Autumn migration and moult of the Spotted Flycatcher *Muscicapa striata* and the Pied Flycatcher *Ficedula hypoleuca* at the Signilskär bird station

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The autumn migration of the Spotted and the Pied Flycatcher was studied in 1971 and 1972 at Signilskär in the western group of islands of the Åland archipelago. The moult of captured birds was investigated. Adult Spotted Flycatchers migrated before the juveniles. In the Pied Flycatcher similar difference was not found.

A survey of the autumn migration of the two species on the basis of Finnish ring recoveries is presented. The length of the time spent by Flycatchers at Signilskär was computed. Most of the Spotted Flycatchers resting at the island moulted their tertiaries. Also part of the Pied Flycatchers moulted wing feathers. Causes for the different timing of the migration of the two species are discussed.

Introduction

Among publications dealing with the autumn migration of Spotted and Pied Flycatchers the handbook edited by v. HAARTMAN et al. (1967—72) may be mentioned. Data on the age-ratio during autumn migration and on the speed of migration are, however, scant.

Of papers dealing with the moult of the Spotted Flycatcher mention may be made of WILLIAMSON (1960), DIESSELHORST (1961), STRESEMANN (1963), STRESEMANN & STRESEMANN (1966), SVENSSON (1970) and WILLIAMSON (1972). Information on the moult of the Pied Flycatcher is given by STRESEMANN (1963), STRESEMANN & STRESEMANN (1966) and SVENSSON (1970).

Methods

Signilskär lies west of the Åland archipelago (60.12 N, 19.20 E). Judging from the number of individuals ringed during migration both the Spotted Flycatcher and the Pied Flycatcher pass the place in large numbers.

In 1971 observations were made August 4—September 17 and in 1972 August 5—September 2 and September 16—November 6 Trapping was carried out with nets and Heligoland traps. The number of nets was kept constant in 1971 and nearly so in 1972. The purpose was to obtain comparable data throughout the observation period. Most nets were set at the edges of woods. This favoured the capture of Spotted Flycatchers. Nets were kept through day and night except on some stormy days.

The age of a bird was determined with the aid of SVENSSON's (1970) guide. By juvenile birds (=1—y) we understand birds born in the breeding season of the calendar year, adult birds (over 1—y) were born in an earlier calendar year. Every adult bird was investigated to determine whether it moulted its wing and/or tail feathers. Moult data were inserted on moult cards (SNOW 1967, HAUKIOJA 1971 a).

Autumn migration of the Spotted and the Pied Flycatcher

Both species migrate at night, resting during daylight or, as indicated by field observations, perhaps moving a short distance to a near-by isle. Table 1 sum-

marizes the numbers of Spotted and Pied Flycatchers caught during different times of the day. The Spotted Flycatchers were caught evenly during daylight but the majority of the Pied Flycatchers during the forenoon.

Spotted Flycatcher

The autumn migration of the Spotted Flycatcher begins at Signilskär according to four years of observation on August 2—7, reaching a peak at the turn of August—September. The last ones were found between September 12 and October 3 (11 years of observation). A single individual was noticed on October 12 and a dead one on November 5 (VON HAARTMAN et al. 1967—72).

Figure 1 presents the numbers of ringed Spotted Flycatchers in periods of four days. In the autumn of 1971 the total number was 403, in 1972 162. In 1971 144 individuals were adults (36 %) and in 1972 69 (43 %). Figure 1 shows that adult individuals are caught mainly at the beginning of the migratory period and disappear almost totally after the beginning of September. Young Spotted Flycatchers are rare until about August 20, after which a clear change in their favour takes place. The age ratio of Spotted Flycatchers is perhaps biassed in favour of old birds as in 1971 observations ceased before migration was over, and in 1972 there was a pause of 5 days in observations made at the beginning of September.

The numbers ringed show that peak migration of adult Spotted Flycatchers occurred in 1971 on August 9 and in 1972 on August 12. The peak for juvenile birds was reached in 1971 on August 30 and, in 1972, on August 29. The total number of ringed Spotted Flycatchers irrespective of age, culminated in 1971 on August 30 and in 1972 on August 22.

Adult birds migrating earlier than juveniles in autumn is a characteristic feature of an American Flycatcher, *Empidonax minimus* (HUSSELL et al. 1967).

Pied Flycatcher

The autumn migration of the Pied Flycatcher begins in the southwestern archipelago of Finland on August 3—17 and reaches its peak in the latter part of the month. The autumn migration is over between September 15 and October 4 (Lågskär, 9 years, v. HAARTMAN et al. 1967—72). The observation period at Signilskär in 1971 was shorter than the autumn migratory period of the Pied Flycatchers. There was a pause in observations in 1972.

TABLE 1. Numbers of Spotted and Pied Flycatchers caught during morning, forenoon, noon, afternoon and evening.

	Time (hr)				
	to 6	6—10	10—14	14—18	from 18
Spotted Fl.					
1971	4	85	90	98	64
1972	3	48	46	37	37
total	7	133	136	135	101
Pied Fl.					
1971	2	47	46	31	23
1972	0	54	56	41	30
total	2	101	102	72	53

Note: Netting efficiency was small before 6 a.m.

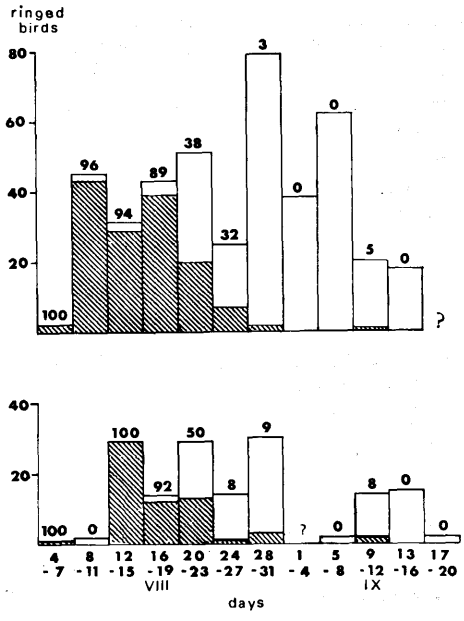


FIG. 1. Number of ringed Spotted Flycatchers divided into periods of four days in 1971 (upper) and 1972 (lower). Shaded blocks = adult individuals, unshaded blocks = juvenile individuals. The figures indicate the percentage of adults in the samples.

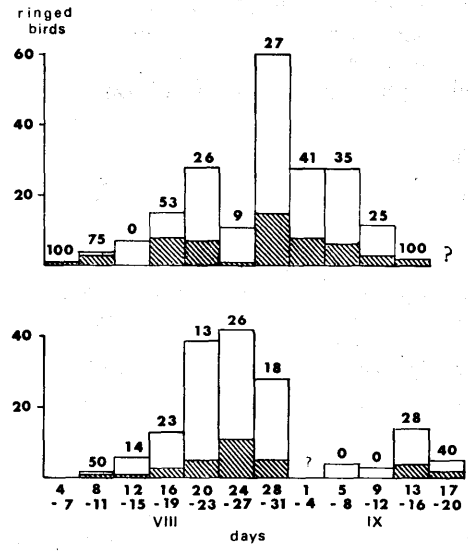


FIG. 2. Number of ringed Pied Flycatchers in periods of four days in 1971 (upper) and 1972 (lower). See fig. 1. for further explanations.

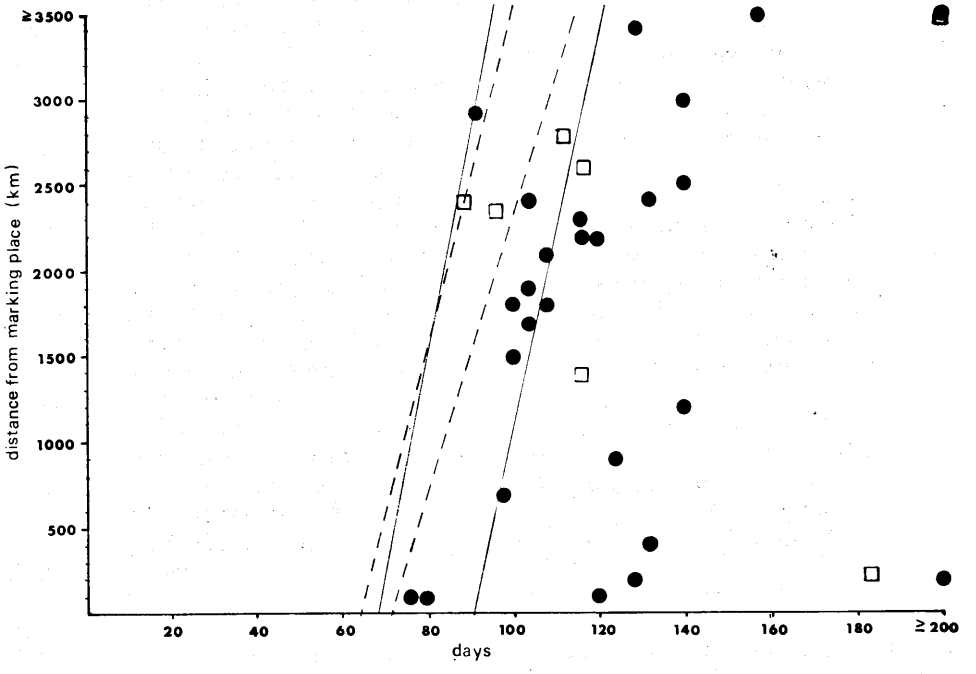
In Figure 2 the numbers of ringed Pied Flycatchers have been divided into periods of four days. In the autumn of 1971 the total number of ringed Pied Flycatchers was 182, and in the autumn of 1972 157. In 1971 the number of adult birds was 57 (31 %) and in 1972 32 (20 %). The first individuals were ringed in 1971 on August 6 and in 1972 (a single bird) on August 8. The numbers ringed of both adult and juvenile Pied Flycatchers, culminated on August 30 in 1971. In 1972 peak migration of adult individuals was on August 27 and of juveniles on August 22. In 1972 the last individual was ringed on September 18. In these two years the age-ratio remained unchanged during the whole migration period.

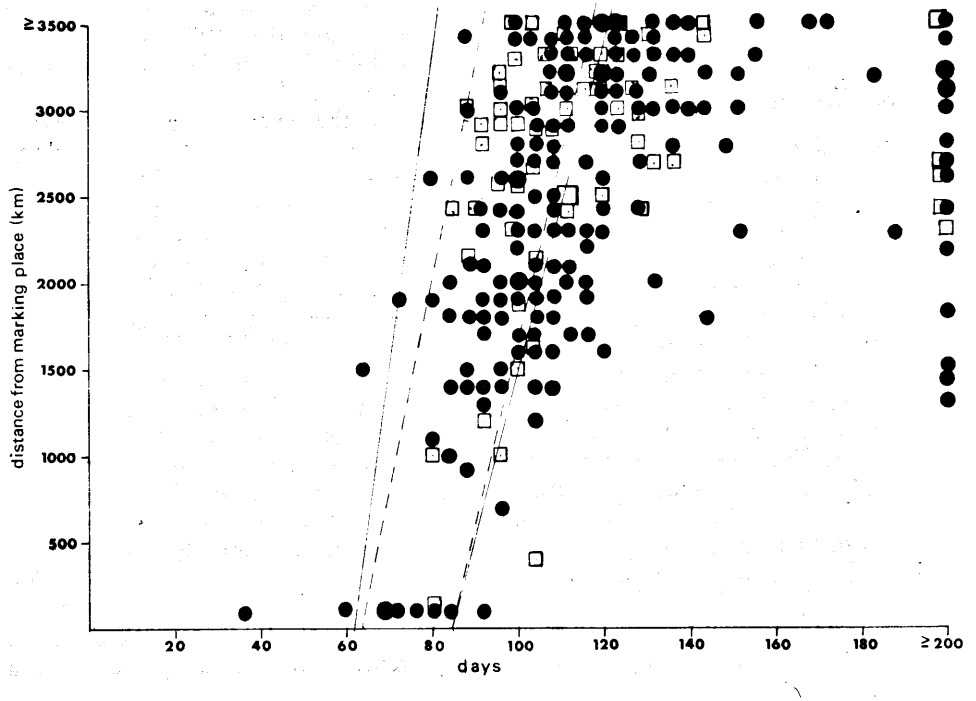
Progress of the migration to the wintering areas

For an analysis of autumn migration of the two species to their wintering areas the Finnish Bird Ringing Reports were

FIG. 3. (Above) Autumn migration of Spotted Flycatchers to their wintering areas as a function of distance and time ● = juvenile (1—2 ind.), □ = adult (1—2 ind.), broken lines = progress of the migration of the first adult individuals (left line) and of the majority (right line), unbroken lines = juveniles, respectively. Day number 1 is June 1.

FIG. 4. (Below) Autumn migration of Pied Flycatchers to their wintering areas as a function of distance and time. For explanations see Fig. 3, besides, bigger symbols, ● and □, 3—5 ind.


≥3500
3000
2500
2000
1500
1000
500
distance from marking place (km)
20
40
60
80
100
120
140
160
180
≥200
days


≥3500
3000
2500
2000
1500
1000
500
distance from marking place (km)
20
40
60
80
100
120
140
160
180
≥200
days

used (published in *Memoranda Societatis pro Fauna et Flora Fennica*). Also unpublished data were used with the kind permission of Mr. I. Stén, M.Sc.

Figure 3 presents recoveries of 8 adult and 26 juvenile Spotted Flycatchers. There is no clear difference between old and young birds with respect to the timing of autumn migration. This does not support our opinion that old birds migrate faster than young ones to their wintering areas (see p. 139). It should, however, be noticed that the number of recoveries is too small to draw firm conclusions.

The speed of the migration of both adults and juveniles is about 100—150 km/day towards south (applying linear regression analysis on Fig. 3).

Figure 4 presents recoveries of 71 adult and 225 juvenile Pied Flycatchers. There is no clear difference between the age groups as to the speed of autumn migration. This is in accordance with our observations at Signilskär.

The speed of migration of both adult and juvenile birds is about 120—170 km/day towards southwest.

Factors affecting the autumn migration

The Spotted Flycatcher regularly sheds its whole plumage in its wintering area in Africa. Adult birds moult in November—April and young birds presumably in the latter part of winter (WILLIAMSON 1960, DIESSELHORST 1961, STRESEMANN 1963, SVENSSON 1970, WILLIAMSON 1972). It seems obvious that old individuals start migrating as early as possible to begin moulting in the wintering area. The nesting period of the Spotted Flycatcher is generally over by the middle of July (VON HAAARTMAN 1969). In the summer of 1971 the first young were fledged in Häme about July 1 and the last ones about July 20 (Hyytiä, Kolunen, Vikberg, unpubl.). After fledging the young depend upon their parents for some time. If autumn migration starts at the beginning of August there is approximately one month or less for adult birds to prepare for migration. Probably they store some lipid during this month.

In North America the autumn migration of *Empidonax minimus* greatly resembles that of the Spotted Flycatcher. This species migrates to Central America where adult birds moult. Adult birds migrate as soon as possible to their wintering areas after the nesting period. Young birds change their body feathers before migration and this is why they are later migrants than adult birds (HUSSELL et al. 1967).

Adult Pied Flycatchers moult remiges and rectrices before the autumn migration (e.g. STRESEMANN & STRESEMANN 1966). In Kilpisjärvi (69° N) 30 moulting individuals were investigated. The earliest individuals started to moult their remiges about June 25 and the last ones as late as about July 25 (Peiponen, unpubl.). According to Haukioja (written statement) the earliest Pied Flycatchers started to moult in the whole of Finland in 1971 at the turn of June—July, but the last ones only at the turn of July—August. Haukioja supposed the length of moulting period in the Pied Flycatcher to be c. 45 days.

The regular nesting period of the Pied Flycatcher is over in Finland by about July 10 (VON HAARTMAN 1969). In the summer of 1971 the first young fledged in Häme about June 25 and the last ones about July 10 (Hyytiä, Kolunen, Vikberg, unpubl.). The moult starts immediately or very soon after the nesting period. During the nesting period, especially on cold and rainy days, the stress on the parents is obviously great. There is a period of c. 40 days between the end of the nesting period and the start of migration, during which remiges and rectrices are moulted. Migration may start, when a bird is still partly in moult. It seems possible that the Pied Flycatcher does not achieve as high a

TABLE 2. Number of Spotted Flycatcher repeats during autumn migration at Signilskär in 1971 and 1972.

Days elapsed after ringing	+ 1-v			1-v			Total
	1971	1972	Total	1971	1972	Total	
0	19	6	25	67	8	75	100
1	6	—	6	24	7	31	37
2	5	2	7	5	5	10	17
3	2	3	5	—	2	2	7
4	1	1	2	3	—	3	5
5	2	—	2	1	2	3	5
6	1	—	1	4	—	4	5
7	1	1	2	1	1	2	4
.							
.							
.							
14	—	1	1	—	—	—	1
Total	37	14	51	105	25	130	181

TABLE 3. Number of Pied Flycatcher repeats during autumn migration at Signilskär in 1971 and 1972.

Days elapsed after ringing	+ 1—y			1—y			Total
	1971	1972	Total	1971	1972	Total	
0	4	4	8	28	22	50	58
1	—	2	2	14	11	25	27
2	—	—	—	5	9	14	14
3	—	—	—	—	5	5	5
4	—	—	—	1	5	6	6
5	—	—	—	—	2	2	2
6	—	—	—	—	—	—	—
7	—	—	—	1	1	2	2
9	—	—	—	—	1	1	1
.							
.							
.							
12	—	—	—	—	1	1	1
Total	4	6	10	49	57	106	116

level of lipid storage as the Spotted Flycatcher before migration, because of the energy needed for moulting. The fact that adult Pied Flycatchers are encountered during the whole of the migration period is perhaps a consequence of moulting before migration; they are not in such a hurry to reach their winter quarters as are adult Spotted Flycatchers.

Resting periods of migrating Flycatchers

The number of Spotted Flycatcher repeats during autumn migration at Signilskär is presented in Table 2 and those of Pied Flycatchers in Table 3.

The numbers of repeats make it possible to estimate the resting period of birds and also estimate the total number of resting individuals (N). Let us

TABLE 4. Resting periods of Spotted and Pied Flycatchers at Signilskär in 1971 and in 1972. (p = catching efficiency, q = proportion of ringed birds resting, $\bar{t}$ = average resting period).

	Spotted Flycatcher			Pied Flycatcher		
	+ l—y	l—y	Total	+ l—y	l—y	Total
p (%)						
1971	13	26	21 ± 1	7	22	17 ± 1.5
1972	9	9	9 ± 2	13	18	17 ± 1.5
Total	12	21	18 ± 1	9	20	17 ± 1
q (%)						
1971	32	36	35 ± 6	—	50	45 ± 13
1972	—	88	50 ± 29	50	50	50 ± 14
Total	24	41	37 ± 6	25	50	47 ± 12
$\bar{t}$ (days)						
1971	1.3	0.8	0.9 ± 0.2	—	0.7	0.7 ± 0.5
1972	2.7	1.6	2.0 ± 0.8	0.3	1.8	1.6 ± 0.6
Total	1.7	0.9	1.2 ± 0.3	0.2	1.3	1.2 ± 0.4

assume that the catching efficiency is the same independent of the weather and, further, that the resting periods remain the same during the whole autumn. Let n be the total number of ringed birds. The catching efficiency (p) is thus

$$p = n/N = 100 \cdot n/N\ \% \qquad (1)$$

From Tables 2 and 3 we can see that the number of repeats decreases from day to day more or less geometrically. The number of repeats (n_i) in the days following ringing can be computed from the equation

$$n_i = pq^i n, \qquad (2)$$

where i indicates the number of days elapsing after the ringing day. We can now calculate p (for example $p = n_0/n$) and q (for example $q = n_1/(pn)$). In Table 4 values for p and q are given. In the autumn of 1971 about 1900 Spotted Flycatchers ($N = n/p = 403/0{,}21 = 1900$) rested at Signilskär; in the autumn ot 1972 the number of the resting Spotted Flycatchers was also about 1900 ($162/0.087 = 1860$). In the autumn at 1971 about 1000 ($182/0.173 = 1050$) Pied Flycatchers rested at Signilskär and in the autumn at 1972 also about 1000 ($157/0.166 = 950$) individuals. We find that catching efficiency is greater for the Spotted Flycatcher than the Pied Flycatcher in 1971 (21/17) but less in 1972 (9/17).

The average resting period of migrating birds ($\bar{t}$) can be calculated, using repeats, from the equation:

$$\bar{t} = \frac{\Sigma i \cdot n_i}{\Sigma n_i} \qquad (3)$$

The migrating Spotted and Pied Flycatchers rest on average twenty-four hours on Signilskär before continuing. In this respect the data do not show any difference between the two species, but between old and young birds there seems to be a great difference. The difference is not significant because data are scant (over l—y). BERGMAN (1969) mentions, without giving more precise data, that flycatchers rest on the isles of the outer archipelago especially after foggy and rainy weather.

As shown earlier the average speed of

the migration is about 100—170 km/day. Because birds rest about one day after every migratory night, they have to fly 200—300 km (about 4—5 hours) per night.

Moult during the autumn migration

The Spotted Flycatcher

In 1971 the moult of 109 and in 1972 69 adult Spotted Flycatchers was observed. In 1971 92 (85 %) and in 1972 44 (63 %) individuals moulted tertiaries. In 1971 9 and in 1972 also 9 individuals had new tertiaries. In 1972 one individual moulted two secondaries in both wings. As shown in Table 5 the stage of tertiary moult varies randomly. The number of birds moulting only one wing was in 1971 5 and in 1972 4 individuals. The number of birds showing the same stage of tertiary moult in both wings was in 1971 54 (59 % of the moulting birds) and in 1972 20 (45 %). Among individuals exhibiting different stages of moult in both wings (38 ind. in 1971 and 24 ind. in 1972) these stages were often widely different. The middle tertiary was, however, new in almost every wing (the right wing 80 % in 1971 and 75 % in 1972, the left wing 84 % in 1971 and 77 % in 1972 of the moulting birds). The number of wings in which the first and the third tertiary were more advanced than the second one was in 1971 15 (16 % of moulting wings) and in 1972 4 (9 % of moulting wings). There was no correlation between the stage of the moult in the investigated individuals and the time. Moulting birds were captured during the whole migration period.

The data obtained at Signilskär in the autumns of 1971 and 1972 indicate that the Spotted Flycatcher moults tertiaries first (postnuptial moult). According to our data adult individuals moult tertiaries more frequently during autumn migration than was previously supposed (e.g. SVENSSON 1970). Of tertiaries the middle one is moulted first as has been found to be the rule among passerines. Tertiaries are, as a rule, moulted before the moult of the secondaries and primaries is completed and their moult is finished earlier (e.g. SVENSSON 1970). The function of the tertiaries is presumably like that of the coverts, and the missing tertiaries obviously do not affect flying ability.

TABLE 5. Tertiary moult of adult Spotted Flycatchers at Signilskär in 1971 and in 1972.

	Number of wings							
	1971		1972		Total		%	
Tertiary[1] 123	right wing	left wing	right wing	wing	right wing	left wing	right wing	left wing
0i0	38	39	18	15	56	54	40	40
0ii	18	18	14	11	32	29	23	21
00i	1	—	2	—	3	—	2	—
i00	1	—	1	—	2	—	1	—
i0i	—	1	—	—	—	1	—	1
ii0	8	8	5	5	13	13	9	10
iii	22	23	12	12	34	38	25	28

[1] 1 is tertiary nearest to the body, 2 is the middle one and 3 ist nearest to the secondaries, i = new tertiary in phase 1, . . . , 5

TABLE 6. Moult of remiges of Pied Flycatchers trapped at Signilskär in 1971 (every case concerns a different individual).

Date	Phase	
9.8	555.345555.555555555	
22.8	555.445555.555555554	
22.8	555.455555.555555555	right
	555.345555.555555555	left
31.8	555.455555.555555554	
31.8	555.005555.555555555	
1.9	555.555555.555555554	
3.9	000.000345.555555555	
5.9	555.445555.555555554	
12.9	555.455555.555555555	
15.9	555.004555.555555555	
17.9	555.000445.555555555	

The Pied Flycatcher

In 1971 57 adult Pied Flycatchers were caught, of which 11 had moulted their secondaries (Table 6). Every bird had new tertiaries, primaries and rectrices, with a few exceptions presumably not having their 9th primary quite ready. The raggedness of wing with regard to secondaries was 12 at most (cf. method: HAUKIOJA 1971 a). As shown in Table 6 four adult Pied Flycatchers had the 2—3 innermost secondaries in pre-moulting condition, the rest being moulted. This shows that some Pied Flycatchers moult as late as the start of migration, and that some do not moult all secondaries before migration. On the other hand, in the period August 5—September 2 1972, no moulting Pied Flycatchers were caught (26 birds in all).

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Selostus: **Harmaa- ja kirjosiepon syysmuutosta Signilskärillä ja muutonaikaisesta sulkasadosta.**

Harmaa- ja kirjosiepon syysmuuttoa ja muutonaikaista sulkasatoa tutkittiin v. 1971 ja 1972 Signilskärin lintuasemalla.

Taulukossa 1 on esitetty pyydystettyjen harmaa- ja kirjosieppojen määrien vuorokautinen jakautuma.

Harmaasiepon syysmuutossa (kuva 1) vanhojen lintujen muutto keskittyy muuttokauden alkupuolelle. Mitä pidemmälle muuttokausi etenee sitä suuremmaksi nuorten osuus kasvaa. Vertailun vuoksi ja muuton etenemisen selvittämiseksi, on kuvassa 3 esitetty rengaslöytöjen perusteella syksyiset nuorten ja vanhojen lintujen muuttorintamat. Mahdollisesti aineiston pienuudesta johtuen ei ikäryhmien välillä havaittu eroa.

Kirjosiepon syysmuutolle (kuva 2) on luonteenomaista vanhojen lintujen esiintyminen tasaisesti koko muuttokauden ajan. Muuttojakautuma on sekä vanhoilla että nuorilla linnuilla samanlainen ja ajoittuu samaan aikaan. Kuvassa 4 on rengaslöytöihin perustuen esitetty vanhojen ja nuorten kirjosieppojen muuttorintamat. Aineisto osoittaa, kuten havainnot Signilskärilläkin, nuorten ja vanhojen samanaikaista muuttoa.

Syysmuuton aikana saarella uudelleen pyydystettyjen harmaasieppojen määrät on esitetty taulukossa 2 ja kirjosiepon osalta taulukossa 3. Näiden perusteella voidaan arvioida lintujen keskimääräiset levähdysajat (taulukko 4). Havaitaan molempien lajien muuttavien yksilöiden levähtävän keskimäärin alle vuorokauden.

Valtaosa tutkituista vanhoista harmaasiepoista (74 %) sulki tertiaalejaan (taulukko 5). Sulkimisvaiheessa ja -järjestyksessä eri tertiaaleja toisiinsa verrattaessa oli suurta hajontaa. Sulkiminen alkaa kuitenkin yleensä keskimäisestä. Edelleen näyttää siltä, että vanhat harmaasiepot aloittavat siipisulkasadon tertiaaleista.

Sulkasatoisia kirjosieppoja tavattiin syksyllä 1971 kaikkiaan 11 yksilöä (taulukko 6). Näillä joko kyynärsulkia sulittiin tai osa kyynärsulista oli vanhoja ja osa täyteen mittaan ehtineitä uusia.

References

BERGMAN, G. 1969. Linnut ja saaristomme. — Söderström, Helsinki.

CORNWALLIS, R. K. & SMITH, A. E. 1963. The bird in the hand. B. T. O. Field Guide N. 6. (Rev. by K. WILLIAMSON). — Holywell, Oxford.

DIESSELHORST, G. 1961. Ascendente Handschwingen-Mauser bei Muscicapa striata. J. Orn. 102:360—366.

HAARTMAN, L. VON. 1969. The nesting habits of Finnish birds I. Passeriformes. Comm. Biol. Soc. Scient. Fenn. 32:1—187.

HAARTMAN, L. VON, HILDÉN, O., LINKOLA, P., SUOMALAINEN, P. & TENOVUO, R. 1967—72. — Pohjolan linnut värikuvin II. — Otava, Helsinki.

HAUKIOJA, E. 1971a. Processing moult card data with reference to the Chaffinch Fringilla coelebs. Ornis Fenn. 48:25—32.

— 1971b. Sulkasadon selvittely lintuasemilla. Lintumies 7:39.

HUSSELL, D. J. T., DAVIS, T. & MONTGOMERIE, R. D. 1967. Differential fall migration of adult and immature Least Flycatchers. Bird Banding 38:61—66.

SNOW, D. W. 1967. A guide to moult in British birds. B. T. O. Field Guide No. 11. — Office Services Ltd., Luton.

STRESEMANN, E. & STRESEMANN, VESTA 1966. Die Mauser der Vögel. J. Orn. 107. Sonderheft.

STRESEMANN, VESTA 1963. Zur Richtungsumkehr der Schwingen- und Schwanzmauser von Muscicapa striata. J. Orn. 104:101—110.

SVENSSON, L. 1970. Identification Guide to European Passerines. — Naturhistoriska Riksmuseet, Stockholm.

WILLIAMSON, K. 1960. Moult as a study in field-taxonomy. Bird Migration 1:171—175.

— 1972. Reversal of normal moult sequence in the Spotted Flycatcher. Brit. Birds 65: 50—51.

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