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Distribution, status and population trends in the Temminck's Stint *Calidris temminckii* in the Finnish Bothnian Bay

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Distribution and population trends of Temminck's Stint *Calidris temminckii* were studied along the Finnish coast of the Bothnian Bay. The southernmost birds bred in Vaasa, the northernmost pairs were found in Tornio. The current population size was estimated at 170–200 pairs. Most pairs bred in non-protected, natural habitats on the mainland. Most sites were inhabited by 1–4 pairs. The colony size varied between one and twenty. Comparision with previous censuses revealed that the Temminck's Stint has decreased coastwide during the twentieth century. The magnitude and time of the decline differed from sub-area to another. The causes may include shrinkage and deterioration of habitats and increased predation and human disturbance. Validity of these and other possible explanations are reviewed and discussed.

1. Introduction

The Temminck's Stint's breeding range extends from Scandinavia to the Bering Strait in the Eurasian tundra and northern parts of the taiga (Hayman et al. 1986). The core breeding area in Fennoscandia is in Lapland and the Scandes, and a smaller population inhabits the coast of the Bothnian Bay (Hildén 1983).

In the beginning of the twentieth century, Temminck's Stint was one of the commónest waders in parts of Lapland and on the coast of the Bothnian Bay (von Haartman et al. 1963–1972). Up to the 1970s the breeding range was continuous between these areas (Haftorn 1971). In Fennoscandia a decline in numbers and a contraction in the range have been evident during the twentieth century. The decline has been the most severe in the Bothnian Bay area (also on the Swedish side, SOF 1990) and in the inland of northern Finland (Hildén 1983, Hildén & Hario 1993). The birds have almost disappeared between Lapland and the Bothnian Bay; the populations are nowadays separated by about 300 km, with only a few sites between them (Hildén & Hario 1993). The lowland population of southern Norway has also decreased, but the population of northern Norway has been stable, and the range expanded southwards in the mountain areas of southern Norway during the years 1950–1970 (Breiehagen 1994). The Norwegian population is estimated to be about 3 400 (Breiehagen 1994), and the Swedish one ca. 6 500 pairs (SOF 1990). The majority of the world population breeds in Russia.

The most recent estimate of the population in Finnish Lapland based on line transect censuses is ca. 4 000 pairs (Koskimies 1992). The previous estimates vary considerably, from "more than a thousand" (Hildén 1983) to 10 000–20 000 (Koskimies 1989). The population on the Finnish side of the Bothnian Bay was estimated at 500 pairs during 1974–1979 (Koskimies 1989) and 170–200 pairs

during 1987–1992 (Rönkä 1992). The coastal Temminck's Stints, except in the northernmost part of the range, have been listed vulnerable or endangered (IUCN classification) in the Finnish red book (Rassi et al. 1986, 1992). The Lappish population has not been listed. On a European scale, the status of the Temminck's Stint is secure (Tucker & Heath 1994).

The purpose of this study is to establish the current (1987–1995) population level and range on the Finnish coast of the Bothnian Bay, to provide a baseline census with which the future censuses can be compared, to indicate important breeding sites and to discuss the causes of the decline.

2. Study area

The study area lies between 63°N–65°50′N and 21°E–25°30′E. It consists of the coast and islands of the Finnish side of the Bothnian Bay from the Finnish Quark in the south to the town of Tornio in the north (Fig.1).

The study area is characterized by flat, low-levelled coastal plain and islands covered by wave-washed moraine. Extensive dunes are typical for the area between Lohtaja and the Krunnit Islands.

New sites for shorebirds are created constantly by the land uplift, while the existing meadows become unsuitable for them because of the succession of the vegetation (Vartiainen 1980). In recent decades, the overgrowth of the vegetation has been speeded up by eutrophication and the termination of grazing and haymaking in the 1950s (e.g. Soikkeli & Salo 1979).

Rapidly rising sea water regularly destroys nests of shorebirds, ducks, gulls and terns in the lowest-lying shores (Merilä et al. 1975). There is not a regular tide in the Bothnian Bay; the changes of the water level are mainly caused by wind. The amplitude of the fluctuations in the sea level increases towards the north, being 100–120 cm in the southern part of the study area and more than 200 cm in the north during June–August (Karlsson 1986). For a detailed description of the study area, see, e.g. Ericsson and Wallentinus (1979) and Vartiainen (1980).

The coast and islands of Tornio, Kemi and Simo (the northernmost part of the Bothnian Bay) are hereafter referred to as Kemi. Respectively, Haukipudas refers to the outer archipelago of Haukipudas and a few islands belonging to the commune of Hailuoto northeast of it, and Hailuoto refers to the main island of Hailuoto and the island of Isomatala (Fig.1).The outer archipelago of Kemi and Tornio is a part of Kemi.

3. Material and methods

3.1.. Estimation of current population

The basic data come from ca. 40 birdwatchers and ornithologists, faunistical reports in local and national ornithological periodicals and from numerous published and unpublished bird censuses. I surveyed the areas which were not covered in the above sources during 28.5.–18.6.1992. In addition, a part of Pyhäjoki was surveyed in 1994 and new data from Vaasa, Lohtaja, Kalajoki, Tauvo, Oulu and parts of Hailuoto, the Krunnit Islands and Liminganlahti were obtained in 1995. The main breeding area between Lohtaja and Tornio has been monitored almost completely, at least once during the breeding season between 1987 and 1995. Virtually no potential Temminck's Stint habitats were overlooked in the census in this area (Rönkä 1992). However, the Kemi coast was surveyed fragmentarily, and I do not present site-specific data from there.

About half of the data are from 1992 to 1995 (Table 1). The sources of data and study years are listed in the Appendix.

The most important sub-areas (Hailuoto in 1992 and Oulu, Tauvo and Kalajoki in 1995) were monitored by repeated Temminck's Stint censuses throughout the breeding season or territory mapping. The data from, e.g. Haukipudas and the coast between Kemi and Oulu (1989) and from the archipelago of Raahe (1992) come from single-visit censuses, which were not species-specific. South of Kemi, the census types above cover about 90% of the birds (Table 1). The rest of the data are mainly based on single visits to sites and casual observations. In Kemi, all of the above methods were used.

The estimations of pair numbers are usually based on displaying males, since during incubation the Temminck's Stint is very inconspicuous and difficult to count. However, on small islands and in

narrow shore meadows it is easy to find the birds at any phase of breeding. From hatching to about two weeks after hatching, the alarming adults are again very conspicuous. Because of predation during the breeding season, the censuses during the displaying period give the greatest numbers of territories.

As the breeding system of the Temminck's Stint is rather complicated ("successive bigamy") and the pair bond lasts for only about one week (Hildén 1975), a "pair" in this study usually means a territory occupied by a male. "Colony" refers to a local population.

3.2. Population changes

The basic data concerning population changes from the beginning of the century to the late 1980s comes from similar types of sources as above. Because colonizing new sites rapidly and disappearing from them when they become unsuitable is typical for Temminck's Stints (e.g. Hildén 1978), conclusions about regional population trends cannot be drawn from data based on too few colonies. Therefore, only sub-areas with four or more colonies have been included in the main data (Fig. 3ab). The only exception is data from Kokkola, approximately 60 km southwest of Kalajoki (Fig.1), where a colony was studied intensively during 1963–1972 by Hildén (1975, 1978, see also Tikkanen & Pohjoismäki (1991–1992). The sources of data are in the Appendix.

4. Results

4.1. Current status and distribution

A total of 167 pairs were found (Fig. 1). However, due to some birds not seen during single visits to sites or being missed in too late censuses, this is probably a slight underestimate. A better estimate is 170–200 pairs, which is as many pairs as were found during 1987–1992 (Rönkä 1992).

Only a few pairs bred south of Kalajoki and along the coast between Oulu and Simo (Fig. 1). The southernmost pair was found in Vaasa. About half of the population bred in the area between Raahe and Haukipudas.

I could determine the number of pairs accurately for 48 sites (113 pairs). The colony size varied between one and twenty. In most sites, the number of pairs was 1–4. Most of the birds inhabited these sites. Only three sites were occupied by more than five pairs (Fig. 2).

Most pairs were in non-protected natural habitats in the mainland (Table 2). The colony size in man-made habitats (e.g. industrial landfills and harbour yards) was more than twice as high as in natural habitats (Mann-Whitney U-test, $Z = 2.28$, $p = 0.02$). Island and mainland colonies did not differ in size ($Z = 0.07$, $p = 0.95$). The largest colony (20 pairs) was in a protected area. However, the data from protected and non-protected sites was insufficient to allow comparision.

Table 1. Number of pairs of Temminck's Stints in different types of censuses during 1987–1995.

Year	Accurate repeated censuses	Single-visit censuses, not species-specific	Casual observations	Sum
1995	58	1	1	60
1994	4			4
1993				
1992	11	7	2	20
1991		1	1	2
1990		2	2	4
1989		18	6	24
1988		3		3
1987		1		1
Sum	73	33	12	118

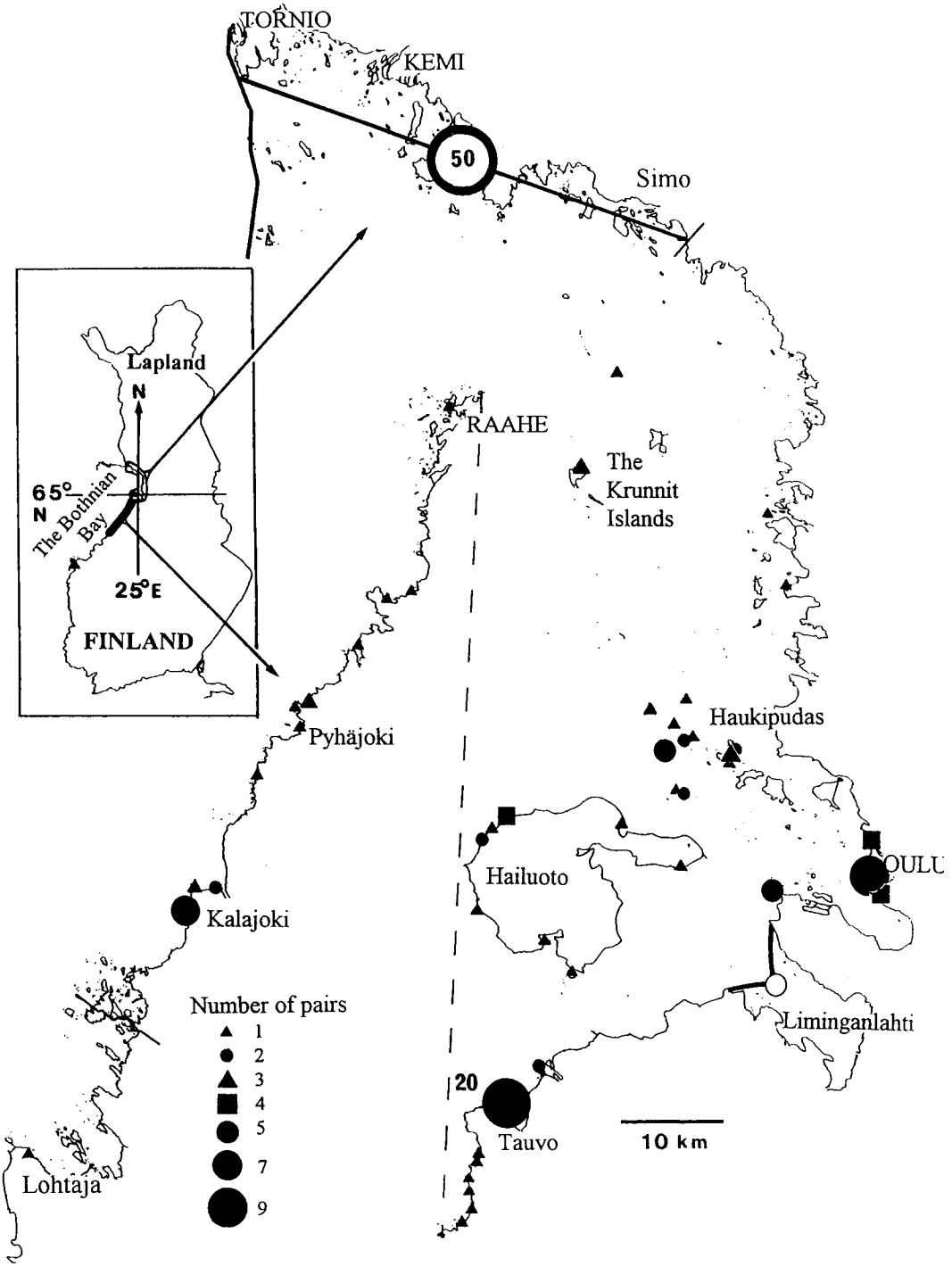

Fig. 1. Distribution of the Temminck's Stint in the Finnish Bothnian Bay. Open symbols = number of pairs in the indicated area. Number in/beside a symbol = number of pairs. A single pair in Vaasa (on the southern border of the study area) indicated in the inset map. Kokkola is situated ca. 30 km southwest of Lohtaja.

4.2. Population changes

Temminck's Stints have declined coastwide during the whole observation period (Fig. 3a and b). The decline started at different times in different parts of the Bothnian Bay. The decrease started before the 1950s in both the Krunnit Islands and Hailuoto. The data from Kemi shows a drastic decline between the 1970s and the 1990s — however, there are no census data before 1960 (Fig. 3a). There was a considerable decrease in Kalajoki and Lohtaja in the beginning of the 1990s (Fig. 3b; no reliable data before ca. 1970 and 1990, respectively).

Also, the magnitude of the decline differs from one sub-area to another. The population crash has been the most severe in the outer archipelago of Kemi and Tornio, the Krunnit Islands, the archipelago of Raahe and Kokkola.

The population decline in Kemi, the Krunnit Islands, Hailuoto and Kalajoki was about 70% between periods 1968–1979 and 1988–1995. On the basis of this, the number of the Temminck's Stints in the study area was about 600–700 during 1968–1979. If the magnitude of the decline before 1968–1979 in the whole Bothnian Bay was as great as in Hailuoto and the Krunnit Islands, the total number of stints in the beginning of the century was several thousands of pairs.

A slight increase has taken place in Haukipudas. New sites have appeared in man-made habitats in Oulu and Liminganlahti. Tauvo, where the number of pairs was 1–2 in 1977 (Ohtonen et al. 1983), was occupied by the largest colony in 1995, 20 pairs.

5. Causes of the decline

5.1. Changes outside the breeding range

Because both the Lappish and the Bothnian Bay populations have decreased, a common reason for the decline in both areas could be suggested. Scandinavian birds migrate in autumn to directions from SW to SE in a broad front over the continent (Fig. 4; see also Saurola 1980). Wintering areas of Scandinavian Temminck's Stints are not known, but it is likely that they are scattered around the Mediterranean, North Africa and probably also Southern Asia. Since it is not reasonable to expect parallel changes in the quality of all these wintering

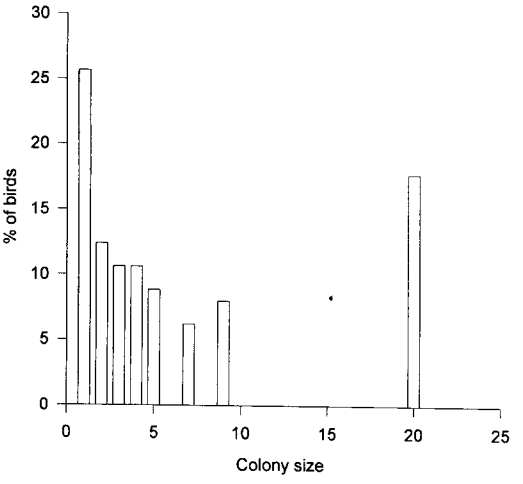

Fig. 2. Proportion of the Temminck's Stints in colonies of different sizes.

sites, I conclude that the population decline in parts of the species' Scandinavian range has been caused by events in breeding areas.

In addition, the range expanded in southern Norway between 1950 and 1970 (Breiehagen 1994) when the decline had already started in the Bothnian Bay. This indicates that the fate of the Bothnian Bay and the inland population are not totally interconnected.

No ringing recovery data exist to show an increase in mortality outside the breeding season.

5.2. Changes in breeding habitats

In Scandinavia, the Temminck's Stint breeds near water on sandy and gravelly meadows and heaths with sparse and low vegetation, near fishing huts and summer cottages and in industrial workings

Table 2. Numbers of Temminck's Stints in different habitats.

	Pairs	Sites	Pairs/site
Mainland	85	32	2.7
Islands	28	16	1.8
Natural habitats	90	43	2.1
Man-made habitats	23	5	4.6
Protected sites	24	3	8.0
Non-protected sites	89	45	2.0

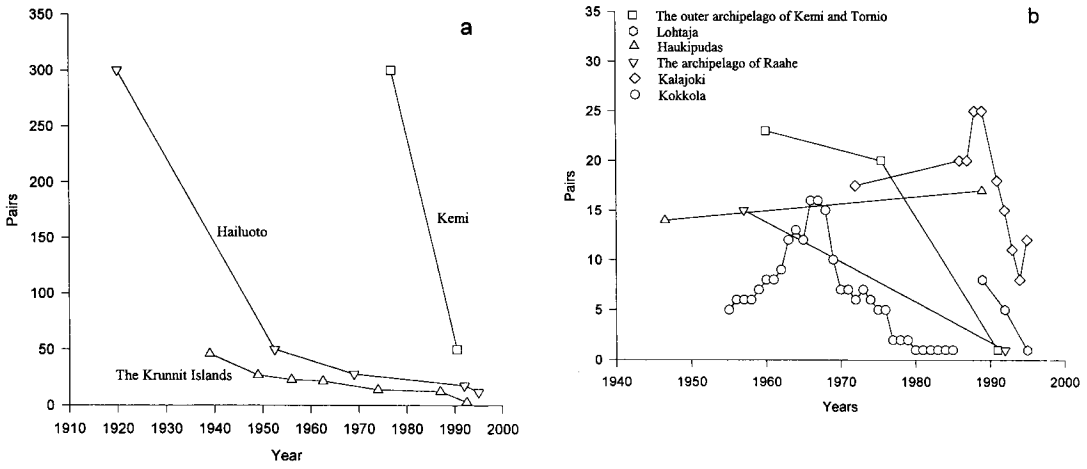

Fig. 3. Population changes of the Temminck's Stint. a) Kemi, the Krunnit Islands and Hailuoto. "300 pairs" in Hailuoto = "hundreds of pairs" in 1902–1924 (Merikallio 1928). Values of the 1950s, the 1960s, the 1970s and the 1980s in the Krunnit Islands are means of observations of several years. b) The outer archipelago of Kemi and Tornio, Haukipudas, Raahe, Kalajoki, Lohtaja and Kokkola.

and other man-made habitats (e.g. von Haartman et al. 1963–72). The population crash of the Temminck's Stint has usually been linked with shrinkage and deterioration of suitable, open habitats (Helle & Mikkola 1969, Hildén 1978) due to eutrophication and especially termination of haymaking and grazing on shore meadows in the 1950s, which has led to narrowing and overgrowth of the shore meadows (e.g. Soikkeli & Salo 1979).

If the above causes are the main reason of the decline, a) the population decline and the decrease in the area of suitable habitats should have started simultaneously, b) also other shorebirds of open habitats should have decreased and c) new sites formed by man or land uplift should become occupied by Temminck's Stints.

In Kokkola, the Temminck's Stint population decline took place simultaneously with the decrease of suitable habitats (Hildén 1978). In Hailuoto, the decrease started before the cessation of grazing in the 1950s. From the Krunnit Islands there are no census data prior to termination of haymaking and grazing, and the Temminck's Stint has disappeared also from the smaller islands, where these activities were not carried out (Rönkä 1992).

Coastal Dunlins *Calidris alpina schinzii* and Ringed Plovers *Charadrius hiaticula*, which also breed in open meadows, have decreased due to decrease in habitats (e.g. Soikkeli & Salo 1979, Rassi et al. 1986), but the numbers of the latter have increased recently in many coastal areas (Hildén & Hario 1993).

The Stints have invaded new sites in Oulu and Tauvo. On the other hand, not all suitable habitats are occupied, for instance, in Kalajoki (Tikkanen & Pohjoismäki 1991–1992), in the Krunnit Islands and in parts of Hailuoto, where a dune field was occupied by four pairs in 1992 (Rönkä 1992) but none in 1995 (pers. obs.).

The decrease of breeding habitats does not seem to be the only cause of the Temminck's Stint decline.

5.3. Increased nest predation and human disturbance

Temminck's Stint nests are predated by several bird (e.g. Hooded Crow *Corvus corone cornix* and Common Gull *Larus canus*) and mammal predators (e.g. Weasel *Mustela nivalis*, American Mink *Mustela vison* and Fox *Vulpes vulpes*) (e.g. Hildén 1978, Helle et al. 1988). The Ruddy Turnstone *Arenaria interpres*, which appeared to be the main predator in Kalajoki (Tikkanen & Pohjoismäki 1991–1992), may specialize in nest predation and decrease the breeding success of terns and gulls considerably (Brearey & Hildén 1985).

The American Mink, Herring Gull *Larus argentatus*, Ruddy Turnstone and Common Gull

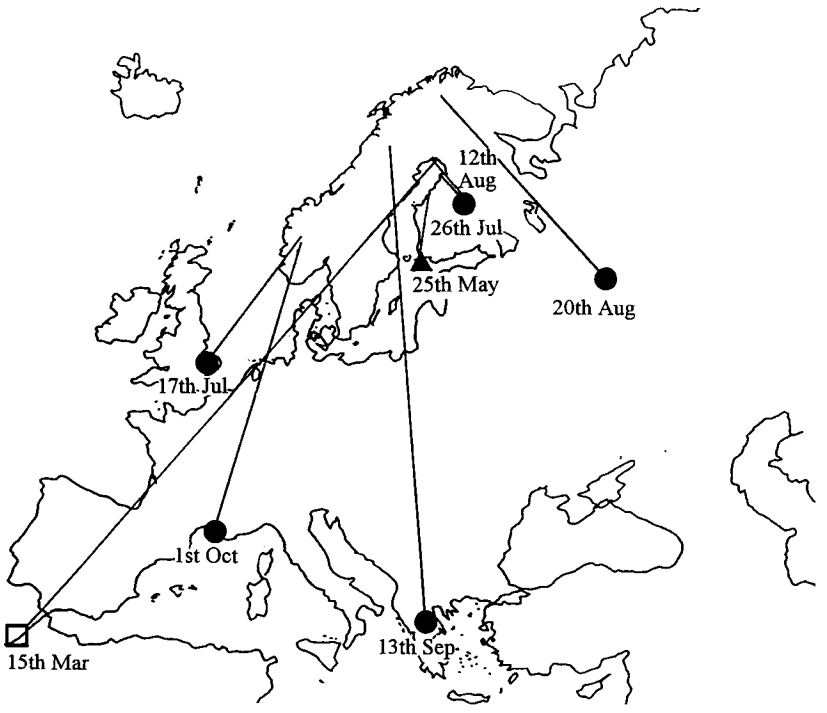

Fig. 4. Recoveries from migration and wintering areas of Temmick's Stints ringed in Scandinavia as pulli or juveniles in breeding sites. Date = date of recovery. Lines connect the sites of ringing and recovery. Black symbol = recovery during the year following the ringing, open symbol = recovery later. Circle = autumn, square = winter, triangle = spring. Finnish data from Zoological Museum of Helsinki, Swedish data from Bird Ringing Centre, Stockholm, Norwegian data from Glutz et al. (1975) and Breiehagen (1989).

have increased in the Bothnian Bay since the 1950s (e.g. Vikberg 1976, Helle et al.1988, Hildén & Hario 1993, Rauhala 1994). For example, in Hailuoto the increase of the Ruddy Turnstone was seven-fold from the 1950s (10 pairs, Törnroos 1956) to the beginning of the 1990s (70 pairs, Hilden & Hario 1993), and the increase of the Common Gull in the Krunnit Islands eleven-fold from about 20 in 1939 (Merikallio 1950) to 227 in 1985 (Helle et al. 1988).

However, despite the increase of Common Gulls and Ruddy Turnstones in Haukipudas, the Temminck's Stint has increased there slightly (von Haartman 1947, Rautkari 1952, Merilä & Vainio 1990ab).

Also, the increase of human disturbance, including the building-up of the sites favoured by the Temminck's Stints, may have affected the breeding success either directly or indirectly, e.g. by trampling, increased hatchling predation and abandonment of nests (e.g. Kury & Gochfeld 1975, Hand 1980, Safina & Burger 1983).

In Kokkola 58% of the Temminck's Stints nests hatched during 1963–1967. From 1968 to 1972 the number of predators and recreational disturbances increased and only 33% of the nests hatched; nest predation was the main cause of nest losses (Hildén 1978). No nest data exist to show increases in predation except for Kokkola.

Since the Temminck's Stint population on the Krunnit Islands (bird sanctuary since 1936) has almost disappeared and the decline in Hailuoto started before the increase of tourism in the late 1960s, due to improved communications by a ferry, the increased recreational pressure cannot be the main cause of the decreasing trend of the Temminck's Stint population in the Bothnian Bay.

5.4. Other causes

Several other suggestions can be made to explain the decline.

1) The narrowing of open shore meadows since the termination of grazing has forced the stints to nest nearer the water, more vulnerable to rising sea water (Tikkanen & Pohjoismäki 1991–1992). In a Norwegian mountain population, flooding was the main cause of nest losses (Breiehagen 1989). The narrowing of the shores may also

have affected breeding success, if the rate of nest predation is higher near the forest edge than further from it (e.g. Gates & Gysel 1978, Johnson & Temple 1990, Burger et al. 1994).

2) A decrease in the availability of Chironomids, the main food for breeding Temminck's Stints (Moksnes 1987), due to pollution (Hildén 1978).

3) A large-scale increase in predation and vegetation cover in the formerly open meadows may together have decreased the breeding success of Temminck's Stint and other waders of open shore meadows with long visibility. The antipredatory strategy of such waders involves usually early surreptitious departure which decreases the probability of nest predation (Gochfeld 1984, Rytkönen 1988). The flushing distance of Temminck's Stint is long also when other birds give alarms (Cramp 1985). Non-aggressive waders, as the Temminck's Stint (Larsen 1991), might also benefit from breeding near aggressive nest-defenders like terns (e.g. Burger 1987). If no alarming and nest-defending birds are present and when the the visibility is short due to thick and tall vegetation (Rytkönen 1988), the flushing distance is shorter and the probability of the nest to become predated greater, because the predators can locate the nest by a flushed adult (Erikstad et al. 1982, Byrkjedal 1987, Westmoreland & Best 1985).

To sum up, there probably does not exist a single reason for the decline of the Temminck's Stint, but rather several processes operating in concert. These include increased nest predation pressure, overgrowth and shrinkage of the habitats and increased human disturbance.

The distribution of the coastal population has fragmented, and most sites are nowadays occupied by only a few pairs. Moreover, the Lapland and the Bothnian Bay populations are geographically separated by a gap of ca. 300 km. It is not known whether there is an influx from Lapland to the Bothnian Bay coast or not. Small populations are vulnerable to unpredictable and stochastic events (Gilpin & Soulé 1986), such as flooding and temporarily increased rates of predation and human disturbance, which decrease their reproductive success. Recognizing and protecting the source areas of the Bothnian Bay population, which allow surplus individuals to migrate to sites of lower quality, is of utmost importance for the future of the species in the Bothnian Bay. More study is clearly needed on the reproductive success and migration between populations.

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Selostus: **Lapinsirrin *Calidris temminckii* esiintyminen ja kannanmuutokset Suomen Perämeren rannikolla**

Tutkin lapinsirrin esiintymistä ja 1900-luvulla tapahtuneita kannanmuutoksia Suomen puoleisella Perämeren rannikolla. Lisäksi pohdin kannamuutosten syitä. Lapinsirri on alueellisesti uhanalainen suurimassa osassa Perämerta.

Lapinsirrejä pesi 1987–1995 170–200 paria, eteläisin Vaasassa, pohjoisimmat Torniossa. Noin puolet kannasta oli keskittynyt Haukiputaan ja Raahen väliselle rannikkoalueelle (Kuva 1). Useimilla paikoilla pesi yksi pari, ja vain kolmella paikalla viisi tai useampi (Kuva 2). Suurin esiintymä oli Siikajoen Tauvossa, 20 paria. Useimmat parit pesivät rauhoittamattomilla luonnonhabitaateilla mantereella (Taul. 2.). Lapinsirrit olivat vähentyneet suurimmassa osassa tutkimusalueetta, mutta vähenemisen voimakkuus ja aika vaihtelivat (Kuva 3ab). Krunneilla ja Hailuodossa väheneminen alkoi jo ennen 1950-lukua. Kemin ympäristössä kanta romahti 1970-luvun jälkeen sekä Kalajoella ja Lohtajalla vasta 1990-luvulla; näiltä alueilta ei kuitenkaan ole vanhaa laskenta-aineistoa vertailukohteeksi. Lapinsirri on miltei hävinnyt Kemin ja Tornion ulkosaaristosta, Krunneilta ja Raahen saaristosta. Toisaalta uusia lapinsirriesiintymiä on syntynyt maankohoamisen luomille paikoille sekä tekobiotoopeille kuten ruoppausmaa-altaille.

Otaksun vähenemisen johtuneen useista pesimäalueen tapahtumista. Sopivat habitaatit ovat vähentyneet, koska laiduntamattomat rannat ovat kasvaneet umpeen 1950-luvun jälkeen. Monet lapinsirrin

munia ja poikasia saalistavat pedot, mm. karikukko ja kalalokki, ovat lisääntyneet. Myös vapaa-ajan vietto rannoilla on lisääntynyt, mikä on voinut heikentää poikastuottoa.

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Appendix.

Study years and sources of information

1) The coast and islands of Simo, Kemi and Tornio 1974–1976 (Rauhala 1980), 1991–1992 (Rauhala 1994)
2) The outer archipelago of Kemi and Tornio 1960 (Korpijaakko 1962), 1974–1976 (Rauhala 1980), 1991–1992 (Rauhala 1994, P. Rauhala, pers. comm.).
3) The Krunnit Islands 1939 (Merikallio 1950), 1949 (Salkio 1952), 1950s and 1960s (Grenquist 1965), 1970s and 1985 (Helle et al. 1988), 1988 (Kirkkomäki 1990), 1989–1992 (Rönkä 1992), 1995 (K. Koivula & A. Rönkä, pers. obs.)
4) Haukipudas 1946 (Rautkari 1952), 1947 (von Haartman 1947), 1989 (Merilä & Vainio 1990ab)
5) Hailuoto 1904–1924 (Merikallio 1928), 1950s (Törnroos

1956), 1968 (Helle & Mikkola 1968), 1992 (Rönkä 1992), 1995 (A. Rönkä, pers. obs.)

6) The archipelago of Raahe 1957 (O. Hildén pers. comm.), 1992 (J. Hauru, pers. comm.)
7) Kalajoki 1971–1972 (Hildén 1975), 1986–87 (Pohjoismäki 1987, 1988), 1988–1989 (Pohjoismäki 1990), 1991–1992 (Tikkanen & Pohjoismäki 1991–1992), 1993 (Tikkanen 1994), 1994–1995 (M. Pohjoismäki, pers. comm.)
8) Kokkola 1957–1985 (Casén 1960, Hildén 1975, Tikkanen & Pohjoismäki 1991–1992)
9) Lohtaja 1989 (Hannila et al. 1989ab), 1992 (M. Pohjoismäki & H. Tikkanen, pers. comm.), 1995 (M. Pohjoismäki, pers. comm.)

For the sources of the current population data, see also Rönkä (1992), except Pyhäjoki 1994, Tauvo and Oulu 1995 (K. Koivula & A. Rönkä, pers. obs.), Vaasa 1995 (H. Seppälä, in net), Liminganlahti 1992 (Siira 1994) and 1995 (K. Koivula & A. Rönkä, pers. obs.)