Canada and the northern United States. There, too, numbers have decreased. Data from autumn migration indicate widespread and significant declines, with annual rates estimated at -7.0% in the Maritime Provinces (1974–1998), -5.0% in Ontario (1966–1999), and -6.7% on the east coast of the U.S. (1974–1982; Morrison et al. 2001:35–36, cf. Howe et al. 1989, Gratto-Trevor 1992, Morrison et al. 1994). In a recent reanalysis,

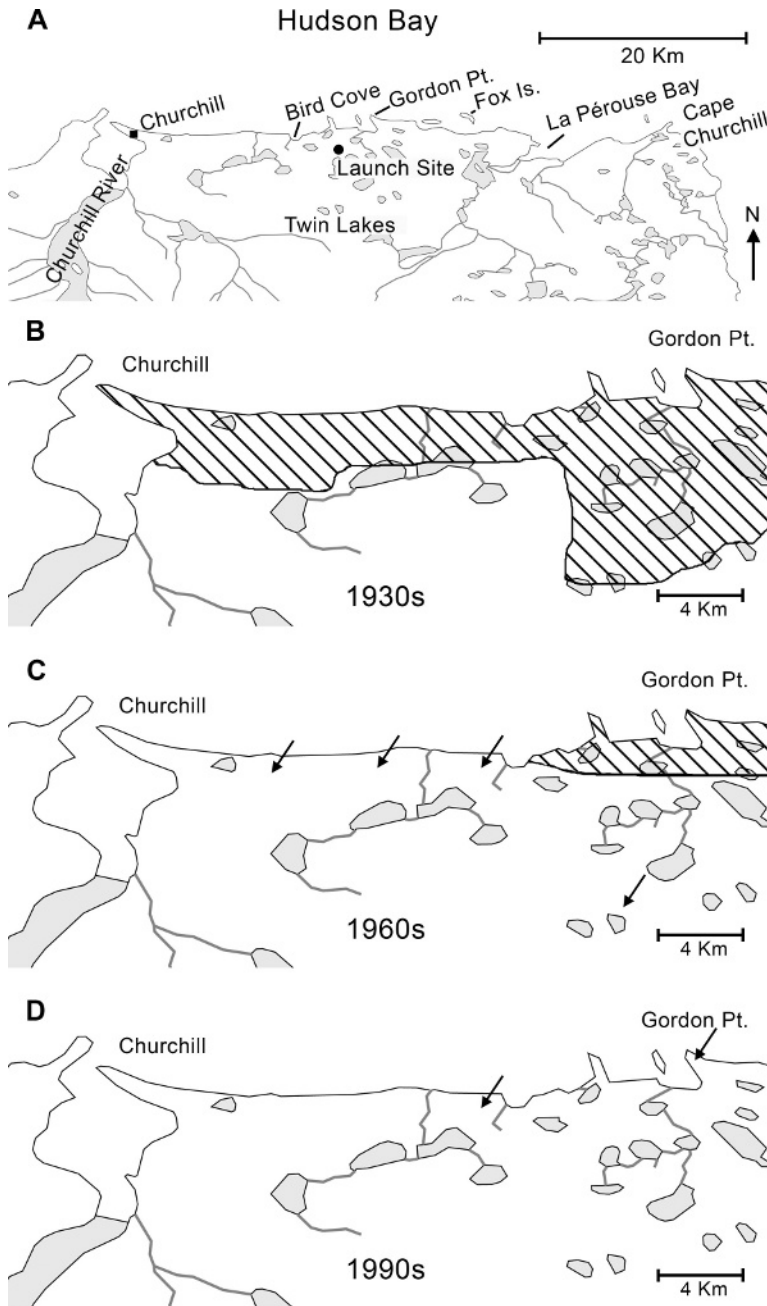


FIGURE 2. The Churchill, Manitoba, area showing (A) the major localities mentioned in the text and (B, C, D) presumed (1930s) or known (1960s, 1990s) breeding localities of the Semipalmated Sandpiper (cross-hatched or arrows).

Bart et al. (2007) determined that a significant annual decline of 4.0% had occurred in North Atlantic fall migrants between 1974 and 1998, and a nonsignificant 1.7% decline in those

passing through the midwestern United States. At the major fall staging area in the Bay of Fundy, numbers declined from about 800 000 in 1982 to 260 000 in 2004, a 5.0% annual

decline (P. Hicklin and J. Chardine, Canadian Wildlife Service, unpubl. data); this was attributed primarily to a decrease in migrants from the eastern part of the range (P. Hicklin, Canadian Wildlife Service, pers. comm.). In addition, significant declines among wintering birds were detected on Christmas Bird Counts in eastern North America from 1959 to 1988 (Sauer et al. 1996).

From 1991 through 2004, I studied the biology of several species of shorebirds at Churchill, with an emphasis on the population dynamics of Semipalmated Sandpipers, and I compared the results to those obtained by C. Gratto-Trevor and associates at La Pérouse Bay in the 1980s (Gratto-Trevor 1992 and references therein, Hitchcock and Gratto-Trevor 1997). Studies on the breeding grounds are pertinent to understanding population trends because they provide essential data that might only be inferred from studies during migration or in winter.

METHODS

From my studies in 1964–1967 I was familiar with the status of shorebirds in the Churchill area (Jehl and Smith 1970). When I resumed studies in 1991 I found that nesting areas formerly used by Semipalmated Sandpipers were largely unchanged, yet I did not encounter breeding birds until 1993, when I found a small colony just as the earliest clutch was hatching (Jehl 2006). From 1993 through 2004 (no data in 2002), I attempted to find all nests, mark all individuals, follow the success of each nest, and determine brood size at the time of leaving the nest. As I rarely encountered families for more than several days after the clutch hatched, I was unable to measure fledging success.

I checked the status of each nest every few days. I trapped incubating adults with a simple walk-in trap and marked them with aluminum (stainless steel, when available) and individually coded colored plastic bands. Although rapid loss of aluminum bands can be a problem (Hitchcock and Gratto-Trevor 1997), it did not appear to occur in my study as there was no evidence of corrosion or extreme wear in any returning birds. I made standard measurements (culmen and tarsus to ± 0.1 mm; flattened wing to ± 1 mm; data not presented) and weighed each bird on a digital scale (to the nearest 1 g). I sexed birds using a combination of mensural

and behavioral data (Jehl 2006) and aged adults by distinguishing first-year from older birds by partial replacement of the outer primaries (Gratto and Morrison 1981). Chicks were caught and banded at the nest; any that returned to breed in subsequent years were trapped, sexed, and color-banded as incubating adults. This enabled me to establish the identity and follow the status of most adults (88% of 93 from 1993–2001) and young (73% of 120 in 1993–2000). I calculated annual reproductive success following Murray (2000). In 2001–2004 I concentrated on documenting population size and the identity of returning birds.

RESULTS

Upon arrival in late May or early June, Semipalmated Sandpipers moved immediately to breeding areas, which by 1993 had been reduced to a single meadow. There, in a space of 3–4 ha, five pairs formed a colony. Numbers increased slightly into 1995 (11 pairs) and perhaps 1996, but late runoff in 1996 flooded some early nests and may have prevented some pairs from finding a suitable territory or renesting. In 1997 I encountered about 12 adults early in the season, but found only two nests. Subsequently, through 2001, the last year of successful nesting, the colony fluctuated between two and three pairs, and by 2003 (and perhaps 2004) held only a single unpaired male (Jehl 2006).

Nesting started as soon as habitat conditions allowed and was highly synchronous. The earliest clutches were produced by experienced breeders (Jehl 2006) and typically were completed by 8–12 June; 84% of the clutches hatched between 28 June and 7 July. Annual variations were associated with the availability of dry nesting sites. In the exceptionally late and cold spring of 2000 nesting was greatly delayed; the earliest complete clutch was found on 25 June, the first chick on 15 July. Renesting was documented once, when an experienced pair lost a full clutch (4 eggs) to flooding on 14 June and produced a full replacement eight days later. At 11 nests the incubation period, accurate to ± 12 hr, averaged 19.9 ± 0.5 days (range: 19.0–22.0 days). Nests found before the clutch was completed were often attended by the male; if a female was present I suspect it was for only a short time after an egg was laid. Visits to document nest status showed that

TABLE 1. Population size and breeding success of Semipalmated Sandpipers at Churchill, Manitoba, 1993–2004.

Year	Number of adults observed	Number of banded adults present	Number of clutches found (and number successful) ^a	Probability of hatching ≥ 1 young (s_1)	Number of hatchlings	Number of hatchlings per successful clutch (k_1)	Overall success ($s_1 k_1$) ^b
1993	10	10	5 (5)	1.00	19	3.80	3.80
1994	16–19	14–15	8 (7)	0.88	24	3.43	3.02
1995	22–24	21–22	11 (8)	0.73	25	2.27	1.66
1996	21–24	16–17	8 (5)	0.62	17	3.40	2.12
1997	12	6+	2 (2)	1.00	6	3.00	3.00
1998	7	6	3 (3)	1.00	11	3.67	3.67
1999	4	4	2 (2)	1.00	8	4.00	4.00
2000	6–8	6	3 (2)	0.67	7	3.50	2.34
2001	6	6	1				
2002	ND ^c						
2003	1	1	0				
2004	1?	ND ^c	0				

^a One reneesting not included. So, the proportion of successful clutches (c_1) = 44/43 = 1.02.

^b Because per capita nesting success (the number of young that leave the nest) = $c_1 s_1 k_1$, and $c_1 = 1.02$, this column $s_1 k_1$ is essentially annual reproductive success.

^c ND = no data.

males were usually present during the day (83% of 60 sightings between 07:00 and 20:00) and females at “night” (69% of 42 sightings between 20:00 and 07:00; cf. Hitchcock and Gratto-Trevor 1997:523, who found “no notable day/night differences”). Parental roles seemed to remain stable through the incubation period, and either parent might be present when the eggs hatched. Afterward, one or both stayed with the brood for the first 1–2 days, after which the female became progressively less attentive, usually leaving before day 6. Males attended chicks until about day 14.

Body mass showed little sexual dimorphism or year-to-year variation, despite annual differences in local environmental conditions (male mean: 27.4 ± 3.0 g, range: 23.1–27.4 g, $n = 19$; female mean: 27.5 ± 1.3 g, range: 25.5–31.0 g, $n = 21$). For all years combined, male mass remained stable over the season, whereas females were relatively heavy early in incubation, lost weight mid-term, and started to regain it late in incubation. Gratto (1983:fig. 4.1, 4.2) found a similar pattern.

Major aspects of population biology at Churchill in 1993–2004 (Table 1) were similar to those reported at La Pérouse Bay in 1980–1986 (Table 2). Clutch size averaged 3.9. Of 42 first clutches followed to completion, 34 produced at least one chick, and the probability that a first clutch would produce at least one

young was 0.81 (34/42). The major cause of complete failure (five nests, 12%) was predation, the most likely agent being the short-tailed weasel (*Mustela erminea*). Flooding (2) and desertion (1) accounted for the other losses. Of 159 eggs followed, 118 hatched (74%). Failure was attributed to predation (17), flooding or persistent rain (8), damage or displacement from the nest (5; partly due to investigator effects), desertion (4), failure to hatch on time (4), and infertility (3). All chicks left the nest successfully. Clutch size was similar at La Pérouse Bay, but only 48% of nests produced young, largely because of predation by foxes (Gratto-Trevor 1993–1994). At Churchill there was no evidence of adult mortality during the breeding season, whereas at La Pérouse Bay 15 deaths (12 females) were noted at 104 nests over three seasons. Age at first breeding is usually two years (Gratto et al. 1983, Gratto-Trevor 1992). In my study, no adult of unknown history was judged to be in its first year, and only one local chick returned in its first year (ages at first recovery were: males 1, 2, 2, 2, 3; females 2, 5). The return rate of young (7.5%) was similar to that at La Pérouse Bay (5.3%).

At La Pérouse Bay, annual return rates were calculated from both observational data and survival rates determined from a SURGE program (Sandercock and Gratto-Trevor 1997). The latter controls for the probability of

TABLE 2. Population parameters of Semipalmated Sandpipers nesting at Churchill (1993–2001) and La Pérouse Bay (1980–1986).

Parameter	Churchill	La Pérouse Bay	References ¹
Mean clutch size	3.9 (<i>n</i> = 45)	3.9 (<i>n</i> = 44)	Gratto et al. (1983)
Probability of hatching ≥ 1 young (<i>s</i> ₁)	0.81 (<i>n</i> = 42)	0.48 (<i>n</i> = 202; 1980–1982)	Gratto et al. (1983)
Nests lost to predation	12% (<i>n</i> = 42)	42% (range: 26%–76%, <i>n</i> = 506; 1980–1987)	Gratto-Trevor (1993–1994)
Mortality of breeding adults	0 individuals of 44 pairs	7.2%; 15 individuals of 104 pairs	Gratto-Trevor (1991)
Yearlings in population (%)	1.2% (range: 0.0%–4.3%); data for 1996–2001 only	7.4% (range 2.0%–10.3%; 1980–1982)	Gratto et al. (1983)
Return of banded young	7.5% (7/93)	5.3% (20/375)	Gratto et al. (1985)
Annual survival rates of adults	Male 61% (range: 33%–91%; <i>n</i> = 44), Female 60% (range: 0%–100%; <i>n</i> = 40)	Male 61% (<i>n</i> = 415), Female 56% (<i>n</i> = 401)	Sandercock and Gratto-Trevor (1997), Gratto-Trevor and Vacek (2001)
Maximum observed longevity	6–7 years	About 17 years	Gratto-Trevor and Vacek (2001)

¹ References pertain to La Pérouse Bay.

recapture or incomplete resightings of birds not associated with nests, but cannot distinguish between mortality and dispersal (Sandercock and Gratto-Trevor 1997:308). At Churchill I calculated return rates from raw data using all resightings, because the sample was small, philopatry and breeding site fidelity is high in adult shorebirds, there was no evidence of local adults dispersing to other breeding areas, and the colony area was so small that there was little chance of overlooking marked birds. Return rates (males: 61%; females: 60%) were higher than uncorrected estimates from La Pérouse Bay but nearly identical to those calculated by the SURGE model (Table 3). I found no temporal trend at La Pérouse Bay, whereas at Churchill returns were much higher in both sexes in 1993–1995, then declined.

Semipalmated Sandpipers at Churchill bred for up to 4–5 years, with breeding longevity (including skipped years) averaging 2.3 years in males and 2.4 years in females, being highest in adults caught in 1993 and then decreasing in those marked in later years (Table 4). No returning chick nested for more than one season. At La Pérouse Bay (531 adults and 802 nestlings from 1980–1983 and 1997–1998), Gratto-Trevor and Vacek (2001) recorded several birds >11 years old (the oldest at least 17). As the sample from Churchill was smaller (93 adults and 120 young from 1993–2001) and obtained over a shorter period, it is not surprising that individuals older than 6–7 years were not encountered, though some indication of greater longevity might have been expected in view of the high philopatry of experienced adults.

DISCUSSION

Semipalmated Sandpipers disappeared from the Churchill area in the first years of the 21st century. Because this followed a long-term decline that became apparent by the early 1960s and incontrovertible by the late 1970s (Jehl 2004), it is unlikely to have resulted from stochastic fluctuations in a very small population. Moreover, the decline was not confined to the Manitoba coast of Hudson Bay near Churchill itself, but was also documented at La Pérouse Bay from the 1980s onward (Gratto-Trevor 1993–1994), Gordon Point between 1991 and 2004 (Jehl 2004; JRJ, unpubl. data), and the Ontario coast at Cape Henrietta

TABLE 3. Return rates of adults and recruitment of new individuals into the Semipalmated Sandpiper population at Churchill and La Pérouse Bay, Manitoba. La Pérouse Bay data from Sandercock and Gratto-Trevor (1997).

Year and locality	Male		Female		
	Number at risk at time <i>t</i>	Number (%) return at time <i>t</i> + 1	Number at risk at time <i>t</i>	Number (%) return at time <i>t</i> + 1	Number (%) recruits
Churchill 1993–1995	24	18 (75)	23	18 (78)	16 (43) ^a
Churchill 1996–2000	20	9 (45)	17	6 (35)	25 (55)
Churchill total	44	27 (61)	40	24 (60)	41 (50)
La Pérouse Bay 1980–1985 (field data)	415	206 (50)		177 (44)	ND ^b
La Pérouse Bay (SURGE)		(61)		(56)	

^a 1994 and 1995 only.
^b ND = no data.

Maria. There, the Semipalmated Sandpiper was the most abundant shorebird in 1970 and bred fairly commonly on the outer beach ridges (G. Peck, pers. comm.). By 1983, it was uncommon and local (Peck and James 1983, Cadman et al. 1987). Although fieldwork in 2004 and 2005 revealed several new localities, the species is now much scarcer and the Least Sandpiper (*Calidris minutilla*) predominates (M. Peck, Royal Ontario Museum of Zoology, pers. comm.). In contrast, numbers at Cape Churchill were reported to have increased four-fold between an initial study in 1984 and a follow-up survey in 1999–2000 (Sammiller 2001). This anomalous finding is hard to evaluate because numbers were based on extrapolation from line transects rather than actual counts of birds or nests. The two techniques will not necessarily give similar results, particularly because Semipalmated Sandpipers nest in clusters. If nesting areas shifted between studies, quite different results would be inevitable, even if the overall population remained unchanged.

What factors were involved in the decline? At La Pérouse Bay it was attributed to low

numbers of returning adults (termed “emigration”) and low recruitment of new birds (Hitchcock and Gratto-Trevor 1997). However, emigration is improbable because Semipalmated Sandpipers (and many other calidridines; Jehl 1970, 1973, 2006; JRJ, unpubl. data) show high territory and mate fidelity, and retain the same nest scrape annually, even if the environs have been severely degraded. They are analogous to our aging parents, who resist moving because “we have always lived here and all our friends are here.” The only plausible explanation for the failure of adults to return is death. With respect to immigration, Hitchcock and Gratto-Trevor (1997) reported that the proportion of recruits dropped from 32% to 19% during their study, when an annual rate of >34% was needed to prevent a decline. Although the decline at La Pérouse Bay coincided with massive habitat destruction by grazing Snow Geese (*Chen caerulescens*; Ankney 1996, Abraham and Jefferies 1997, Jehl 2004:30–31, Jefferies et al. 2004, 2006), which greatly reduced nesting and foraging opportunities for several species, Hitchcock and Gratto-Trevor

TABLE 4. Number of breeding seasons for individual Semipalmated Sandpipers at Churchill, Manitoba, 1993–2000.

Year banded	Male		Female	
	<i>n</i>	Number of breeding seasons; range (mean)	<i>n</i>	Number of breeding seasons; range (mean)
1993 ^a	5	1–4 (3.0)	5	2–4 (3.2)
1994–1995	10	1–4 (2.1)	7	1–4 (2.4)
1996–2000	6	1–3 (1.7)	6	1–3 (1.3)

^a Data are underestimates as previous history of these individuals is unknown.

(1997) considered any relationship to be unlikely. Had that decline been caused by habitat loss, one might have expected marked birds to shift to undisturbed sites nearer Churchill. No such movements were recognized.

The Churchill population declined even though the few remaining birds continued to breed successfully (the probability of breeding success was much higher than at La Pérouse Bay) and immigrants continued to find the colony at a rate considered sufficient to prevent extirpation: from 1993–2003 the recruitment rate averaged 50% and increased as the population declined. Evidently, these factors were insufficient to compensate for: (1) a loss of breeding adults, whose overall return rates were similar to those at La Pérouse Bay, but which declined in both sexes during the course of this study, resulting in a drop in the mean number of breeding seasons per adult; (2) the low number of local young returning to join the population; and (3) the fact that returning young bred only once before disappearing.

While the Churchill area has undergone some physical changes since the mid-1960s (Jehl 2004; JRJ, unpubl. data), I found no indication that habitat alteration by humans or geese had affected any of the Semipalmated Sandpiper breeding locations that existed in the 1960s. Global warming may seem to be a likely candidate because species at the southern limit of their range would be expected to retreat northward as the climate ameliorates. Indeed, the remaining breeding sites (Gordon Point, La Pérouse Bay, and Cape Churchill) are much colder than those nearer Churchill (JRJ, pers. obs.). However, temperatures in the Churchill area and central Canadian Arctic remained largely stable from the mid-1940s through the mid-1990s (Zhang et al. 2000). Not only were numbers dropping throughout this period, but the trend did not abate in the relatively cold years of 1958–1971 (Zhang et al. 2000, Ganon and Gough 2005; JRJ and J. Klima, unpubl. data). To be sure, the sandpiper's terminal decline did coincide with an increase in local temperatures that began in the mid-1990s; however, birds were still breeding successfully and recruits (both local and foreign) continued to arrive and breed.

As no changes on the breeding grounds are readily apparent, the cause of the decline probably lies elsewhere. Migration routes are

well known (Harrington and Morrison 1979, Hicklin 1987, Gratto-Trevor 1992, Gratto-Trevor and Dickson 1994). After breeding, sandpipers from the eastern part of the range fatten in southern James Bay, then shift to the main staging area in the Bay of Fundy, New Brunswick (Hicklin 1987) before undertaking an over-water flight to the northeastern coast of South America (principally Suriname). Gratto-Trevor (1992) did not identify any apparent causes of high mortality in autumn migration or winter. In spring, Semipalmated Sandpipers return north along the Atlantic coast of the United States, where extensive and continuing development of shorelines in the southeastern states has reduced habitat available to many species. However, that does not explain why the situation at Churchill became terminal in the mid-1990s. The last stop for many northbound Semipalmated Sandpipers is Delaware Bay, where thousands stop to gorge on eggs of horseshoe crabs (*Limulus polyphemus*) before moving to the Arctic (Clark et al. 1993). Possibly the commercial harvesting of crab eggs, which commenced in the early 1990s, led to a shortage of food at this critical point in the annual cycle. The consequences could have been manifested in several ways that would lead to impaired migration, reduced breeding attempts, or lower survivorship. Similar effects have been shown or inferred for Red Knots (*Calidris canutus rufa*; Baker et al. 2004, Morrison et al. 2004) migrating through Delaware Bay. While Semipalmated Sandpipers are probably less dependent than knots on crab eggs, there are indications that the number of migrants in Delaware Bay is declining (Clark et al. 1993). In addition, rates of fattening were lower in 2000–2005 than in 1995–1997, a pattern not seen in Least Sandpipers, for which crab eggs are a minor part of the diet (D. Mizrahi, New Jersey Audubon, pers. comm.).

Over the past three decades, monitoring programs along the Atlantic coast have shown that the number of fall-migrating Semipalmated Sandpipers has undergone a continuous decline. Data from the Hudson Bay breeding grounds indicate that this trend has been in progress for a half-century or more. Bart et al. (2007) concluded that it stemmed, in this and other species of shorebirds, from “a decline in the breeding populations that supply migrants to the North Atlantic region,” which implies

that poor production was responsible. Yet, Semipalmated Sandpipers disappeared from Churchill despite good nesting success and acceptable rates of recruitment. This leads to a different conclusion, namely that the number of birds returning to the north in good condition is inadequate to maintain the population.

Successful management requires documenting the problem, determining the cause(s), and taking remedial action in a timely manner. Monitoring migrants, though useful for revealing population trends, does little to clarify causality (Jehl 1999), and the time needed to verify a decline virtually ensures that the findings may be of more relevance to historians than to those charged with recovery (the U.S. Shorebird Conservation Plan [Brown et al. 2001] requires evidence of a 50% drop over a 20-year period at a 0.1 level of significance). Research on the breeding grounds can help frame hypotheses, but this also takes time. The two studies of Semipalmated Sandpipers at Hudson Bay spanned more than two decades. Although the results were mutually reinforcing in indicating that events in the nonbreeding season were probably of paramount importance, they might not apply to populations in other parts of the species' extensive range.

The case history of the Semipalmated Sandpiper shows that the kinds of studies used to document population trends, determine causality, and develop management responses are too slow and indirect to have much relevance to conservation biology. Only rarely are "answers" more than tentative, and by the time the data are collected, a consensus is reached, and a response is formulated, the time for remedial action may be past (Jehl 2004:70–71). More timely and effective actions emphasizing habitat protection throughout the range will be needed to arrest the declines of this and other species.

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