THE MIGRATION ROUTES OF FINNISH COMMON AND ARCTIC TERNS (*STERNA HIRUNDO* AND *S. PARADISAEA*) IN SCANDINAVIA

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The migration routes of the Common and Arctic Terns in Europe are known in general. The Common Terns migrate from Europe to the coast of middle and southern Africa, and a considerable number of Arctic Terns winter still further south. The migration route of the Arctic Tern is the longest known for birds, extending from the Arctic areas down to Antarctica. Both these species follow special routes, as for instance, the western coasts of Europe and Africa.

Despite the low recovery percentage of ringed Common and Arctic Terns (1.1 for Common Terns and 0.4 for Arctic Terns ringed in Finland, NORDSTRÖM 1963), a continued and progressive ringing may still reveal new features in their migration.

Material and Methods

All recovery data obtained during the autumn migration in Scandinavia and on the southern coast of the Baltic have been taken into account. The material is extracted from the annual reports of the Bird Ringing Office of the University of Helsinki for the years 1916—1965 (the reports have been published in *Ornis Fennica* in 1925—1928, and in *Memoranda Societatis pro Fauna et Flora Fennica* in 1929, 1931—35, 1937—38, 1940, 1942, 1950—51, 1953, 1957—67). More recent, but still unpublished, data have also been included here.

Corresponding data have also been extracted from the Swedish and Norwegian ringing material (part of the Swedish data have appeared in *Göteborgs Museums årskrift* in 1919—31, 1933—46, and in *Göteborgs Naturhistoriska Museums årskrift* in 1948—50, 1952—57, and 1959—60; the ringing results obtained in Norway appeared in *Sterna* in 1958—67 and in *Stavanger Museums Småskrifter, Zool. Ser.* in 1951—57). Part of the Swedish material is unpublished and kept in the archives of Riksmuseets Ringmärkningscentral in Stockholm; I reviewed these files in the autumn of 1967.

Figs. 1—3 summarize the sites of ringing and recovery of the terns ringed in Finland. The migration routes of the Common Terns ringed in Sweden are

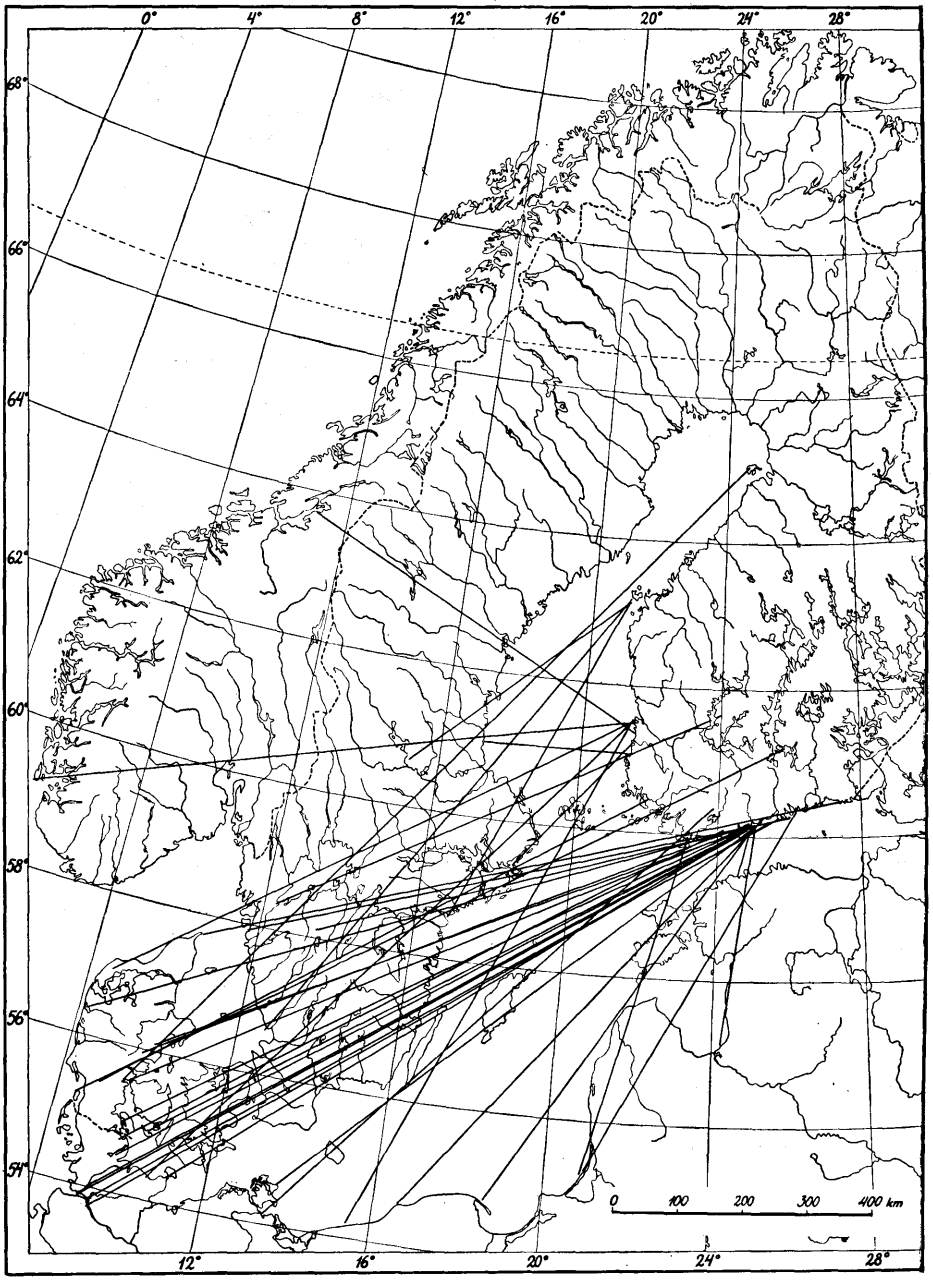

FIG. 1. Migration routes in Scandinavia and in the Baltic area of juvenile Common Terns, ringed in Finland before the 1960's.

KUVA 1. *Suomessa ennen 1960-lukua rengastettujen nuorten kalatiirojen muuttosuunnat Skandinaviassa ja Itämeren alueella.*

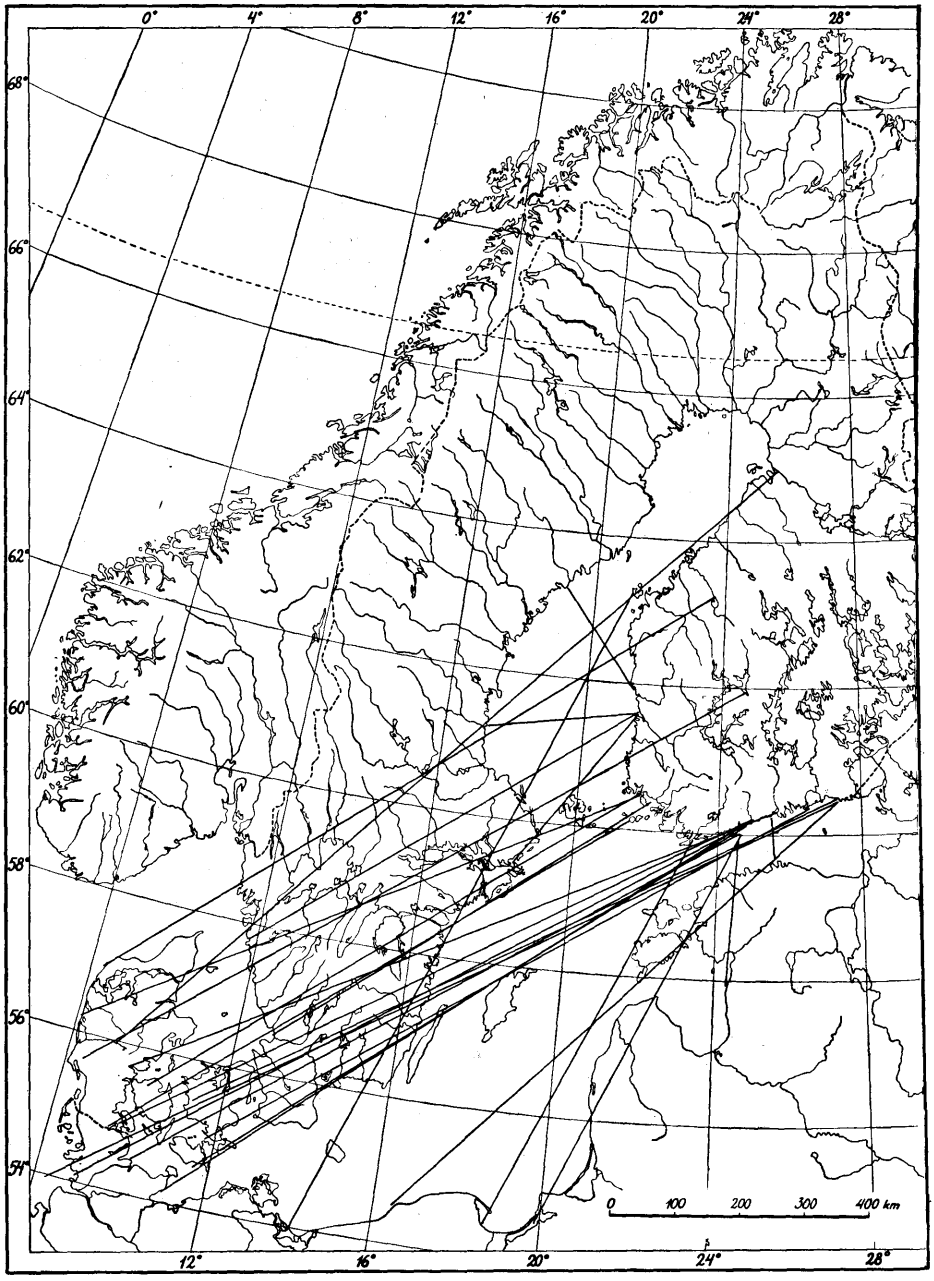

FIG. 2. Migration routes in Scandinavia and in the Baltic area of juvenile Common Terns, ringed in Finland in the 1960's.

KUVA 2. *Suomessa 1960-luvulla rengastettujen nuorten kalatiirojen muuttosuunnat Skandinaviassa ja Itämeren alueella.*

parallel to the routes of those ringed in Finland, while the very few recoveries of Swedish Arctic Terns, especially in the Gulf of Bothnia, do not allow any conclusions to be drawn.

Most of the recoveries were made on young terns born in the same year. The recoveries of adult Common Terns did not deviate from that of the young and for simplicity are not marked on the maps. The recoveries of two adult Arctic Terns are shown by broken lines in Fig. 3.

The data concerning Arctic Terns are much fewer than those for Common Terns, mostly because the number of ringed Arctic Terns in Finland is considerably lower and their rate of recovery consequently much smaller. The number of Arctic Terns recovered in Scandinavia and on the southern coast of the Baltic in the autumn was 21, while the corresponding number for Common Terns was 58. (Specimens marked as *Sterna sp.* were not taken into account).

Results

As depicted in Figs. 1 and 2, nearly all Finnish Common Terns migrate in a south-westerly direction; recoveries from the Baltic and Scandinavia are almost exclusively made in southern Sweden, Denmark, and on the southern coast of the Baltic. There are only two recoveries from the Norwegian west coast (faulty determinations?). The results for the Arctic Terns differ from those above, in that the majority of the recoveries are from the Norwegian coast (Fig. 3). The large rivers in Sweden which flow towards the south-east certainly make good migration routes. The south-western archipelago of Finland seems to form a barrier, because all Arctic Terns, except one, ringed at the Gulf of Finland were recovered in the south-west, while nearly all birds ringed at the Gulf of Bothnia were recovered in Norway. Arctic Terns ringed on the coast of southern Sweden migrated in a southerly direction.

The possibility exists that the Arctic Terns recovered on the west coast of Sweden and Denmark arrived there from the north along the Norwegian coast. However, when the dates of recovery are compared those from central Norway do not appear earlier than those from Denmark and the south of Sweden.

Unfortunately so few terns have been ringed on the western coast of the Gulf of Bothnia that recoveries are still lacking. However, the migration routes for the Finnish populations from the Gulf of Bothnia show a statistically significant difference (in the Fisher exact probability test, $P = 0.0028$) between the Arctic and the Common Tern. Included in the test were only those recoveries that were at least 500 kilometers from the ringing site.

Conclusions

Immature Common and Arctic Terns may, before commencing their southward migration, also fly in other directions. For example, young Arctic Terns ringed on the Farne Islands off the coast of Great Britain have been recovered in Sweden, Denmark and Germany in late summer (BANNERMAN 1962). Similarly, immature Common and Arctic Terns ringed in Småland and on Öland have quite frequently been recovered on the coasts of the Baltic countries, having thus flown directly eastward (JÄGERSKIÖLD 1936, MATHIASSON 1962). According to JÄGERSKIÖLD, severe storms from the west may also cause terns to drift across the Baltic.

It is true that also immature terns ringed in Finland move into various directions immediately after having acquired the skill to fly; however, the two migration routes observed through recoveries of ringed birds are so distinct that a mere random scattering cannot be involved.

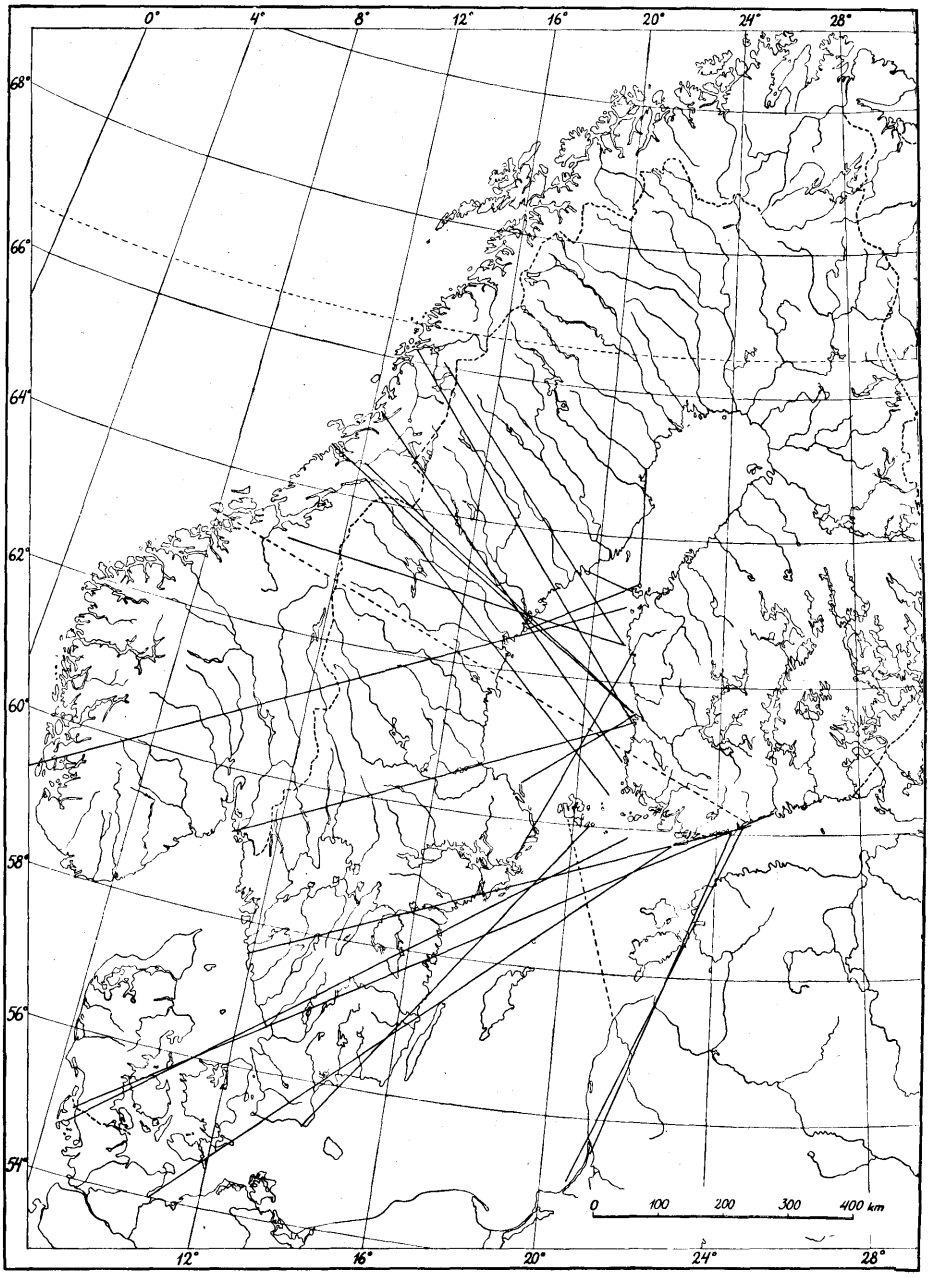

FIG. 3. Migration routes in Scandinavia and in the Baltic area of juvenile Arctic Terns, ringed in Finland (dotted line = adult indiv.).

KUVA 3. *Suomessa rengastettujen nuorten lapintiirojen muuttosuunnat Skandinaviassa ja Itämeren alueella* (*katkoviiva = ad. yks.*).

The two separate directions of migration observed in the Arctic Terns can be explained in two different ways: (a) The dependence of the migration paths on the ancestral route of expansion, and (b) the migration path is chosen to pass areas where food is most available.

It is generally agreed that the circuitous paths taken by many migratory birds follow their ancestral range extensions (e.g. BERNDT *et al.* 1959). Such species occurring in Finland are, among others, Arctic Warbler (*Phylloscopus borealis*), Greenish Warbler (*P. trochiloides*), and Red-breasted Flycatcher (*Muscicapa parva*). In contrast to most other Finnish migratory birds, their direction of migration in the autumn is east and south-east towards their original wintering quarters in south-eastern Asia and India. Similar phenomena characterize part of the fauna of Greenland (NØRREVANG 1964).

The relation of migration routes to the direction of expansion of the species may not necessarily remain unchanged. For example, drifting with storms into new areas or the influence of other birds that are migrating in other directions may result in a species assuming a new migration route or direction (BERNDT *et al.* 1959). The new direction and the new wintering area become permanent only if they are better suited for the ecology of the species (cf. KULLENBERG 1946). This is true, for instance, for the Shorelark (*Eremophila alpestris*), which has arrived in Scandinavia from the east and used to migrate eastward, but has during the last decades more frequently migrated to the south (LACK 1954, NØRREVANG 1964).

Arctic Tern populations breeding in the north-east of North America have been observed migrating across the Atlantic to the west coast of Europe, before finally turning to the south. This has been regarded as an indication of the route for the ancient expansion of this species. KULLENBERG (1946) has criticized this notion on the ground that the old route of expansion would not remain a migration route for long if it did not have definite advantage, for instance, availability of food. He has stressed the importance of food ecology to such an extent that he doubts the existence of any relation between the migration route and the path of expansion of the Arctic Terns in North America.

According to KULLENBERG, the dietary conditions in the Baltic area are well suited for Arctic Terns, and hence they would hardly benefit by moving from their breeding grounds to the coast of Norway. The diverse migration routes in the area of the Gulf of Bothnia thus, in my opinion, denote a different route of expansion between the species.

The preservation of the tradition in the population is facilitated by the habit observed in both Common and Arctic Terns whereby they at least partly migrate in families (PALMER 1941, NØRREVANG 1960), the young birds thus learning the route from their parents.

Already EKMAN (1922) suggested that the Arctic Tern most likely has arrived in Scandinavia from the north-east and possibly also from the south across the Baltic. The populations which arrived by the latter route would have settled as far north as the Quark (the narrowest portion of the Gulf of Bothnia). But the population in northern part of the Gulf of Bothnia would have originated from the populations at lakes in northern Finland and Sweden, which in turn came from the coasts of the Atlantic and the Arctic Ocean. The Arctic Terns that reside at the lakes in the north of Finland arrive there from the north in spring (LAINE 1966). If the deviating direction of migration of Arctic Terns at the Gulf of Bothnia is taken as a result of the route of expansion, the question of the age of this tradition arises. If the species did not gain any

appreciable ecological advantage in migrating across Sweden to the coast of Norway, this tradition most likely would have vanished and, instead, the terns would have taken a shorter way across the Baltic to the North Sea. Therefore it is concluded that the present route of migration probably is of relatively recent origin.

According to EKMAN (1922) and KULLENBERG (1946), the range of the occurrence of Arctic Terns makes an inland extension from the coast of the Atlantic in the area of Trondheim, extending up to the lake area of Jämtland, Sweden. In addition to this, the range makes three wedge-like extensions inland at the Lofoten Islands, reaching the upper tributaries of the rivers in Norrbotten. These inland extensions of the range makes it possible for terns to move away from the coast of Norway to the Gulf of Bothnia, which they do especially if the population on the Atlantic coast is dense, but scarce along the Gulf of Bothnia. The Arctic Terns occure in largest numbers on the coast of Norwegian Lapland (Ruija). They also abound in the Lofoten and around Trondheim, that is in areas where inland as well as coastal breeding occurs (EKMAN 1922).

The data published late in the last century and in this century of the numbers of Arctic Terns breeding at the Gulf of Bothnia are so scarce that no general trend emerges. Observations have been made of the populations at Hailuoto, by SANDMAN (1892), MERIKALLIO (1928) and STUART BAKER (1929): Arctic Terns were found to be relatively numerous. According to MELA (1882), Arctic Terns were common at Oulu, but were found only rarely at Vaasa and on the Åland Islands (as well as on the southern coast of Finland). According to MERIKALLIO (1930), Common Terns were frequently found in the archipelago of Oulu, Haukipudas, and Ii in the 1920's, while Arctic Terns occurred only on the outer skerries, where they were more numerous than the Common Terns. Several papers published during the last century (cited by MERIKALLIO 1930), only mention the Common Tern in the archipelago of Oulu and not at all the Arctic Tern. DRESSER (according to MERIKALLIO 1930), who was the first to observe the Arctic Tern within this area in the midnineteenth century, says that it occurs more frequently in the Oulu area than the Common Tern. KRANK (1898) reports that the Arctic Tern breeds around Kokkola only on the outer islands, while the Common Tern was very common everywhere in the Kokkola archipelago. According to TAXELL (1934), the tern population of Valassaaret exceeded 100 pairs in the 1930's; most of them being Common Terns, while the Arctic Terns numbered only a few pairs.

Hence it appears that a fairly strong population of Arctic Terns may have been residing in the northern part of the Gulf of Bothnia at the turn of the century. In the south the Arctic Terns apparently were much fewer in the number than the Common Terns.

Some data in the paper of MERIKALLIO (1930) refer to the fact that the Arctic Tern population in the Oulu archipelago would have been increasing late in the nineteenth century. However, caution is warranted when the data of the two tern species are interpreted, because separation of the species in the field is difficult and thus a possibility of a faulty determination always exists.

On the Finnish coasts the tern populations underwent a strong decline late in the 1920's. Most of the decrease occurred among the Common Terns, while the numbers of Arctic Terns remained nearly unchanged (v. HAARTMAN *et al.* 1967, see also BERGMAN 1939, 1948, 1957, PAAVOLAINEN 1950, HILDÉN 1966).

Since the 1950's the terns have started to increase in numbers, but the studies, where a separation between the species has been made, show that it is only the Arctic Terns that have become more numerous. As a result the Arctic Terns are dominating the tern populations on the Finnish coasts, while before the decline Common Terns were more common or at least the difference in the numbers was considerably smaller (NORDBERG 1950, BERGMAN 1957, HILDÉN 1966, TENOVUO 1966). HILDÉN holds that the reason for the upward trend in the numbers of terns at Valassaaret (the Gulf of Bothnia) is the increase in the breeding ground resulting from land rise. However, this does not explain the increase on populations in the south-western archipelago.

The growth of the Arctic Tern populations has been more vigorous at the Gulf of Bothnia and in the south-western archipelago than at the Gulf of Finland. For example, at Valassaaret the number of Arctic Terns increased from 110 pairs to 210 pairs during the interval from 1949 to 1956, and in 1963 it consisted of as many as 345 pairs (HILDÉN 1966), while in the archipelago between Porkkala and Helsinki the increase was only modest or from 130 pairs in 1941—43 to 180 pairs in 1956 (BERGMAN 1957). Recent observations, however, indicate a more rapid increase also at the Gulf of Finland in the middle of the 1960's (H. Miettinen, pers. comm.). On the coast of Estonia the Arctic Tern population has been decreasing (KUMARI 1958, ONNO 1966). Also, in Skåne, Sweden, this species has undergone a decline, though a slight recovery in some places at least, in the 1950's has been observed (CURRY-LINDAHL 1961). No noticeable change in the numbers of Arctic Terns has occurred in Denmark (LØPPENTHIN 1967). In general, however, the detection of minor changes in the populations of Common and Arctic Terns is difficult, because in most quantitative studies no separation has been made between the two species.

Hence it is possible that the Arctic Terns have moved from the coast of the Atlantic to the Baltic area, especially to the Gulf of Bothnia. This movement may have occurred late in the last century and maybe also after the depression of the 1920's and 1930's. The latter possibility is supported by the following observations: (a) the Arctic Tern has inhabited new lakes for breeding in the lake area of Jämtland, Sweden, (e.g., Vagen, Harkänget, Liselet), late in the 1940's, and the new stock very probably came from the west (CURRY-LINDAHL 1961; P. N. Jonsson, written communication), (b) the upsurge of the Arctic Tern populations was stronger at the Gulf of Bothnia and in the south-western archipelago than at the Gulf of Finland and the south of the Baltic, (c) all recoveries of ringed Arctic Terns on the Norwegian coast are from the 1960's (this is not very conclusive, however, as altogether only 4 recoveries prior to the 1960's have been made).

The very few ringings of Arctic Terns in Norway and the small frequency of recovery do not, however, support the theory of the terns moving across Scandinavia. Neither has any increase occurring before the period of population growth at the Gulf of Bothnia been observed (J. Willgohs, Edw. Barth, written communication). On the contrary HOLGERSEN (1951) suggests a decline occurring prior to the 1950's. Too few quantitative studies on terns in Norway have been carried out, for the problem to be settled at the moment.

A large increase of some competitive strong species within a certain area may cause a decline in the numbers of a weaker species or, at least, prevent an increase in the population, and thus force a part of the population to move away from the area. For instance, the increase

in the numbers of Herring Gulls (*Larus argentatus*) in the Saimaa lake area and the more frequent occurrence of Black-headed Gulls (*Larus ridibundus*) in the lake area of Keuruu and archipelago of Helsinki very probably are the reasons of a retreat of tern populations from these areas (BERGMAN 1939, VOIPIO 1954, LEINONEN 1964). Both the Herring and the Black-headed Gulls have been on the increase in Norway (HAFTORN 1958, YTREBERG 1957), but no data about the effects of this on tern populations exists.

Summarising, it can be said that the Arctic Tern populations of the Gulf of Bothnia and of the south-western archipelago of Finland exhibit a clear tendency to migrate across Scandinavia to the coast of Norway before turning south. Because the coasts of the Atlantic and the Baltic have little differences in food types for this species, this migration route taken by the Arctic Tern most likely reflects the old route of expansion. This stretch of the migration route is of minor biological importance for the Arctic Terns compared to the total route down to the South African coast and Antarctica. Hence I conclude that this deviating route would not have persisted for long, but it would have disappeared in the course of a few centuries. However, so far it is not known whether any movement by Arctic Terns from the Norwegian coast to the Baltic occurred late in the last century or during the last two decades. A large-scale ringing activity on the coast of central Norway would further clarify if this movement is still continuing.

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Selostus: **Suomalaisten kala- ja lapintiirojen muuttotavoista Skandinavian alueella.**

Tutkimusta varten on kerätty kala- ja lapintiiraa koskevat, syysmuuton aikana tehdyt rengaslöydöt Fennoskandian ja Itämeren eteläranniken alueelta. Aineisto muodostuu pääasiassa Suomessa rengastetuista tiiroista.

Karttoihin 1—3 on yhdistetty Suomessa rengastettujen tiirojen rengastus- ja löytöpaikat. Valtaosa löydöistä koskee nuoria, samana vuonna syntyneitä lintuja. Kartoista ilmenee, että lähes kaikki kalatiirat ovat muuttaneet lounaissuuntaan. Sen sijaan Pohjanlahdella syntyneet lapintiirat ovat muuttaneet koilliseen Norjan rannikolle. Lounais-Suomen saaristoon näyttää muodostuvan muutonjakaja.

Käytettävissä olevan aineiston perusteella kala- ja lapintiirojen muuttosuuntien välinen ero Pohjanlahden ja Saaristomeren alueella on tilastollisesti merkitsevä.

Syynä lapintiirojen muuttoreittien kaksisuuntaisuuteen saattaa olla kaksi mahdollisuutta: (a) muuttoreitit määräytyvät lajin aikaisemman leviämistien mukaan, (b) muuttosuunnat määräytyvät ravintoekologisesti edullisimpien alueiden kautta. Esimerkkeinä edellisestä tapauksesta ovat Suomessa mm. lapinuunilintu, idänuunilintu ja pikkusieppo, jotka muuttavat itään ja kaakkoon. Muuttosuunta ja talvehtimisalue saattavat kuitenkin muuttua, mikäli uudet alueet ovat ekologisesti entisiä edullisempia. Näin on tapahtunut mm. tunturikiurulle, jonka itäinen muuttosuunta on vaihtunut eteläiseksi.

Itämeren ravinto-olosuhteet ovat kuitenkin lapintiiralle edulliset, joten se tuskin saavuttaa merkittävää ekologista etua siirtyessään pesimäpaikoiltaan ensin Norjan rannikolle. Lisäksi on todennäköistä, että lapintiirapopulaatiot ovat levinneet pohjoisesta ja koillisesta Atlannin rannikolta tunturijärvialueiden kautta ainakin Perämeren alueelle. Tällöin Pohjanlahden lapintiirojen poikkeava muuttosuunta saattaa olla tradition ylläpitämä.

Tradition ikää on erittäin vaikea sanoa. Lapintiirakannat ovat lisääntyneet Suomessa mahdollisesti jo 1800-luvun lopulla (Perämeren alueella) ja varsinkin 1950-luvulta lähtien. On

mahdollista, että lapintiiroja on tällöin siirtynyt Atlannin rannikolta pesimään Itämeren alueelle, varsinkin Pohjanlahdelle. Tätä tukevat seuraavat havainnot: (a) Jämtlannin järvialueella, Keski-Ruotsissa, on 1940-luvun loppupuolella todettu lapintiiran vallanneen uusia järviä pesimisalueeksi ja tämä kannan lisäys on todennäköisesti tullut lännestä päin, (b) lapintiira on lisääntynyt voimakkaammin Pohjanlahden ja Saaristomeren alueella kuin Suomenlahdella ja Itämeren eteläosissa, (c) kaikki Norjan rannikolta tehdyt lapintiiraa koskevat rengaslöydöt ovat 1960-luvulta (tämä seikka on kuitenkin vähämerkityksellinen, koska lapintiiralöytöjä oli ennen 1960-lukua ainoastaan 4 kpl.).

Toisaalta norjalaisesta rengastusaineistosta ei ole saatavissa tukea teorialle tiirojen siirtymisestä Skandinavian yli. Norjassa ei ole havaittu ainakaan selvää kantojen lisääntymistä Pohjanlahden populaatioiden kasvua edeltäneellä ajalla. Tiiroja koskevat kvantitatiiviset tutkimukset ovat kuitenkin Norjassa niukkoja, eikä tarkkoja tietoja ole saatavissa. On myös mahdollista, että ekologisesti voimakkaat lajit harmaalokki ja naurulokki, jotka molemmat ovat enentyneet Norjassa, ovat saattaneet työntää osan tiiroista Pohjanlahden alueelle.

Toistaiseksi on kuitenkin mahdotonta sanoa varmasti, onko viime vuosisadan lopulla tai kahden viime vuosikymmenen aikana tapahtunut lapintiirojen siirtymistä Norjan rannikolta Itämeren alueelle. Suurimittainen rengastustoiminta Keski- ja Pohjois-Norjan rannikolla saattaisi tuoda lisävalaistusta asiaan, mikäli kyseistä siirtymistä tapahtuu edelleen.

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WING LENGTH OF LAPWING (*VANELLUS VANELLUS*) BEFORE AND AFTER SKINNING, WITH REMARKS ON MEASURING METHODS

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In spring 1966 a severe cold period occurred in northern Europe. During this period thousands of Lapwings succumbed in Finland (VEPSÄLÄINEN 1968). I had an opportunity to measure the wing lengths of 11 Lapwings sent to the Zoological Museum of the University of Helsinki. The first measures were taken in spring 1966 from birds that had died recently, and the second ones in autumn 1966 from the same birds now skinned.

The 'minimum chord' of the right wing was measured with a ruler. The median coverts of the folded wing were pressed gently, with the thumb, against the ruler, and the length of the wing was red from the carpal joint to the tip of the longest primary; the normal natural curvature of the primaries was not straightened. The bill was measured with dividers from the tip to the feathering of the forehead (for methods *see* CORNWALLIS & SMITH 1963).

Results

The results of the measurements are shown in Table 1. The measures of the same individuals taken before and after skinning varied considerably. The greatest reduction — compared to the measurements of fresh individuals — was 12 mm; in one case the measures were the same. Hence the shortening of the wing was very uneven. The average re-