Finnish bird stations, their activities and aims

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There are at present nine bird stations along the coasts of Finland. Their main activities consist of observing visible migration, making censuses of resting migrants, ringing and carrying out special investigations. Some main results of the work done so far in each field of activity as well as new research projects are presented.

The regular observations at bird stations have increased significantly our present knowledge of the phenology of migration. Examples of the timing of the spring and autumn migration are given for many species. Annual changes in the total numbers of birds observed or ringed at bird stations can be used as a rough measure of fluctuations in breeding populations (e.g. a catastrophic decline in numbers of the Wood Lark and Shore Lark is clearly demonstrable). Almost all recent information on the occurrence of irregular migrants in Finland is based on data collected at bird stations. The different types of irregular migrants, the annual and seasonal rhythm of irruptions, age and sex ratios among stragglers and the occurrence of return movements in spring are discussed. In recent years between 30 000 and 60 000 birds have been ringed annually at the Finnish bird stations, most of them with mist-nests. For species of which very few young are ringed most information on their migratory journeys is based on recoveries of birds ringed at bird stations. The recoveries have also given valuable data on the speed of migration. Special investigations linked with ringing include ageing, sexing, weighing and measuring birds, recording the state of moult and collecting ectoparasites; some results and problems of these topics are discussed. The scientific value of rare birds recorded at bird stations is briefly reported.

Introduction

Descriptions of the Finnish bird stations, their locality and topography, year of foundation, main forms of activity, etc. have been presented in two papers by Hildén (1968, 1970). Since these were written, one of the stations, Isokari, ceased activity (in 1971), but a new station was founded in 1972 at Tankar, on the west coast (Harju & Hongell 1973). Hence, the present number of bird stations in Finland remains at nine; their locations are shown in Fig. 1.

Besides these "official" bird stations, there are many other places along the Finnish coasts where bird watching and ringing are carried out regularly each year. The activities at some of these localities may be even more effective than at certain "official" stations which are manned annually only for a few weeks, e.g. Hailuoto. As the Finnish bird stations do not receive any financial support from the government, there are no strictly defined conditions which a station should fulfil to be officially recognized. Accordingly, it is a matter for local bird clubs or similar organisations to decide whether or not to call a well-known and regularly occupied observation spot within their area a bird station.

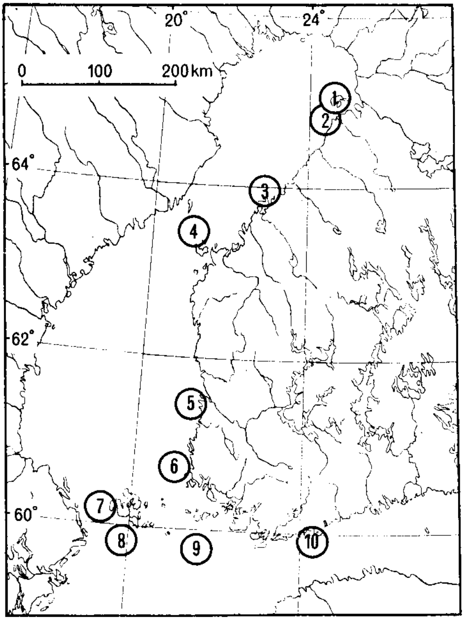

FIG. 1. The Finnish bird stations (in brackets their years of foundation): 1. Hailuoto (1967), 2. Tauvo (1963), 3. Tankar (1972), 4. Valassaaret (1965), 5. Säppi (1962), 6. Isokari (1965), 7. Signilskär (1930), 8. Lågskär (1963), 9. Jurmo (1962), 10. Rönnskär (1961).

Main activities and publications

Traditionally, the main activities of the Finnish bird stations consist of (1) observation of visible migration, (2) censuses of resting migrants, and (3) ringing. In recent years, (4) some special investigations connected with ringing have become popular, e.g. weighing, ageing and sexing of birds.

Unfortunately, there has not been any agreed plan or detailed instructions for operation of the different stations. Hence, the methods employed both in observational work and in data storage have varied from one station to another. Furthermore, the records from different stations are kept in different places, which renders their combined analysis difficult. Undoubtedly the scientific value of the work performed at the Finnish bird stations is reduced by the lack of financial support. Only at Signilskär and Lågskär have observers been given small payments for their work, at all the other stations the work is completely voluntary. In the absence of payment, it is naturally difficult to demand that observers should follow instructions strictly or that each station should publish an annual report of its activities.

The difficulties discussed above are mainly responsible for the limited use so far of the comprehensive material collected at our bird stations. In this respect we compare unfavourable with Sweden, for instance, where the bird stations have produced several dozens of publications. Most of the papers so far published in Finland deal with old data collected at Signilskär in 1930's and 1950's. For example, BERGMAN (1951) has discussed the dependence of bird migration on weather, and in three papers LINKOLA (1957, 1961, 1963) has summarized ringing at Signilskär during 1930—56, the irruptions of tits, and the food of resting Tengmalm's Owls *Aegolius funereus,* respectively. Other papers based on data from Finnish bird stations include small detailed studies of restricted topics: the directions of migrating Rough-legged Buzzards *Buteo lagopus* at Signilskär (SNELLMAN 1931—32), the weights of birds trapped at Signilskär (GRÖNVALL 1938), the migration speeds of some birds ringed at Signilskär (LINKOLA 1958), the age ratio of migrant Crossbills *Loxia curvirostra* and *L. leucoptera* at Signilskär (HILDÉN 1960), the spring weights of Starlings *Sturnus vulgaris* at Lågskär (RINNE 1967), nocturnal observations of birds attracted to the lighthouse of Isokari (TENOVUO & VIRTANEN 1969), and the moult of Spotted Flycatchers *Muscicapa striata* and Pied Flycatchers *Ficedula hypoleuca* at Signilskär (HYYTIÄ & VIKBERG 1973).

Besides these special investigations, several annual reports have been published of the activities of the Finnish bird stations. In the years 1966—69, the main results from each station were reported annually in the field ornithological periodical Lintumies. Mainly on the basis of data presented in these reports, three annual bird station reviews were published in English (HILDÉN 1968, 1969, 1971). Unfortunately, difficulties in receiving regular reports from some of the bird stations interrupted this custom.

In recent years, some improvements in co-ordination of the activities of Finnish bird stations have been effected, or at least are under consideration. For instance, standardized forms for daily records are used nowadays at most stations. A committee was formed in January 1973 to prepare instructions to be followed by all birds stations.

The principal aims for the future work of Finnish bird stations comprise the following:

— Sufficient annual financial support for the effective organisation of activities.

— Clearly delimited research plans as well as uniform methods.

— Publication of annual reports of the activities.

— Co-operation with bird stations abroad, in the first place with those within the Baltic.

On the following pages, the main ornithological problems which might be investigated by bird stations are discussed. Many preliminary results from work done at the Finnish stations so far are presented, mainly as examples of how bird station data can be used in the study of these problems.

Visible migration

Observation of visible migration can provide some of the basic material for solution of many problems, e.g. (1) seasonal rhythms of migration, (2) diurnal rhythms of movement, (3) the influence of weather on migration, and (4) the behaviour of migrants (the height of migration in relation to wind conditions, flock formation, reactions to leading lines, etc.).

BERGMAN (1951) analyzed the data from Signilskär from the years of 1932 to 1939. Unfortunately, three observers who used somewhat different methods took turns of duty at the station, and their observation periods did not cover whole seasons. More consistent and thorough material is available for the five autumns in the 1950's when Pentti Linkola worked as observer at Signilskär throughout the whole season. He watched the migrations according to a strictly prescribed schedule, covering the same hours every day and using fixed observation spots; all birds recorded were grouped into counts for 15 minute periods. Regrettably, this valuable and comprehensive material, covering no less than 2,382 typewritten sheets, is so far unpublished.

Since the introduction of mist-nets, which keep potential observers busy in trapping and ringing birds, watching visible migration has become much less popular. At most Finnish bird stations it is now treated as a duty of secondary importance: observation of migration is performed when the personnel at the station is sufficiently large, or when especially interesting passage is visible (mass flights, reverse migration, special weather movements, etc.). Naturally, the scientific value of these more casual observations is restricted. On the other hand, it is often felt that our present knowledge of visible migration, and the effects of weather upon it, is fairly good (see e.g. SVÄRDSON 1953, SCHÜZ 1971, EDELSTAM 1972); in addition, radar has shown that visual observations give an incomplete picture of bird migration.

In the future, it seems best to confine the systematic observations of mig-

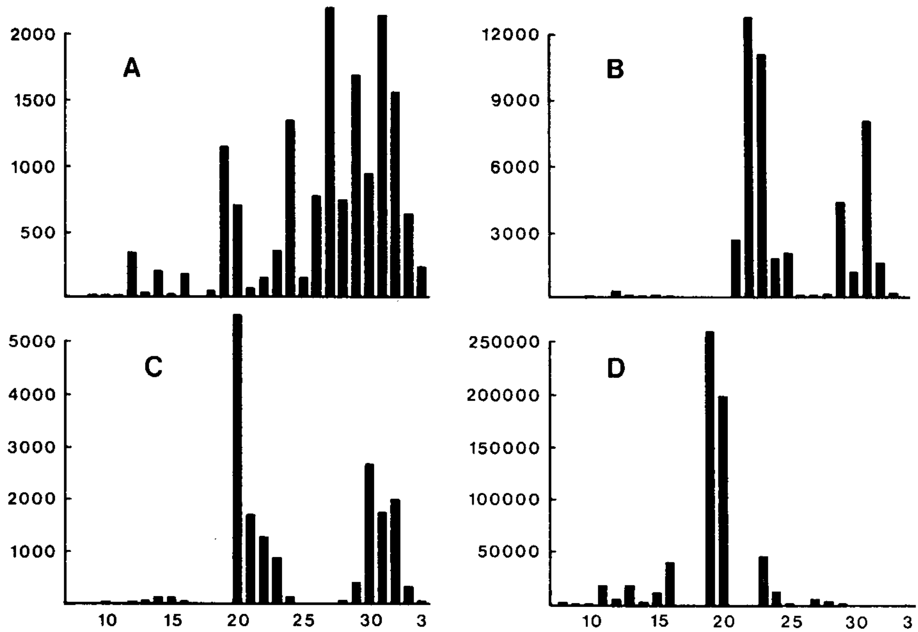

FIG. 2. The passage of arctic migrants at Rönnskär between May 8 and June 3 1968. A = divers (*Gavia arctica* and *G. stellata*), B = waders (*Calidris alpina, Pluvialis squatarola* and *Limosa lapponica* as dominant species), C = geese (on May 20 mainly *Branta leucopsis,* later almost exclusively *B. bernicla*), D = waterfowl (*Clangula hyemalis* and *Melanitta nigra* as dominant species).

ration at the Finnish bird stations to certain selected species, to be studied simultaneously at the different stations according to a common plan. A good example of the effectiveness of selective observation is given by the study of the migration of arctic birds carried out at Rönnskär each spring from mid-May to early June. This has produced a detailed picture of the huge passage along the Gulf of Finland, including the daily numbers and annual totals for each species, the seasonal and diurnal rhythms of the migration, the sizes of the flocks, the heights of migration, the effects of weather factors upon migration, etc. As an example of the results, the passage of geese, divers, waders and waterfowl at Rönnskär in 1968 are shown in Fig. 2, derived from HILDÉN et al. (1968).

Phenological problems

Phenological problems in ornithology, e.g. the timing of the spring and autumn migration of different species, often are considered to be more or less satisfactorily understood. But this is not true. Until recently, for instance, adequate data on the onset of autumn migration and on the termination of spring migration have been lacking, mainly due to difficulties in separating migrants from local breeding birds; such confusion has even led to severe misconceptions. Only regular observations at bird stations in the outer archipelago where breeding populations of most land birds are lacking, have produced reliable data on these questions.

This has revealed that the spring migration of many species in Finland lasts considerably longer and the autumn migration starts earlier than was formerly believed. Some of the earliest migrants which may arrive in March (e.g. *Columba palumbus, Alauda arvensis, Corvus monedula, Carduelis chloris, Emberiza citrinella*) are still seen on passage regularly in mid- or late May, at a date when the breeding populations in southern Finland are already feeding young. Similarly, the migrations of many species which do not start to arrive until late April or early May (e.g. *Saxicola rubetra, Phoenicurus phoenicurus, Phylloscopus trochilus, Motacilla flava*) extend until mid-June. Some passerine species which depart early (e.g. *Saxicola rubetra, Sylvia borin, Phylloscopus trochilus, Ph. sibilatrix, Muscicapa striata*) start migration even by the end of July, according to observations at the bird stations. The remarkably early departures of the Cuckoo *Cuculus canorus* and the Scarlet Rosefinch *Carpodacus erythrinus* were not recognized until recently. The first Cuckoos appear regularly in the outer archipelago in early July, and by the end of the month migration is already heavy. The departure of Scarlet Rosefinches starts at about the same date, reaches its peak by late July and is almost over by mid-August.

It must be emphasized that the mere knowledge of the regular migration seasons of the different species is only a first step in the study of this field of research. Similarly, we know fairly well the average and extreme dates of the breeding seasons and the clutch sizes of our most birds, but nevertheless only a few species have been analyzed thoroughly in these respects. In all the problems mentioned above the basic information tends to indicate a number of new questions, to solving which much reliable data are needed, distributed over a long period of years. Among phenological problems in bird migration, the following ones are particularly well-suited for study at bird stations: (1) annual differences in the migratory periods, with underlying reasons (dependence on weather, food situation, earliness of the preceding breeding season, etc.), (2) time differences in arrival and departure between males and females and between adults and juveniles, (3) differences in time of migration between different populations, (4) migration times of non-breeders or birds whose broods were destroyed, (5) whether double-peaked rhythms of departure occur in species breeding twice during the course of a summer, (6) differences in the timing of migration between stations, indicating the average progress of the migration, and (7) long-term changes in the seasonal rhythms of migration, and reasons for these.

Phenological data collected at our bird stations so far have been used to a great extent in the new handbook of Finnish birds *Pohjolan linnut värikuvin* (v. HAARTMAN et al. 1963—72). But in the course of a few years the data available will be sufficient for more detailed analysis. The average timing of the spring and autumn migration for each species could be presented graphically, using the distribution of numbers ringed or observed daily during at least ten complete migration seasons, as done by EDELSTAM (1972) in his excellent review of visible migration at Ottenby bird station in Sweden. For species in which males and females as well as adults and juveniles are separable, the graphs could be drawn separately for both sexes and age classes. Moreover, annual variations in the onset, peak and termination of the migration could be treated statistically.

In Figs. 3 and 4 as well as Table 1 some examples of these possibilities are presented. The annual differences in the migratory periods of the Robin are striking, in spite of the very precise onset of departure (Fig. 3). In early years (1959, 1972), the peak is already reached in early or mid-September, in late years (1956, 1957) not until one month later; in certain years slight movements still occur in November, in others (1956, 1973) migration is over by about October 20. Besides annually changeable weather conditions, the earliness of the preceding breeding season is attributable to these differences: early breeding is followed by an early departure and *vice*

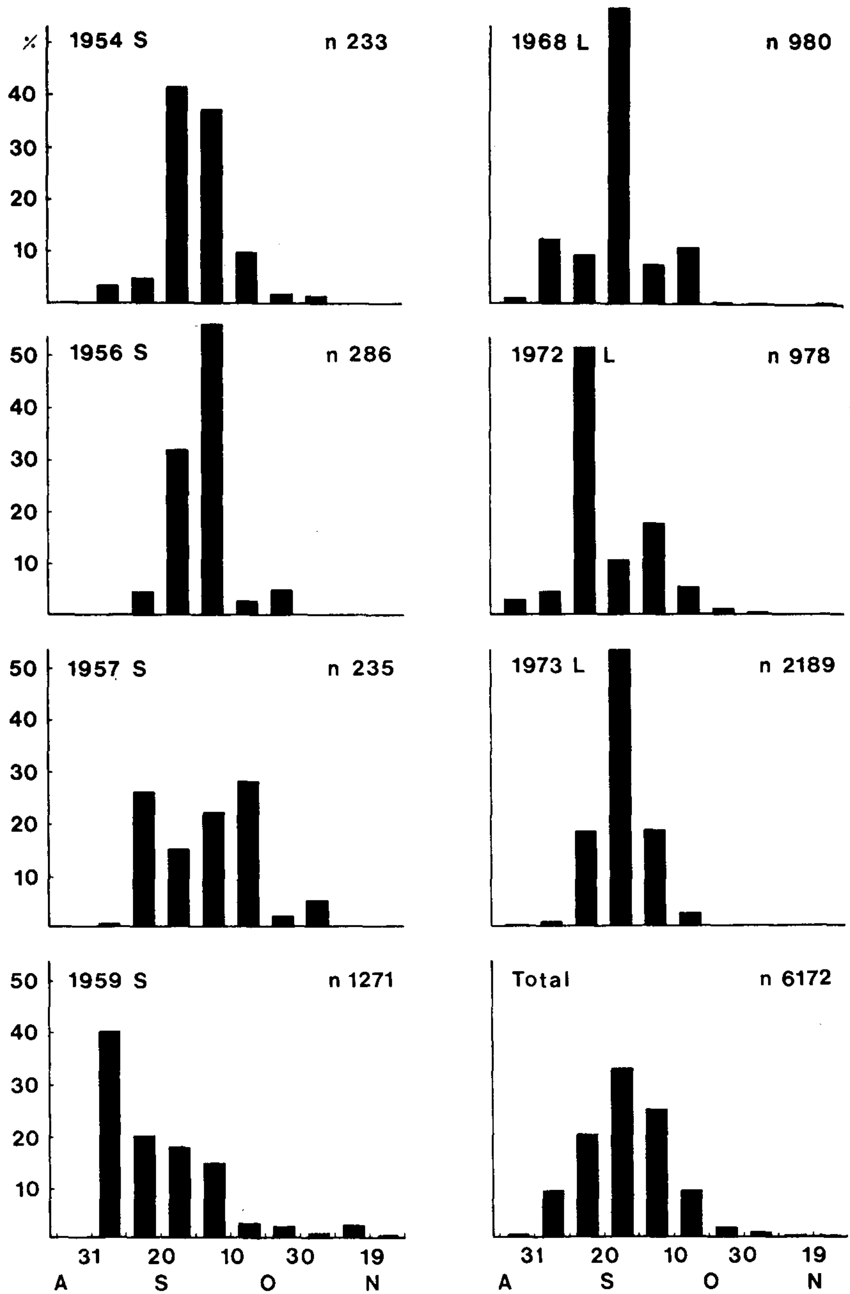

FIG. 3. Migratory periods of the Robin *Erithacus rubecula* at Signilskär (S) and Lågskär (L) during seven complete autumns of observation, according to the distribution of numbers ringed in periods of ten days. The last graph shows the average timing of the autumn migration on the basis of this material.

versa. Fig. 4 shows that the spring passage of Bramblings is later and more concentrated compared with that of Chaffinches, and with less marked difference between the sexes.

Fluctuations in numbers of different species

As is well known, annual censuses of the breeding birds within selected sample areas give the most reliable picture of long-term changes in numbers. But corresponding changes in abundance may also appear during migration, although modified by the breeding success. The relative status of each species each autumn can be estimated at bird stations in three ways, using the total numbers of (1) birds observed migrating, (2) birds resting, or (3) birds ringed.

Unfortunately, there are several sources of error which weaken the reliability of results thus obtained. (1) Exact daily numbers of individuals observed mi-

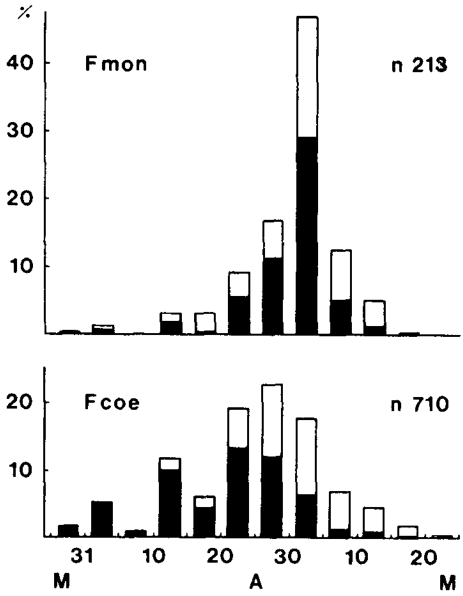

FIG. 4. Timing of the spring passage of Chaffinches *Fringilla coelebs* and Bramblings *F. montifringilla* at Lågskär in 1973, according to the distribution of numbers ringed in periods of five days. Black columns refer to males, white ones to females.

TABLE 1. Observations of first autumn migrants at Signilskär and Lågskär in some selected bird species.

Species	Eearliest	Average	Latest	S.D.	Years
Circus cyaneus	Aug. 14	Aug. 28	Sept. 4	±6.6	14
Falco columbarius	Aug. 17	Aug. 25	Sept. 1	±5.3	11
Lullula arborea	Sept. 15	Sept. 21	Sept. 30	±4.3	16
Eremophila alpestris	Sept. 21	Sept. 30	Oct. 6	±4.7	13
Turdus viscivorus	Sept. 16	Sept. 21	Sept. 30	±4.3	16
T. merula	Sept. 15	Sept. 23	Sept. 29	±4.6	13
Luscinia svecica	Aug. 17	Aug. 25	Aug. 31	±4.2	11
Erithacus rubecula	Aug. 22	Aug. 31	Sept. 5	±4.8	13
Ficedula parva	Aug. 18	Aug. 29	Sept. 7	±5.2	15
Prunella modularis	Aug. 30	Sept. 7	Sept. 14	±4.4	11
Anthus pratensis	Sept. 2	Sept. 5	Sept. 11	±2.4	12
A. cervinus	Aug. 17	Aug. 24	Aug. 29	±3.7	12
Carduelis chloris	Sept. 19	Sept. 24	Oct. 1	±3.6	17
C. carduelis	Sept. 26	Oct. 3	Oct. 11	±4.4	14
Emberiza citrinella	Sept. 12	Sept. 22	Sept. 30	±4.8	17
E. schoeniclus	Sept. 7	Sept. 15	Sept. 23	±4.3	14
Calcarius lapponicus	Aug. 13	Aug. 27	Sept. 2	±4.9	17

grating or resting are noted only for scarce species at most Finnish bird stations. (2) There are differences in methods and capabilities between observers, both as regards watching migration and ringing. (3) The number and effectiveness of traps used for ringing may vary from one year to the next. (4) Annually changeable weather conditions during migration cause differences in the routes used, the height of migration, and the tendency to stop and rest on small islands in the outer archipelago. All these factors may influence the numbers of birds observed or ringed at bird stations.

In spite of these limitations, striking changes in numbers ought to be demonstrable for certain species well-suited to such approaches. The best comparisons are, of course, between autumns in which the same observer was working at the same station. This was the case at Signilskär in the period of 1952—59 (P. Linkola) and at Lågskär in the 1970's (P. Puhjo & H. Tammelin). In Table 2 are given the autumn totals of four species recorded at Signilskär and Lågskär from 1950 to 1973. Both the Wood Lark and the Shore Lark have apparently declined catastrophically during the last 15 years: in recent years only a few individuals were observed each autumn compared with 200—400 during the best autumns in the 1950's. For the Wood Lark, the overall decrease in numbers in Northern and Western Europe is well-known (e.g. OTTERLIND & LENNERSTEDT 1964, PARSLOW 1966, v. HAARTMAN et al. 1963—72, HAFTORN 1971) although reasons for it are obscure, but the corresponding decline of Shore Larks seems to have escaped general attention. The other two species, the Wren and the Goldfinch, show extremely strong annual fluctuations in numbers, as expected since both are known for their highly unstable breeding populations in Finland.

Errors attributable to differences in the effectiveness of trapping methods and in the numbers of traps used can be avoided in part by using, instead of absolute numbers ringed, the percentages of the species to be studied included in the ringing totals, or by comparing numbers ringed of these species to those of some other species. These methods are particularly applicable when investigating long-term changes in numbers on the basis of annual ringing totals.

The Blackbird *Turdus merula* is one of the species which has increased most markedly and expanded its range in Finland during recent decades. Hence, one would expect its population growth to be reflected by an increase in its ringing totals at bird stations. In the tabulation below, I have compared the numbers of Blackbirds ringed at Signilskär (1930—66) and Lågskär (1967—73) to those of Song Thrushes *Turdus*

TABLE 2. Autumn totals (birds observed migrating or resting) of four rare migrants at Signilskär (= S) and Lågskär (= L) during complete autumns of observation.

Species	1950[1] S	1952 S	1954 S	1956 S	1957 S	1959 S	1965 L	1967 S	1968 L	1970 S	1971 L	1972 L	1973 L
Lullula arborea	420	201	364	75	167	107	14	40	30	9	10	8	36
Eremophila alpestris	48	56	210	80	242	35	70	17	24	4	33	88	61
Troglodytes troglodytes	20	112	13	53	24	210	80	138	158	28	96	104	248
Carduelis carduelis	150	37	35	6	15	13	90	25	21	2	58	58	156

[1] Observation ended on October 22; the numbers of later birds are estimated using the mean seasonal distribution of autumn migrants.

philomelos, a species suitable for such comparison because of its relatively stable population in Finland (cf. v. HAARTMAN et al. 1963—72). The figures give the total numbers of Blackbirds ringed as well as their percentages of the corresponding numbers of Song Thrushes.

1930—39	39	24.1
1949—55	124	30.1
1956—60	316	44.8
1961—65	498	69.3
1966—69	810	70.2
1970—73	1225	70.4

The strong increase in numbers of Blackbirds is conspicuous, just as expected, but since 1965 it seems to have come to a standstill.

Irregular migrants

One of the main problems which can be studied successfully at bird stations is the occurrence of irregular migrants, i.e. species showing great annual fluctuations in numbers migrating (cf. SVÄRDSON 1957, ULFSTRAND 1963). In most years typical species of this group show only a weak tendency to migrate but in certain years move in considerable numbers; at irregular intervals they perform mass emigrations to reach areas where they have been absent for years. Typical irruptive species include the Hawk Owl *Surnia ulula,* Great Spotted Woodpecker *Dendrocopos major,* Coal Tit *Parus ater,* Long-tailed Tit *Aegithalos caudatus,* Pine Grosbeak *Pinicola enucleator,* Two-barred Crossbill *Loxia leucoptera* and the Siberian race of the Nutcracker *Nucifraga caryocatactes macrorhynchos.*

Besides these well-known irruptive species there are a number of less typical irregular migrants. In fact, only a few species present in Northern Europe throughout the year are strictly resident; in most autumns at least a small fraction of the population shows signs of long-distance movements, which in certain years may reach proportions approaching those classed as true eruptions. Typical representatives of such species are the Treecreeper *Certhia familiaris,* Great Tit *Parus major,* Blue Tit *P. caeruleus,* Willow Tit *P. montanus* and Tengmalm's Owl *Aegolius funereus.* Even such species as the House Sparrow *Passser domesticus,* Lesser Spotted Woodpecker *Dendrocopos minor* and Three-toed Woodpecker *Picoides tridactylus,* formerly considered strictly resident or short-distance stragglers, have been demonstrated recently to perform occasional emigrations from Finland, although the numbers of birds participating in these long-distance movements always represent a small part of the population (see HILDÉN 1969, 1971). On the other hand, some irregular migrants fall into a position intermediate between irruptive species and true migrants: most of the population leaves its breeding range each autumn, but the numbers of migrants and the extent of their movements may vary greatly from one year to another. The Siskin *Carduelis spinus,* Redpoll *Acanthis flammea,* Brambling *Fringilla montifringilla,* Bullfinch *Pyrrhula pyrrhula,* Waxwing *Bombycilla garrulus* and Goldcrest *Regulus regulus* are typical examples of this category of irregular migrants. Hence the distinctions between resident species, partial migrants, irruptive species and true migrants are not sharp.

Mass irruptions are also easily noticed inland, but often it is difficult or even impossible to get an accurate picture of the intensity and direction of the movements while birds are moving on a broad front. Minor invasions are easily overlooked inland. However, at bird stations, situated on isolated islands and along the topographical leading lines of the coast and island chains, the irruptions are always conspicuous as a result of the concentration of the migrants. Accordingly, almost all recent information on the occurrence of irregular migrants in Finland is based on data collected at bird stations.

Finland has a strategic position in the study of irruptions, much more favourable than most other countries in Western Europe. Irruptive species mainly arrive from the east, moving west- and southwestwards. Hence, before crossing the Baltic, migrants concentrate themselves in great numbers at suitable spots along the Finnish coast. In contrast, at Ottenby, for instance, the numbers of Great Spotted Woodpeckers, Nutcrackers, Coal Tits, Long-tailed Tits and most other irruptive species (EDELSTAM 1972) are extremely small by comparison with numbers seen at the Finnish bird stations. Table 3 lists the invasion autumns of some typical irruptive species in Finland during the last 25 years.

The importance of bird stations in the study of invasions is still greater with regard to the less typical irregular migrants. Before the start of bird station activity in Finland it was largely unsuspected that parts of the populations of many common winter birds perform long-distance movements in autumn, even across the sea; at any rate, the information on the regularity and extent of such movements was very vague. Now, however, the relative strengths of the invasions of each species can be estimated reliably every autumn at bird stations. In the following paragraphs, the occurrence at the Finnish bird stations of three "half-irruptive" species, the Treecreeper, Great Tit and Blue Tit, in recent years is summarized.

The Treecreeper, which (in contrast to other invasion birds) is a night migrant, occurs at bird stations in small numbers every autumn. At Signilskär, for instance, the following numbers of resting birds were counted in the 1950's during complete autumns of observation: 1952 15, 1954 14, 1956 21, 1957 70 and 1959 30 (LINKOLA 1961). But in certain autumns the movements across the Baltic reach much larger proportions, and up to dozens of resting birds may be counted on peak days at a single station. The most marked eruptions in recent years have occurred in the following autumns (the numbers of Treecreepers ringed at certain stations are given in brackets): 1965 (Lågskär 88, Signilskär 58), 1967 (Säppi 139, Jurmo 80, Lågskär 72), 1972 (Säppi 344, Jurmo 220, Lågskär 220, Signilskär 101) and 1973 (Lågskär 332, Rönnskär 193 Signilskär 158).

The Great Tit, likewise, is a regular visitor at the Finnish bird stations each autumn, but the numbers recorded show wide fluctuations. This is illustrated by the annual totals at Signilskär in the 1950's during complete autumns of observation: 1952 ca 60, 1954 ca 85, 1956 33, 1957 ca 100 and 1959 ca 1000 (LINKOLA 1961). Reliable data are not available from the early 1960's but in 1966 and 1967 Great Tits emigrated in very small numbers, and in 1968, 1969 and 1970 in moderate numbers (cf. HILDÉN 1969, 1971). During the last three autumns the numbers of migrants have increased steadily, in parallel with the growing breeding populations, and culminating in a mass eruption in 1973, the largest ever recorded in Finland. Flocks of

TABLE 3. Invasion autumns of some typical irruptive species in Finland during the last 25 years (1949—73). The heaviest irruptions are printed in italics.

Dendrocopos major	*1949*, 1953, 1956, 1957, *1958*, *1962*, 1963, 1966, 1967, *1968*, 1971, *1972*
Nucifraga caryocatactes[1]	1950, *1954*, *1968*, 1971
Parus ater	*1949*, 1951, *1953*, *1956*, 1957, *1958*, *1962*, 1965, *1972*
Aegithalos caudatus	*1949*, 1952, 1953, 1957, *1959*, 1962, 1964, *1965*, 1966, *1969*, *1970*, *1972*, *1973*
Loxia leucoptera[1]	*1956*, 1959, *1966*, 1971, 1972

[1] Besides these major invasion years, single birds or small groups have been recorded in many autumns at the bird stations.

more than one hundred birds frequented the bird stations, and the daily totals amounted to several hundreds or even thousands on peak days (e.g. 2 000—3 000 at Rönnskär on 3 October; 1 500 estimated and 330 ringed at Signilskär on September 30; 270 ringed at Lågskär on September 28). Ringing also produced uprecendented totals, e.g. 1 608 at Signilskär, 1 512 at Lågskär and 607 at Rönnskär.

The picture of the autumn movements of the Blue Tit is very similar to that of the Great Tit. Generally the fluctuations in the numbers of migrants have been parallel in both species: thus the strongest recent eruptions of Blue Tits have also occurred in 1959, 1972 and 1973. The only exception was 1965 when Blue Tits emigrated in large numbers but Great Tits were scarce visitors at bird stations. The annual fluctuations also tend to be more pronounced in the Blue Tit: in trough years departures from Finland across the sea are almost non-existent (e.g. one single bird observed at Signilskär in 1951, none in 1956; LINKOLA 1961), but in peak years a considerable proportion of the Finnish population participates in these long-distance movements. In the mass eruption of 1973, quite unprecedented numbers were reported at the Finnish bird stations: e.g. 1 250 estimated and 252 ringed at Signilskär on October 12, 755 and 600 migrants recorded at Lågskär on the peak days of October 7 and 16.

Other problems connected with irregular migration which can be studied successfully at bird stations include (1) the migratory periods of each species, (2) the age and sex ratios, and (3) the occurrence of return movements in spring. In the following paragraphs, some examples are given of the results so far obtained at the Finnish bird stations.

Table 4 shows the average date of onset, peak and termination of the autumn movements of some irregular migrants in Finland. In Fig. 5 the timing of the irruptions of Coal Tits in two autumns is shown in detail. In spite of the wide annual fluctuations in the numbers of stragglers, the migratory periods in different years vary no more than those of the true migrants. To give one example, in invasion autumns of Great Spotted Woodpeckers the first individuals appear at bird stations regularly in late July, and the peak follows just as regularly about one month later. However, mass irruptions tend to start earlier than minor invasions (cf. EDELSTAM 1972, p. 352). Thus the huge irruption of Siberian Nutcrackers in 1968 commenced as early as late July (HILDÉN 1969), although the first stragglers usually occur in mid- or late August. The Treecreeper provides another good example: in autumns of "normal" migration the first individuals are seen at bird stations in about mid-September, but in invasion years they often appear as early as mid- or late August. To some extent, however, the

TABLE 4. Average date of onset, peak and termination of autumn movements in some irregular migrants in Finland according to data collected at the bird stations.

Species	Onset	Peak	Termination
Dendrocopos major	July 20	Aug. 25	Oct. 25
Parus major	Sept. 25	Oct. 10	Nov. 5
P. caeruleus	Sept. 25	Oct. 10	Nov. 5
P. ater	Aug. 30	Sept. 20	Oct. 25
Aegithalos caudatus	Oct. 5	Oct. 20	Nov. 10
Certhia familiaris[1]	Sept. 15	Oct. 10	Nov. 1
Pyrrhula pyrrhula[2]	Oct. 1	Oct. 25	Nov. 30

[1] In years of large-scale eruptions the migration may commence as early as August 15—20, with the peak in the last days of September.

[2] Slight movements occur in certain years as late as December.

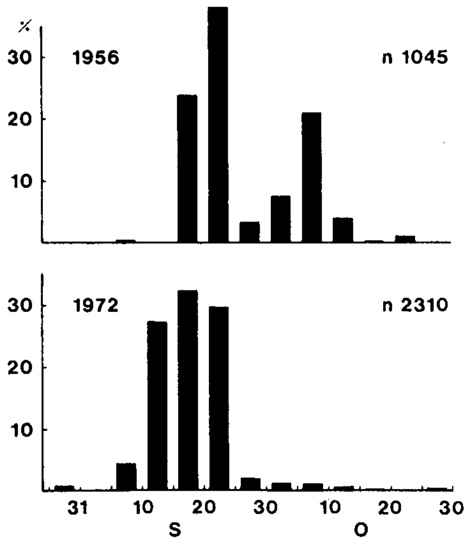

FIG. 5. Timing of the irruption of Coal Tits *Parus ater* at Signilskär in 1956 and at Signilskär and Lågskär (combined data) in 1972, according to the distribution of numbers ringed in periods of five days.

earliness of the first birds in large-scale irruptions is only apparent and due to the simple statistical fact that the distribution in time of a large number of individuals covers a longer period than that of a small number of individuals, even though the peak date of migration remains the same. Indeed, when comparison is made of the peaks, the time difference between major and minor invasions is usually small.

The regularity in the timing of irruptions, discussed above, does not hold for all species, however. The autumn movements of the Siskin, Redpoll, Pine Grosbeak and Waxwing are regulated mainly by the prevailing food-supply, i.e. the seed or berry crop of particular trees. In years of poor crops, migration tends to occur early; when food is plentiful the flocks delay their departure for weeks. The Waxwing provides the most striking example: when the berry crop of the rowan is poor, the main flocks pass through southern Finland rapidly during October, in autumns of a rich berry crop they do not arrive until late December or January. However, a small part of the population seems to time its migration almost independently of the food situation, so that the first migrants are seen at about the same date each autumn. The first small flocks of Waxwings use to appear in southern Finland during the first days of October, with an annual variation hardly exceeding two weeks. The Pine Grosbeak is still more precise in its arrival: in autumns when irruptions reach southern Finland, the first flocks are always seen in late October. The Redpoll, however, is fairly irregular in its date of arrival, which may vary in southern Finland more than one month from one year to the next.

It is known that in many irruptive species young birds predominate in invading flocks, and among adults females outnumber males (e.g. LACK 1954). However, reliable statistics have been rather scarce, partly because of difficulties in ageing and sexing many species. In Tables 5 and 6, some data collected at the Finnish bird stations are presented. All species show an extremely high proportion of juveniles, much higher than the true age ratio should be in autumn populations, thus confirming

TABLE 5. Age ratio in five irregular migrants according to data from birds ringed at some Finnish bird stations.

Species	No. ringed	Per cent juveniles
Dendrocopos major	2167	92.6
Parus major	1572	96.9
P. caeruleus [1]	280	93.6
Pyrrhula pyrrhula	760	80.1
Loxia curvirostra [2]	235	80.0

[1] Only birds ringed at Lågskär in 1973 are included.
[2] Only birds ringed at Signilskär in 1956 are included (see HILDÉN 1960).

TABLE 6. Sex ratio in four irregular migrants according to data from birds ringed at some Finnish bird stations.

Species	No. ringed	Per cent females
Dendrocopos major[1]	159	56.0
Parus major	1903	65.7
Pyrrhula pyrrhula	1696	59.2
Loxia curvirostra[2]	160	57.5

[1] Only adult birds have been sexed.
[2] According to HILDÉN (1960).

that a higher proportion of the young than the adults emigrate. Also in all species, females clearly outnumber males.

Mortality is generally considered to be very high among emigrating birds. Indeed, mass eruptions have sometimes been explained as a mechanism for removing a "doomed surplus", which moves out and wanders till death. But this view has been proved false, as return movements have been both recorded in the field and documented by ringing recoveries. However, present information on the regularity and strength of these return movements in different irruptive species is sparse. In the following sections, some data from the Finnish bird stations are reported.

Table 7 summarizes the occurrence of five irregular migrants at Lågskär during three autumns and subsequent springs. In all these species, regular movements were recorded in the spring, although they were weak compared with the irruptions in the preceding autumn. The strongest return movements occurred in the Great Tit and Bullfinch; using the numbers ringed, the strength of their spring migration amounted to 25—65 % of that of their preceding autumn invasion. The Blue Tit (not included in the table) is comparable to the Great Tit: during the springs of 1972 and 1973 the ringing totals were 36 and 32 %, respectively, of the corresponding autumn totals.

The return movements of Great Spotted Woodpeckers, too, seem to be regular, although not more than a few dozens are recorded at a single station in the course of the spring (cf. HILDÉN 1968, 1969, 1971). In the Coal Tit, spring migration across the sea is very weak compared with the large autumn invasions. However, regular migration was recorded in the spring of 1973, although the ringing total did not amount to more than 2.7 % of that of the preceding autumn's mass irruption. LINKOLA (1961) also reported slight return movements of Coal Tits in the spring of 1954, following the large invasion in 1953. Among the species treated here, the Treecreeper shows the weakest tendency to spring movements. Even in springs following large-scale eruptions, only a few birds are seen at bird stations; at Lågskär, for instance, ringing in spring 1971 and 1972 yielded only 4—5 % of the preceding autumn totals.

A direct comparison of the occurrence in the autumn and the following spring is not, however, a reliable method to measure the strength of the return movements. First, it is not certain that irregular migrants return along the same routes which they used in the autumn. On the contrary, ringing recoveries have revealed a loop migration in at least some species; in the Great Spotted Woodpecker and the Nutcracker, for example, some of the stragglers return to their native regions further east within the course of the same autumn (HILDÉN 1969). This must be the explanation for the absence of spring movements of Nutcrackers at the Finnish bird stations in spite of numerous ringing recoveries further east. Second, all individuals surviving after emigration may not try to return to their place of origin, but remain to nest in the areas invaded, or return only in a later year. Several ringing recoveries of many species have proved that this may

TABLE 7. Summaries of the occurrence of five irregular migrants at Lågskär during three autumns and subsequent springs of complete observation.

Autumn	Spring
Dendrocopos major	
1968: Mass eruption; several dozens recorded on peak days, ringing total 250.	*1969:* Between April 17 and June 2 about 50 recorded, 19 of these ringed.
1971: Minor emigration; daily maximum 5 birds, ringing total 32.	*1972:* Between April 16 and May 5 about 20 recorded, ringing total 8.
1972: Mass eruption; in total about 1 050 recorded and 401 ringed.	*1973:* Between April 22 and June 3 about 60 recorded, 15 of these ringed.
Parus major	
1968: Moderate emigration; 40 birds observed on peak day, ringing total 37.	*1969:* Between March 24 and May 16 about 40 recorded (6 on the peak day), ringing total 12.
1971: Heavy emigration; about 500 birds observed on peak day, ringing total 357.	*1972:* Between March 17 and May 11 almost daily several birds, 40 on peak day; ringing total 87.
1972: Heavy emigration; 15—150 birds recorded each day during whole October, ringing total 174.	*1973:* Between March 22 and May 4 almost daily several birds, 70 on peak day; ringing total 70.
Parus ater	
1968: No observations.	*1969:* No observations.
1971: Very weak movements; in total about 50 birds recorded.	*1972:* One single bird on April 12 and 21—26.
1972: Mass eruption; more than 4 000 recorded in total (at least 1 000 on peak day), ringing total 821.	*1973:* Between April 5 and May 23 about 150 migrants recorded (70 on peak day, April 23); ringing total 22.
Certhia familiaris	
1968: No observations.	*1969:* One individual on April 4.
1971: Moderate emigration; in total 90 recorded, 58 of these ringed.	*1972:* Between March 22 and April 5 4 recorded, 3 of these ringed.
1972: Heavy emigration; in total approx. 350 recorded, ringing total 217.	*1973:* Between March 22 and April 23 24 recorded, 9 of these ringed.
Pyrrhula pyrrhula	
1968: Moderate emigration; in total about 500 recorded, ringing total 118.	*1969:* Between April 6 and May 8 about 300 recorded, ringing total 77.
1971: Moderate emigration; in total about 800 recorded, ringing total 185.	*1972:* Between March 27 and May 10 about 250 recorded, ringing total 58.
1972: Heavy emigration; about 2 100 recorded in total, 200—300 on peak days; ringing total 531.	*1973:* Between March 25 and May 10 about 650 recorded, ringing total 159 (6—10 birds stayed throughout whole May).

happen, but to what extent remains an open question (for the Common Crossbill *Loxia curvirostra,* see NEWTON 1972, pp. 235—236). Third, the location of many Finnish bird stations with respect to leading lines is not as favourable in the spring as in the autumn, so that smaller concentrations are to be expected in spring. All these factors tend to decrease the numbers of irregular migrants recorded at bird stations in the spring.

Two general conclusions from the return movements of irregular migrants deserve emphasis. First, the strength of the spring migration seems to be clearly correlated with that of the preceding irruption, as shown by the data in

Table 7; hitherto, LINKOLA (1961) gave evidence of this in the Great Tit and HILDÉN (1971) in the Great Spotted Woodpecker. Second, the timings of the spring movements are as regular as those of the autumn migration. Thus the passages of Bullfinches, Great Tits and Blue Tits start in late March and that of Great Spotted Woodpeckers regularly in mid-April. The peak dates are also fairly constant, but the termination of spring movements tends to be more indefinite, as some birds often fail to complete their return movements and stay for long periods in the outer archipelago. This is especially common in the Bullfinch.

Ringing

Ringing is at present the main activity of all the Finnish bird stations. The great majority of all birds ringed are trapped with Japanese and English mist-nets. Permanent large Heligoland traps are successfully used only at Signilskär (four) and Lågskär (one). Valassaaret, Säppi and Rönnskär also have one such trap each, but these are badly constructed or in a poor condition, and make only small contributions to the stations' ringing totals. In addition, small wader traps are used, especially at Hailuoto, Tauvo and Jurmo, where extensive muddy shores afford suitable resting places for waders. At Lågskär, good results have been obtained in catching seed-eating birds (*Fringilla coelebs, F. montifringilla, Carduelis chloris, Plectrophenax nivalis*, etc.) by means of simple fall traps. However, they are efficient only in spring, when the birds are often starving on arrival and easily attracted by food. Some stations also have special traps with a decoy dove for catching hawks (mainly Goshawks *Accipiter gentilis*).

In recent years between 30,000 and 60,000 birds have been ringed annually at the Finnish bird stations. This amounts on average to about 20 % of the years' ringing totals in the whole of Finland. Table 8 shows the annual totals of birds ringed by each station during the period 1967—72. In Table 9, the 15 most numerous species on the ringing list are shown. The great differences between the numbers ringed at each station are due partly to actual differences in occurrence of the species in question, and partly to the number and nature of the traps used, the effectiveness of the ringers and the periods of trapping — factors in which great

TABLE 8. Annual totals of birds ringed at the Finnish bird stations in 1967—72 and their percentages of annual totals ringed in the whole of Finland.

	1967	1968	1969	1970	1971	1972	Total
Hailuoto	1857	3876	2955	1840	987	1358	12873
Tauvo	6669	7874	11084	15606	5179	2737	49149
Tankar	—	—	—	—	—	1143	1143
Valassaaret	1824	1526	984	1263	199	555	6351
Säppi	4187	1551	600	4238	3019	8332	21927
Isokari	1245	2909	2450	3438	2135	—	12177
Signilskär	2393	5049	1214	7076	3214	7901	26847
Lågskär	4452	9975	10837	6654	9718	17263	58899
Jurmo	3509	1674	3387	9633	7939	7566	33708
Rönnskär	1374	1033	1232	1008	2110	10313	17070
Total	27510	35467	34743	50756	34500	57168	240144
Percentages	20.8	21.8	18.2	22.0	19.6	27.2	21.8

differences exist between the stations.

Ringing at bird stations is an important supplement to ringing of nestlings, as trapping often produces good results for species of which very few young are ringed. (Such species often conceal their nests extremely well, breed in remote regions not frequented by ornithologists or occur in great numbers only during irruptions.) The tabulation below lists some typical representatives of such "bird station species", judged on the basis of ringing, and gives the total numbers of recoveries of birds ringed in Finland up to and including 1972 alongside the contribution of bird stations to these recoveries. It clearly demonstrates that most information so far obtained about the direction and extent of the migration of these species is based on recoveries produced by ringing at bird stations.

	No. of recoveries abroad	Per cent ringed at bird stations
Accipiter nisus	414	70
Dendrocopos major	29	66
Nucifraga caryocatactes	22	95
Parus ater	10	100
Regulus regulus	12	100
Erithacus rubecula	346	58

Fig. 6 depicts the 108 winter recoveries of Sparrow Hawks *Accipiter nisus* ringed at Signilskär and Lågskär. These show the SW standard direction of the species and the location of its principal winter range in Central Europe. In Fig. 7 are shown some recoveries of irregular migrants ringed at the Finnish bird stations. Bullfinches have dispersed in many directions. Some have been found in the Scandinavian countries, W to SW of the ringing place, others in the opposite direction, in the Soviet Union; the remotest recoveries come from southern Germany and Hungary. Coal Tits have migrated in a SW standard direction, to Sweden, Norway, Denmark, Germany and France. The three recoveries of Common Crossbills are from Sweden, western France and northern Italy, all SW of the ringing place.

Information about the speed of migration is given by recoveries of birds ringed and found when on passage. In Table 10 some data from birds ringed at the Finnish bird stations are presented. The average speed of small passerines is usually 50—80, that of the Sparrow Hawk only about 40 km

TABLE 9. Numbers of the 15 most numerous species ringed at the Finnish bird stations during the period 1967—72.

Species	Ha	Ta	Va	Sä[1]	Is	Si	Lå	Ju	Rö	Total
Erithacus rubecula	105	602	45	2989	1861	3467	9172	5755	2614	26610
Phylloscopus trochilus	3830	12091	481	564	947	1415	2696	3088	1313	26425
Acanthis flammea	358	13621	319	3890	70	3171	3003	204	1217	25853
Regulus regulus	5	28	10	3946	2137	1625	4509	3014	880	16154
Fringilla coelebs	845	840	91	633	387	1375	6250	1067	1269	12757
Phoenicurus phoenicurus	262	1662	234	1036	758	1491	2256	3736	762	12197
Turdus philomelos	81	1081	50	673	392	1263	2256	1757	569	8122
Turdus iliacus	596	1728	124	1127	497	1144	1697	359	558	7830
Muscicapa striata	834	585	113	331	286	1027	1349	1642	568	6735
Sylvia borin	40	644	96	246	274	522	1436	2817	616	6691
Fringilla montifringilla	1505	1456	221	296	73	486	2242	136	125	6540
Carduelis spinus	157	711	22	657	707	988	1021	252	486	5001
Ficedula hypoleuca	95	465	36	210	340	770	1145	1305	296	4662
Pyrrhula pyrrhula	35	22	22	595	79	818	1257	361	635	3824
Parus major	44	299	95	1097	277	268	880	357	341	3658

[1] Results for 1969 are excluded due to the loss of ringing data.

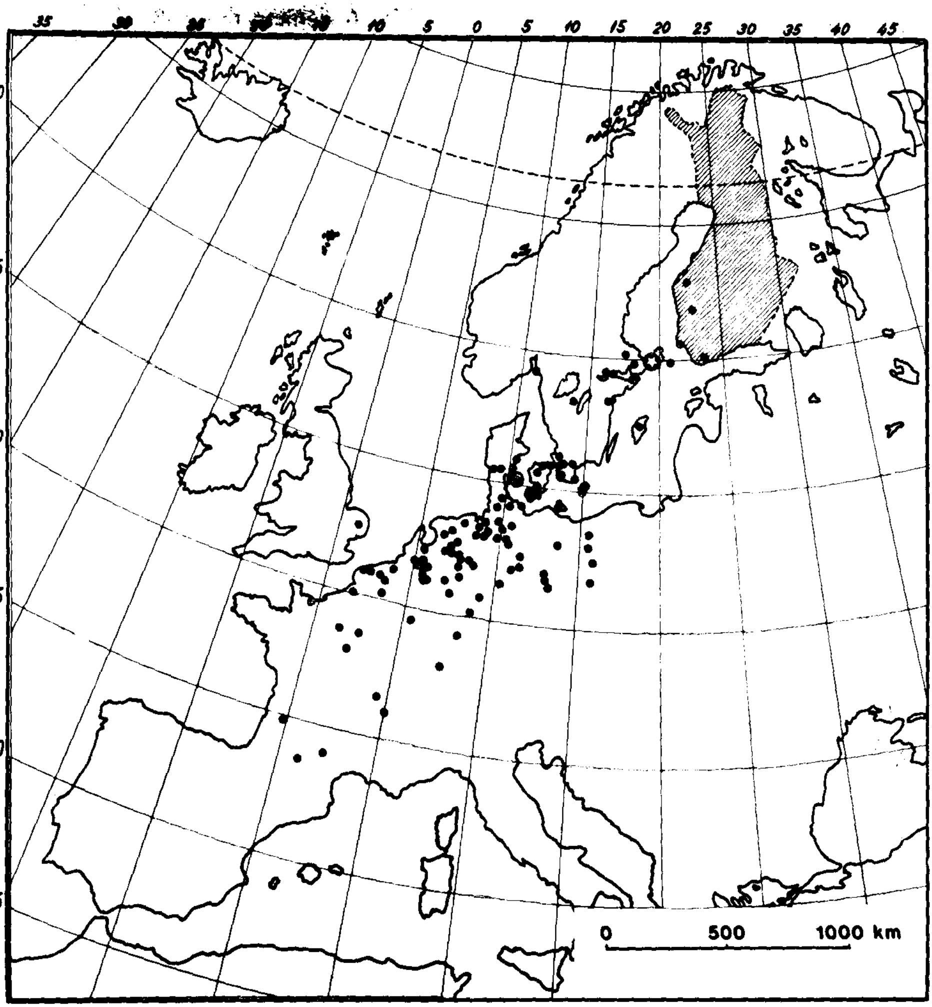

FIG. 6. Winter recoveries (from 1 December to 28 February) of Sparrow Hawks *Accipiter nisus* ringed as passage migrants at Signilskär and Lågskär. The star refers to place of ringing.

a day. These results are, however, far below the maximum flight performance of migrants during short spells of favourable weather. An extreme example is provided by a Song Thrush, ringed at Heligoland on 5 April 1961 at 12.45 hrs and retrapped at Lågskär on the following day at 13.45 hrs. This bird had covered a distance of 960 km in 25 hours, an average of 38 km/hr; but even this is below normal flight speed — perhaps 50 km/hr for a thrush.

Special investigations connected with ringing

Some special investigations allied to ringing have become a regular practice

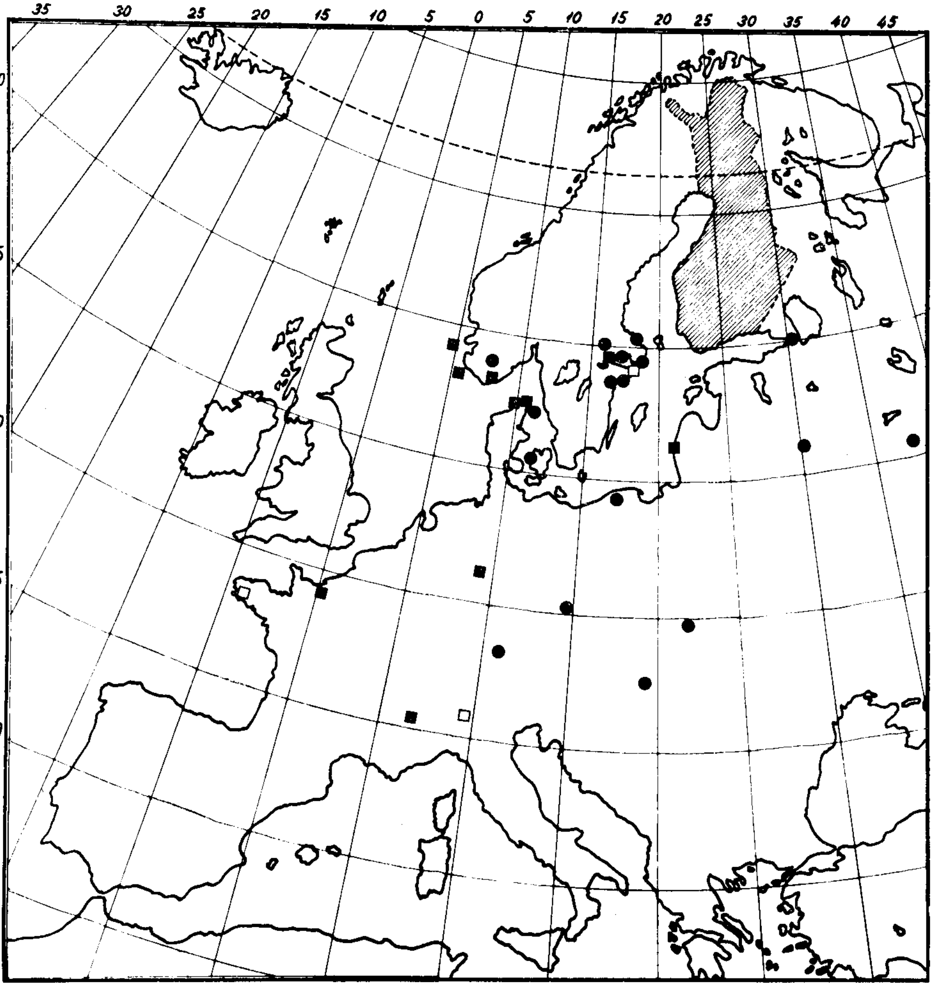

FIG. 7. Recoveries of three irregular migrants, the Bullfinch *Pyrrhula pyrrhula* (●), Coal Tit *Parus ater* (■) and Common Crossbill *Loxia curvirostra* (□), ringed as passage migrants at Finnish bird stations (mainly at Signilskär and Lågskär).

in recent years at many Finnish bird stations. These include (1) ageing and sexing birds, (2) weighing and measuring birds, (3) recording of state of moult, and (4) collecting of ectoparasites.

It is now possible to identify the s e x e s a n d a g e s of most species ringed with the aid of new identification guides, especially the excellent *Identification Guide to European Passerines* by SVENSSON (1970). Sex and age ratios calculated from these records provide suitable material for investigations of various kinds. For instance, the timing of migration can be studied separately for males and females as well as for adults and juveniles, using the daily numbers of birds ringed; an example

TABLE 10. Speed of autumn migration (km a day) of some species, as indicated by recoveries of birds ringed at the Finnish stations and probably still on passage when found. Figures in brackets after records of maximum speed give time interval (in days) between ringing and recovery.

Species	No. of recoveries	Average speed	Maximum speed	
Accipiter nisus	34	37	223 (6)	94 (7)
Turdus philomelos	31	64	108(32)	91(23)
Phoenicurus phoenicurus	24	70	105(30)	102(17)
Erithacus rubecula	32	64	146(17)	112(20)
Sylvia borin	11	88	203 (9)	139(12)
Phylloscopus trochilus	6	84	136(56)	99(33)
Muscicapa striata	10	71	120(14)	96(23)
Bombycilla garrulus	18	41	240 (2)	173 (3)
Carduelis spinus	11	50	92(19)	68(13)
Acanthis flammea	10	44	86 (7)	72(27)
Fringilla coelebs	8	50	197 (7)	74(18)

Note: Only those recoveries are considered made at most 50 days after the ringing and before September 30 (*Muscicapa striata*), October 20 (*Sylvia borin, Phylloscopus trochilus*), October 31 (*Phoenicurus phoenicurus*), November 15 (*Accipiter nisus, Turdus philomelos, Erithacus rubecula, Carduelis spinus, Fringilla coelebs*) or November 20 (*Bombycilla garrulus, Acanthis flammea*). For *Phylloscopus trochilus* a long-distance recovery from Congo, 56 days after ringing, has been included.

concerning the Chaffinch and Brambling was presented on p. 16. Another point of interest is the participation of males and females, as well as adult and young birds, in irruptions, as discussed on p. 22. Two additional problems deserve mention. First, the average breeding success of the preceding summer may be reflected in the age ratio noticed in the autumn: the higher the proportion of juveniles, the better the breeding success. Hence, the annual differences in the age ratio can be used as a rough measure of the fluctuations in breeding success, at least of those species in which adults and juveniles migrate at the same time. Second, the winter mortality of juveniles in relation to that of adults (an important measure in the study of population dynamics) can be studied by comparing the age ratio among the autumn and spring migrants. However, reliable data from the Finnish bird stations are too scanty at present and cover too few years to permit any detailed analysis of these questions.

Several thousand birds have been w e i g h e d at our bird stations in recent years with the aid of Pesola spring balances. The principal aim of this work has been to obtain basic information about the weights of Finnish birds; these data have been used in the new handbook (v. HAARTMAN et al. 1963—72). But weights of birds can be used for many special investigations as well, some of which are now discussed.

(1) *Spring and autumn weights.* One might expect a lower mean weight in spring when birds are arriving after long migratory journeys than in autumn, just after departure, with fat deposits almost unused. This is confirmed for most species by weighings carried out at the Finnish bird stations, even though the differences are unexpectedly small, but some species are exceptions to the rule being heavier in spring than in autumn (Table 11). However, it should be noted that some species are known to depart from there breeding areas in autumn with very small fat reserves, and to increase these reserves during stops on migration.

(2) *Weights of emigrating vz. resident individuals.* If erupting species, like true migrants, lay down body fat before departing, one would expect a higher mean weight among

TABLE 11. Spring and autumn weights (g) of some passage migrants at the Finnish bird stations (Tankar, Valassaaret, Isokari, Signilskär, Lågskär).

Species	Spring			Autumn		
	Extreme values	Mean weight ± S.D.	n	Extreme values	Mean weight ± S.D.	n
Turdus philomelos	52.5— 78.5	66.5±5.9	114	55.5— 79.0	69.8±5.7	45
T. iliacus	49.0— 70.0	58.0±4.9	71	51.0— 76.0	62.2±5.0	182
T. merula	81.0—116.0	97.5±6.6	80	93.0—128.0	105.1±6.9	30
Phoenicurus phoenicurus	12.0— 18.5	15.1±1.3	239	12.0— 17.5	14.8±1.0	243
Erithacus rubecula	12.5— 19.0	16.3±1.3	84	13.5— 20.5	16.4±1.3	93
Sylvia communis	12.2— 18.0	14.6±1.5	23	14.5— 18.5	15.8±0.9	39
S. curruca	9.5— 14.2	11.6±1.1	75	10.3— 16.0	12.6±1.8	55
Muscicapa striata	13.0— 18.5	15.6±1.1	64	13.5— 19.0	15.8±1.0	217
Ficedula hypoleuca	10.4— 15.6	12.5±1.1	102	10.5— 16.4	12.8±1.2	87
Prunella modularis	15.0— 24.0	18.5±2.4	33	15.5— 23.5	19.0±1.9	47
Anthus trivialis	19.0— 25.0	21.9±1.5	28	18.8— 26.7	23.1±1.9	28
Fringilla coelebs (♂♂)	17.3— 27.3	22.8±1.8	150	19.5— 30.0	23.6±2.4	30
F. montifringilla (♂♂)	19.2— 26.7	22.6±1.7	50	19.6— 28.2	23.6±1.6	75

birds caught on passage than among resident individuals. This was, in fact, confirmed by NEWTON (1972, p. 237) in the case of the Common Crossbill *Loxia curvirostra*. But this seems not to be a general rule. Thus emigrating Great Tits weighed in autumn (late September and October) at Signilskär and Lågskär showed significantly lower weights than resident birds weighed in Kirkkonummi, southern Finland, during the same period of the year:

	Extreme values	$\bar{x}$ ± S.D.	n
Migrant ♂♂	15.2—20.1 g	18.1 g±1.04	64
Migrant ♀♀	15.2—20.1 g	17.0 g±1.01	97
Resident ♂♂	17.1—23.1 g	20.0 g±0.96	277
Resident ♀♀	16.2—21.4 g	18.7 g±1.02	216

Similarly, Bullfinches weighed on migration at bird stations were much lighter than resident winter birds trapped in Kirkkonummi during February—April:

	Extreme values	$\bar{x}$ ± S.D.	n
Migrants	24.0—34.0 g	29.2 g ± 2.11	113
Residents	27.5—38.0 g	33.8 g ± 2.24	62

These two examples suggest that, at least in some eruptive species, migrants may deposit less fat than residents, which have to survive long cold winter nights and temporary food shortages.

(3) *Weight variations during the day.* RINNE (1967) has shown that the mean weight of Starlings, caught during a temporary rest on migration at Lågskär between March 30 and April 3 1967, was about 6 g higher in the evening than in the morning, evidently due to the deposition of fat and other reserves during the day and their use overnight. Similar investigations were easy to perform in many other species, too.

(4) *Variations in weight during the course of the migration* may be detected if data are sufficient and cover the whole migratory period. Reasons for these temporal differences may vary: populations from different breeding grounds (autumn) or from different wintering areas (spring) may pass the bird stations at different times, or the condition of birds may vary depending on the food situation, weather conditions, etc. For the same reasons, annual differences in mean weight may be detected.

(5) *Control weighings of the same birds.* At many bird stations, some specimens are recaptured the following day or some days later. If repeated weighings of the same individuals are sufficiently numerous for statistical treatment, they give an opportunity to find out how quickly the weights of different species may vary in parallel with environmental conditions; if food is plentiful and the weather fine, a resting bird is able to gain in weight quickly, whereas in unfavourable conditions the weight may fall to a critical level in a couple of days. Two extreme cases may serve as examples. Three Cuckoos were caught at Lågskär in late July 1971; when recaptured 15—17 days later their weights had risen by 52—62 % (Table 12; H. Tammelin *in litt.*). At that time, the island held many large caterpillars, so that the Cuckoos' rapid gain in weight was made possible. A contrasting

TABLE 12. Gain in weight of three migrant Cuckoos *Cuculus canorus* at Lågskär in 1971.

	Weight when ringed	Weight when recaptured	Gain in weight
Adult ♂	99 g on July 21	160 g on August 6	61 g/16 days = 62 %
Juvenile	87 g on July 24	135 g on August 8	48 g/15 days = 55 %
Adult ♀	98 g on July 26[1]	149 g on August 12	51 g/17 days = 52 %

[1] When retrapped on July 27 the bird weighed only 86 g; compared with this figure the gain in weight was 63 g/16 days = 73 %.

example is provided by the Siberian Nutcracker. During the final stage of the mass irruption in 1968, several birds remained at Lågskär living on diverse and unusual food; they rapidly lost about 30 % of their initial weight and finally starved to death (S. Vuolanto *pers. comm.*).

However, certain limitations in interpreting weights must be borne in mind. First, total weight alone is not a reliable measure of a bird's condition because of individual variations in size. A more important factor is the weight of body fat; therefore, the level of visible fat or the condition of the pectoral muscles should be estimated simultaneously with weighing. Second, weights recorded during migration may vary considerably depending where the birds stop to "refuel" and how much fat they deposit at each stop; either of these may confuse the picture. Third, there are often several potential reasons for differences detected in mean weights between certain samples, and these reasons cannot usually be separated from each other; this renders unambiguous conclusions difficult.

M e a s u r e m e n t s, especially the length of the wing and the bill, are more valuable as taxonomic criteria than weights because they do not change so much in an individual. However, it should be noted that juvenile birds have shorter wings than adults, and that wing-length decreases slightly between one moult and the next because the tips of the feathers become worn. Careful measurements of large numbers of birds may reveal that among some species passing a bird station are different geographical populations, the breeding areas of which can be deduced on the basis of taxonomic characters. A good example is provided by the Dunlin *Calidris alpina* (MARTIN-LÖF 1958, SOIKKELI 1966). Especially for irruptive species, measurements and other taxonomic criteria may give valuable hints about the origins of the invading birds.

Measurements have been collected only irregularly at the Finnish bird stations, except at the new station of Tankar where certain standard measurements are taken from all birds ringed.

Generally, those birds which m o u l t in the breeding areas end their moult before starting migration. However, recent records have shown that many passerine species are still in body moult when caught on passage at our bird stations, and some species (e.g. the Waxwing, Great Spotted Woodpecker) may even moult their wing and tail feathers during migration (HAUKIOJA 1971 a, b and *in litt.*, Hyytiä *in litt.*). Large-scale ringing at bird stations offers an excellent possibility to study in which species and to what extent the moult and migration may overlap. Frequent recaptures of the same specimens also make it possible to follow the progress of the moult.

HAUKIOJA (1971 a, b) has started a moult card programme in Finland, which to some extent has encouraged collection of moult data at the bird stations. HYYTIÄ & VIKBERG (1973) have studied the moult of the Pied Flycatcher *Ficedula hypoleuca* and Spotted Flycatcher *Muscicapa striata* at Signilskär in the early stages of migration. Further investigations at bird stations are clearly desirable. These may reveal differences in moult patterns or timing between different populations of a single species. Eventually comparisons on a European scale will be possible.

Bird stations also provide an excellent opportunity to study the occurrence of ectoparasites of birds. Thousands of birds are caught at the stations each year, among them rare species whose ectoparasites are practically unknown. Unfortunately, this potentially valuable material has been used only to a very limited extent. Investigations so far carried out at the Finnish bird stations concern principally ticks (Ixodidae), mainly because many of them are known vectors of diseases of man or domestic animals. More than 4 500 spring migrants of 81 species have been examined systematically, chiefly at the bird stations of Signilskär, Lågskär and Valassaaret (NUORTEVA & HOOGSTRAAL 1963, SAIKKU et al. 1971). Supplementary collection in the autumn is to be recommended.

The genus *Ornithomya* (Diptera: Hippoboscidae) has been relatively little studied in Finland, although these flatflies are easily noticed because of their large size and are thus easy to collect in connection with bird ringing. The papers so far published (HILL et al. 1964, SORJONEN 1971) are not based on material from bird stations.

The bird lice (Mallophaga) are the most thoroughly studied group of ectoparasites in Finland (see the bibliography in EICHLER & HACKMAN 1973). Nevertheless, as each bird species tends to be parasitized by a different species of louse, a systematic study would without doubt increase our present knowledge considerably. (Specimens collected by M. Haukioja in connection with bird ringing near Pori in 1962—63 included no less than 16 species new to Finland.)

Rarities

More rare birds are recorded each year at bird stations than anywhere else, partly because of their favourable location, partly due to more effective observation. For the observers themselves, these occasional visitors provide novelty and excitement, but the scientific value of rarities has often been depreciated. It has been claimed that long-distance vagrants have only curiosity value but no biological interest. But this opinion is totally unscientific: in fact, many questions of biological significance are connected with observations of rare birds.

First, it has been found that several species which were considered occasional vagrants before the start of bird station observations, are in fact regular visitors to Finland in small numbers each year. Among such species are the White-billed Diver *Gavia adamsii,* King Eider *Somateria spectabilis,* Stonechat *Saxicola torquata,* Pallas's Warbler *Phylloscopus proregulus,* Yellow-browed Warbler *Ph. inornatus* and Richard's Pipit *Anthus novaezeelandiae.* Hence the whole picture of their occurrence in Finland has changed through the intensification of observation in recent years.

Second, rare visitors may be good indicators of changes in numbers occurring in the central parts of the species' range. An increase in visits generally implies that the species is increasing and/or expanding its range, whereas a decline in observations indicates the contrary. Another possibility is that the species is slowly changing its migratory routes. At present, the Finnish bird stations have been in operation for too short a time to measure reliably the frequency of occurrence of all rare visitors, but after 10 or 20 years the situation will be changed. In Table 13, the occurrences of two rare visitors in Finland, the Turtle Dove *Streptopelia tur-*

TABLE 13. Occurrences of two rare visitors at Signilskär and Lågskär during the last 25 years.

	Streptopelia turtur			*Phoenicurus ochruros*		
	Birds observed	Observation days[1]	Birds/100 obs. days	Birds observed	Observation days[2]	Birds/100 obs. days
1949—53	0	359	0.0	0	435	0.0
1954—58	1	276	0.4	0	304	0.0
1959—63	4	362	1.1	8	446	1.8
1964—68	9	662	1.4	15	796	1.9
1969—73	35	1037	3.4	35	1250	2.8

[1] From May 1 to October 31
[2] From April 1 to October 31

tur and the Black Redstart *Phoenicurus ochruros,* during the last 25 years have been examined using their frequency at Signilskär and Lågskär. The results clearly prove that both species have become more frequent visitors to Finland and thus are probably expanding their breeding range, which accords with the general opinion among Finnish ornithologists. Two rare species, on the contrary, seem to be on the decrease: the Crested Lark *Galerida cristata* and the Rose-coloured Starling *Sturnus roseus.* The number of observations have hardly risen, in spite of the greatly intensified ornithological activity.

Third, the appearance of rarities is often connected with exceptional weather conditions, such as continuous strong winds or spells of unusually warm weather. Cases in which great numbers of birds are driven far from their normal course provide particularly good correlation with weather conditions; almost every year such cases are recorded at bird stations. An analysis of the weather conditions preceding the occurrence of vagrants often give valuable information on factors which may prolong migration or cause drift, as well as indicating their significance in spreading birds into new areas.

Selostus: **Suomen lintuasemat, niiden toiminta ja tavoitteet.**

1. Suomen rannikoilla toimii nykyisin 9 lintuasemaa (kuva 1). Lisäksi eräissä muissa paikoissa tarkkaillaan muuttoa ja rengastetaan lintuja melko säännöllisesti.

2. Päätoimintana lintuasemilla on (1) muutontarkkailu, (2) lepäilijöiden laskenta, (3) rengastus ja (4) eräät rengastukseen liittyvät sivututkimukset. Työn tieteellisiä tuloksia ovat tähän asti heikentäneet yhdenmukaisten toimintaohjeiden puuttuminen ja lähes olematon taloudellinen tuki.

3. Suomen lintuasemien tärkeimmät tulevaisuuden tavoitteet ovat: (1) riittävät määrärahat tehokkaan toiminnan järjestämiseksi, (2) selvästi rajattu tutkimussuunnitelma ja yhdenmukaiset toimintaohjeet, (3) vuosittain julkaistavat katsaukset kultakin asemalta ja (4) yhteistyö ulkomaisten, lähinnä Itämeren piirissä toimivien lintuasemien kanssa.

4. Muutontarkkailulla pyritään selvittämään (1) muuttokauden ajoittumista, (2) muuton päivärytmiikkaa, (3) sään vaikutusta muuttoon ja (4) muuttajien käyttäytymistä (muuttokorkeus, parvimuodostus, johtolinjojen vaikutus jne.). Lähes jatkuvaa päivystystä vaativien lintuverkkojen käyttöönoton jälkeen muutontarkkailun osuus lintuasemilla suoritettavasta työstä on olennaisesti pienentynyt. Tulevaisuudessa onkin syytä keskittää järjestelmällinen

muutontarkkailu vain tiettyihin lajeihin (esimerkkinä arktisten lajien muutto Rönnskärillä: kuva 2).

5. Havainnointi lintuasemilla on viime vuosina kartuttanut huomattavasti tietämystä eri lintulajien muuttofenologiasta, etenkin kevätmuuton päättymisestä ja syysmuuton alkamisesta. Vaikka muuttofenologian pääpiirteet nyt tunnetaankin hyvin, monet juuri lintuasemilla tutkittaviksi sopivat erikoiskysymykset kaipaavat lisävalaistusta. Kuvissa 3 ja 4 ja taulukossa 1 on esitetty eräitä esimerkkejä fenologisista tutkimuksista lintuasemilla.

6. Vuosittaisia kannanvaihteluita voidaan tutkia lintuasemilla vertailemalla (1) ylimuuttajien, (2) lepäilijöiden tai (3) rengastettujen lintujen kokonaismääriä. Taulukossa 2 on esitetty neljästä lajista syksyn kokonaismäärät Signilskärillä ja Lågskärillä 1950—73: kangaskiuru ja tunturikiuru ovat vähentyneet romahdusmaisesti, peukaloisen ja tiklin runsaus taas on vaihdellut jyrkästi. Mustarastaan vahva lisääntyminen maassamme ilmenee selvästi verrattaessa lajin vuosittaisia rengastusmääriä Signilskärillä ja Lågskärillä laulurastaan vastaaviin lukuihin (taul. s. 18).

7. Lintuasemien päätehtäviä on vaelluslintujen tutkiminen. Lähes kaikki viimeaikainen informaatio vaelluslintujen esiintymisestä Suomessa perustuu juuri lintuasemilla koottuihin havaintoihin. Selväpiirteisimpien, epäsäännöllisin välein massavaelluksia suorittavien invaasiolajien (esim. käpytikka, kuusitiainen, kirjosiipikäpylintu, pähkinähakki) lisäksi on monia vähemmän tyypillisiä vaelluslintuja, jotka edustavat välittävää tyyppiä joko paikkalintuihin (esim. puukiipijä, tali- ja sinitiainen) tai muuttolintuihin (esim. vihervarpunen, urpiainen, punatulkku, tilhi). Taulukossa 3 on lueteltu eräiden tyypillisten vaelluslintujen invaasiosyksyt Suomessa viimeisten 25 vuoden aikana. Puukiipijän, tali- ja sinitiaisen viimeaikaisia vaelluksia käsitellään tekstissä.

8. Taulukossa 4 on esitetty eräiden invaasiolajien vaellusten keskimääräinen alku, huippu ja päättyminen, kuvassa 5 kuusitiaisen vaellusten ajoittuminen 1956 ja 1972. Useimpien invaasiolintujen vaelluskausi on yhtä säännöllinen kuin muuttolintujen, joskin suurinvaasiot alkavat yleensä aikaisemmin kuin pienemmät vaellukset. Poikkeuksia ovat vihervarpunen, urpiainen, tilhi ja taviokuurna, joiden vaellusten kulku määräytyy paljolti ravintotilanteen mukaan.

9. Kaikkien tutkittujen vaelluslajien rengastetuista yksilöistä valtaosa oli nuoria (taul. 5). Samoin naaraita oli selvästi enemmän kuin koiraita (taul. 6).

10. Taulukossa 7 on esitetty tiivistelmä viiden invaasiolinnun kevätvaelluksista Lågskärillä. Kaikkien lajien selvää kevätvaellusta on todettu: talitiaisen ja punatulkun rengastusmäärät keväällä vastasivat 25—65 % edeltävien syksyjen luvuista, käpytikan, kuusitiaisen ja puukiipijän kevätvaellus oli paljon heikompaa syksyiseen verrattuna. Lintuasemilla keväisin todetut vaelluslintujen määrät eivät kuitenkaan vastaa elossa olevien syysvaeltajien määrää, koska osa jää uusille alueille tai palaa toista kautta. Kevätvaellusten voimakkuus on selvästi riippuvainen edellissyksyisen invaasion suuruudesta, ja niiden ajoittuminen on yhtä säännöllistä kuin syksyisin.

11. Viime vuosina on lintuasemillamme rengastettu 30.000—60.000 lintua/v., mikä vastaa n. 20% vuosittaisten rengastusten kokonaismäärästä Suomessa (taul. 8). Pääosa rengastuksesta tapahtuu lintuverkoilla. Taulukossa 9 on esitetty lintuasemien 15 eniten rengastettua lajia. Eräitten lajien muuttomatkoista nykytietämys perustuu pääosin lintuasemarengastuksen tuottamiin tuloksiin (taul. s. 25). Kuva 6 esittää Signilskärillä ja Lågskärillä rengastettujen varpushaukkojen talvilöytöjä, kuva 7 eräiden invaasiolintujen kaukolöytöjä. Taulukkoon 10 on koottu lintuasemilla rengastettujen lintujen muuttonopeutta valaisevia löytöjä.

12. Monilla Suomen lintuasemilla suoritetaan nykyisin rengastuksen yhteydessä erikoistutkimuksia: (1) ikä- ja sukupuoliaineistojen kokoamista, (2) punnituksia ja mittauksia, (3) sulkasatotutkimuksia ja (4) ulkoloisten keräilyä. Kustakin aiheesta esitetään eräitä tähänastisia tuloksia sekä tutkimusmahdollisuuksia.

13. Lintuasemilla tavattavilla harvinaisuuksilla ei ole merkitystä vain havainnoitsijoille itselleen, vaan myös tieteellistä mielenkiintoa. Monista aikaisemmin satunnaisina pidetyistä lajeista järjestelmällinen havainnointi lintuase-

milla on osoittanut, että ne ovatkin säännöllisiä, vähälukuisia vierailijoita maassamme (esim. kyhmyhaahka, hippiäisuunilintu, isokirvinen). Toiseksi harvinaisuuksien esiintymisfrekvenssin muuttuminen on yleensä merkkinä lajien leviämisestä tai taantumisesta (ks. taul. 13). Kolmanneksi harvinaisuuksien näyttäytymiseen liittyvien sääolojen tutkiminen antaa usein arvokkaita tietoja harhautumiseen johtavista säätekijöistä.

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