Roosts and roosting flights of wintering Jackdaws *Corvus monedula* at Tampere, Finland.

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Nowadays from 1000 to 2000 Jackdaws roost each winter in the City area of Tampere, where Jackdaws settled down to breed at the turn of the 1940's—50's. The total feeding area of the flock covers about 1000 sq. km.

The Jackdaws change their roosting habits seasonally. In the nesting period they roost close to their nests and in the late summer and early autumn in several groups scattered throughout the study area. In the period from October to April roosting takes place in a single flock in the City area where three alternative roosting places have been used.

The Jackdaws leave their winter roost at dusk each morning, and arrive in the evening under similar conditions. In the summer the flights to and from the roost take place during the period between sunrise and sunset. At Heidelberg, in southern Germany, the daily active period of Jackdaws in the middle of the winter is three hours longer than at Tampere. It seems possible that the shortness of winter days at high latitudes is an important factor inhibiting wintering of birds hardy enough to withstand climatic conditions.

The sizes of feeding flocks are compared with those flying between the roost and feeding grounds.

The significance of communal roosting is discussed with special reference to the fact that the winter roosts of Jackdaws are commonly located in cities from where birds have to fly far to reach their feeding grounds.

Introduction

The purpose of this paper is to report the main results of our investigations concerning (1) the roosting of Jackdaws *Corvus monedula* at Tampere (61°30'N, 23°50'E), and (2) their daily flights to and from the roosting sites and the feeding places in the neighbourhood of the City.

Our investigations were mostly concentrated to the non-breeding period of the Jackdaw. As yet, there are no reports of the roosting behaviour or feeding flights of Finnish Jackdaws. The roosting of this species has been studied e.g. in southern Sweden (BORGVALL 1952, LUNDIN 1962), Estonia (LINT 1964, 1971) and Germany (ASCHOFF & v. HOLST 1960). In the last work the dependence of the roosting of Jackdaws upon the light conditions was investigated at Heidelberg (49°35'N, 08°42'E), about 1300 km south of our study area.

The wintering of diurnal birds in high latitudes is probably greatly limited by day-length, as days are at their shortest, when temperature is at its minimum and food is most restricted due to snow cover. The ASCHOFF & v. HOLST (1960) study makes it possible to compare our observations with an area with dissimilar light conditions and day-length. We are dealing with a population living at the ecological limits of the species, as Tampere is one of the

northernmost localities where Jackdaws regularly occur.

The roosting of the Rook *Corvus frugilegus* in different parts of Europe has been dealt with in a number of papers summarized by e.g. BURNS (1957) and COOMBS (1961). As Jackdaws quite commonly roost together with Rooks, these papers contain many observations of Jackdaws, too. In Finland, TUOMINEN (1968) has investigated roosting of the Crow *Corvus cornix* at Pori at roughly the same latitude as our study area.

Study area and investigations

Investigations were made at Tampere and in its neighbourhood. The area, covering about 1000 sq. km, was that from where Jackdaws gathered to their common winter roost in the City, when this area was at its largest in the winter. Its boundaries were estimated by more or less random observations of Jackdaws, especially during winter bird censuses. The regular field investigations were concentrated to two places: Rassi has made observations of feeding flights in Kangasala church village and its neighbourhood about 15 km to the east from Tampere City since 1962 and Tast studied roosting at Tampere City from 1966 onwards.

Population under study

The wintering population — During recent years there have been from 1000 to 2000 Jackdaws at Tampere in winter roosts. Both wintering and breeding of this species at Tampere is of relatively recent origin.

According to Th. Grönblom (oral statement) the species was not at all found at the beginning of this century in the City area. The bird observation diary of S. Lilja (at Tampere Biological Museum) of the years of 1909 and 1910 does not contain any observations of Jackdaws either during winter or summer. Nor were Jackdaws seen in the 1930's according to KALELA (1938, and oral statement). In the archives of A. O. Salonen (Tampere Ornithological Society) there is an observation on 27.1.1935 of 25 birds observed at Pitkäniemi, about 10 km to the west of the centre of the City. Records of S. Virtanen (Tampere Biological Museum) contain an observation of a single bird seen on 27.3.1940, and of 10 individuals on 6.1.1941. Since then Jackdaws have been seen more regularly. In the winter of 1945/1946 about 100 birds wintered in the area, but during the following years there were again fewer, in 1947/1948, for example, some 50 (Virtanen and Salonen). A year later there were more than a hundred, and since then their numbers have rapidly increased.

Establishment of breeding — The Jackdaw belongs to about 50 bird species whose distribution in Finland is mainly southerly, but which have during the recent decades extended their breeding range (see TAST 1968, and the literature quoted).

This extension of the breeding area of the Jackdaw is partly due to change of habitat. Earlier it bred mainly in settled habitats in the countryside and old towns, nesting in old churches and other suitable buildings. Recently it has been expelled from several churches (ANTIKAINEN 1968). Although the Jackdaw has earlier been reported as breeding in woods (see e.g. PALMGREN 1930, p. 147), this habit has greatly increased in recent decades (e.g. BRANDER 1958, JALKANEN 1960), and it sometimes nests relatively far from man-made habitats (p. 41).

Further, Jackdaws have recently settled in some of our largest cities. The Jackdaw first bred in Helsinki in 1954 (KAJOSTE 1961, TENOVUO 1967). In Tampere the first nests were found in about 1950 (A. O. Salonen). Obviously Jackdaws began to breed in the City in the same years as they began to winter there.

Size of breeding population — There are now some 30 breeding pairs in the City area. The figure is based on the numbers of (1) nests or nesting sites found, (2) birds observed feeding during breeding time (p. 32) (3) birds found in roosts in early autumn (p.32—33).

The size of the Jackdaw population breeding within the total study area can be estimated only approximately. In the central parts of Kangasala there breed about 50 pairs, and our rough estimate of the total population is some 300 to 400 pairs.

Apparently all the Jackdaws observed roosting at Tampere during winters could have bred in the study area. However, about half of the Finnish Jackdaw population migrates according to BUSSE (1969), and recoveries show that many Jackdaws wintering in Finland are found at considerable distances from the areas where they were ringed as nestlings. Among the birds roosting at Tampere in winter, there are obviously some which have been born in other parts of our country.

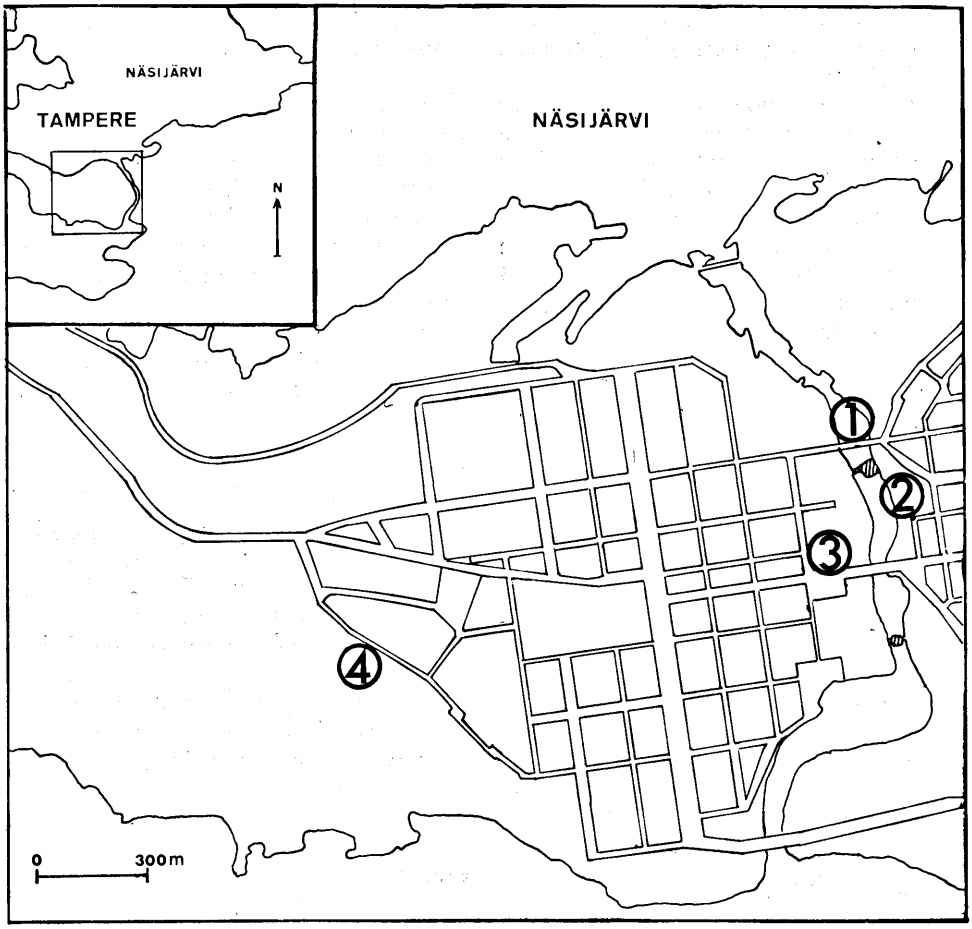

FIG. 1. Winter roosts at Tampere. 1=Konsulinsaari, 2=Koskipuisto, 3=Central Market, 4=Pyynikki. The inset shows the location of the area. Further details in text.

Roosting

Winter roosts

Jackdaws have roosted regularly for several years in the very same places shown in Fig. 1. In November and December, and, again, from February onwards, they roosted in some dozen deciduous trees on a small islet, Konsulinsaari, in the central part of the City near one of the main streets, Satakunnankatu. In January and February, they roosted either on the roofs of buildings around the Central Market, or in another park some 200 metres from Konsulinsaari. All these places lie within a distance of some 400 m.

The Jackdaws have been observed quite regularly from night to night in the same places, although there are hundreds of corresponding places in the City area. This fact must be due to the

traditional habits of Jackdaws, known since the investigations of LORENZ (e.g. 1927, 1931).

Occasionally, however, Jackdaws have roosted in other places, probably due to disturbances caused by human activities near their ordinary roosts. Thus, Mr. I. Mäkisalo, M.A., observed the Jackdaw flock roosting about ten times in the winters of 1971/1972 and 1972/1973 at Pyynikki Park about 1 km from the ordinary roosting sites (Fig. 1).

Roosts during other seasons

After the break-up of the winter roost (p. 33), most Jackdaws apparently roost in pairs in their nests or, anyway, in their nesting territories (COOMBS 1960, ANTIKAINEN 1970). The breeding season lasts in our study area from April to the end of June. First eggs are laid in the latter half of April (cf. also v. HAARTMAN 1969), and young commonly leave their nests in mid-June.

At this time Jackdaws are met with in relatively small numbers in the City area proper, usually only single birds or a few pairs. The largest flock observed during the nesting period before young had fledged consisted of 18 individuals.

At Kangasala flocks have contained at most some 30 birds, those at Sahalahti about 60. These flocks were observed close to the largest colonies. However, the colonies consisted of less than 15, respectively 30 pairs. According to LORENZ (1931), Jackdaws breed for the first time only when nearly two years old. Apparently there exist non-breeding young Jackdaws in the flocks assembling in the vicinity of the colonies. Where food conditions are poor, breeding Jackdaws may fly considerable distances to places with a good food supply (cf. observations made at Evo, p. 41).

After the young have left their nests, Jackdaws assemble to form a few large flocks. In late summer those observed at Kangasala have contained 100—400, those seen in Tampere City always less than 100 birds. At Kangasala Jackdaws have been found to roost e.g. in small birch and alder woods on the shores of the lake Kirkkojärvi.

The roosting habits are at that time less regular than at any other time of the year. Jackdaws may change their roosting place quite unexpectedly.

Jackdaws have never been observed to roost during the breeding season or in late summer and early autumn in the places where they roost during the winter. In the autumn 80—120 birds have overnighted on the town hall, over a period of c. 15—30 days, but this small number of birds had probably bred in the City area (p. 30).

Establishment of winter roosting habits

The ordinary winter roosting place at Konsulinsaari was passed almost regularly by Tast every morning and evening. As Jackdaws are very conspicious, the dates, when they began to use the winter roost, could be determined rather exactly:

7. XI. 1966	29. X. 1969
18. X. 1967	8. XI. 1970
6. XI. 1968	26. X. 1972

Summarizing, Jackdaws started to roost in the City area at the end of October, their numbers being several hundreds from the very beginning.

The above dates coincide fairly well with the period when migrating Jackdaws leave Finland. According to v. HAARTMAN et al. (1968, p. 694), at Signildskär Bird Station, Åland Islands, the first migrating Jackdaws have been recorded between September 27 and October 8 and the last ones between November 4 and November 18.

In 1967 Jackdaws were seen in their winter roosting place at an earlier date

than in other years, obviously due to peculiar climatic conditions. At that time, October 18, the earth was covered by snow unusually early, and simultaneously the temperature fell below freezing point. Two nights earlier, on October 16, there were still no Jackdaws in this place, but about 80 individuals roosted in the town hall.

On October 18, 1967, great numbers of Crows, Rooks, and Jackdaws, were observed migrating WSW at Lågskär Bird Station, Åland Islands, during a heavy snow storm (ANON. 1968).

In Kangasala, local autumnal roosts have broken up by the end of September, i.e. about one month before the winter roost has been established at Tampere City. Apparently these birds have roosted somewhere in the City, as the daily flights from Sahalahti and Kangasala towards Tampere City and back began between September 25 and October 11 (p. 36 and Fig. 2).

At Gothenburg, Sweden, BORGVALL (1952) found that Jackdaws roosted in different places in October than in the summer or in the winter.

Abandoning of winter roosts

Most Jackdaws leave their winter roost in the middle of March at approximately the time, when the migratory part of Jackdaw population returns to Finland (cf. HILDÉN 1960). However, all Jackdaws do not leave the roost simultaneously, but part of them utilize the place some weeks after the first ones have abandoned it. This can be seen e.g. from the following observations made in 1967:

The total roosting population in the winter of 1966/1967 was about 1100 birds. On March 20, there were still some 600 birds in the common roost; on March 28, c. 400 to 450 individuals, similarly also on April 6. Thereafter the roost was totally abandoned, but on April 20 it snowed with the result that some 130 Jackdaws again roosted here.

Similarly, in 1972, on April 18 it snowed all day, and the winter roost was re-established, and about 120—150 Jackdaws gathered together at their common roost.

Times of roosting

The records of the times at which the Jackdaws flew to their roost and at which they departed are summarized in Fig. 2. In addition, the periods of twilight are given.

In the winter period the Jackdaws tend to begin their roosting in the twilight or darkness, and they depart from their roost before sunrise under conditions of twilight or dark. Some records of illumination were made by a luxmeter at the winter roost both in the evening and morning. Due to the location of the roost near street lights, light did not fall under 2 lux. Usually, birds departed, when the illumination was still 2 lux, i. e. when darkness prevailed. However, when birds left the roost over a longer period in small groups (see p. 35), the last ones were seen in the roost, when it was already rather light up to some 20 lux. The records of January 29, 1969, as presented on p. 35, may serve as an example.

Correspondingly, in the evening, the Jackdaws mostly flew to their winter roost when darkness had already fallen. Most observations were from 25 to 50 minutes after illumination had fallen to 2 lux.

The roosting habits of Jackdaws show clear-cut seasonal differences with respect to light. In Fig. 3 some observations made at Kangasala at the late summer roost show that the Jackdaws begin to roost and depart from there under quite different light conditions from the winter. It seems that change in this respect takes place at approximately the time when winter roosts are established. On three evenings of 1967 (November

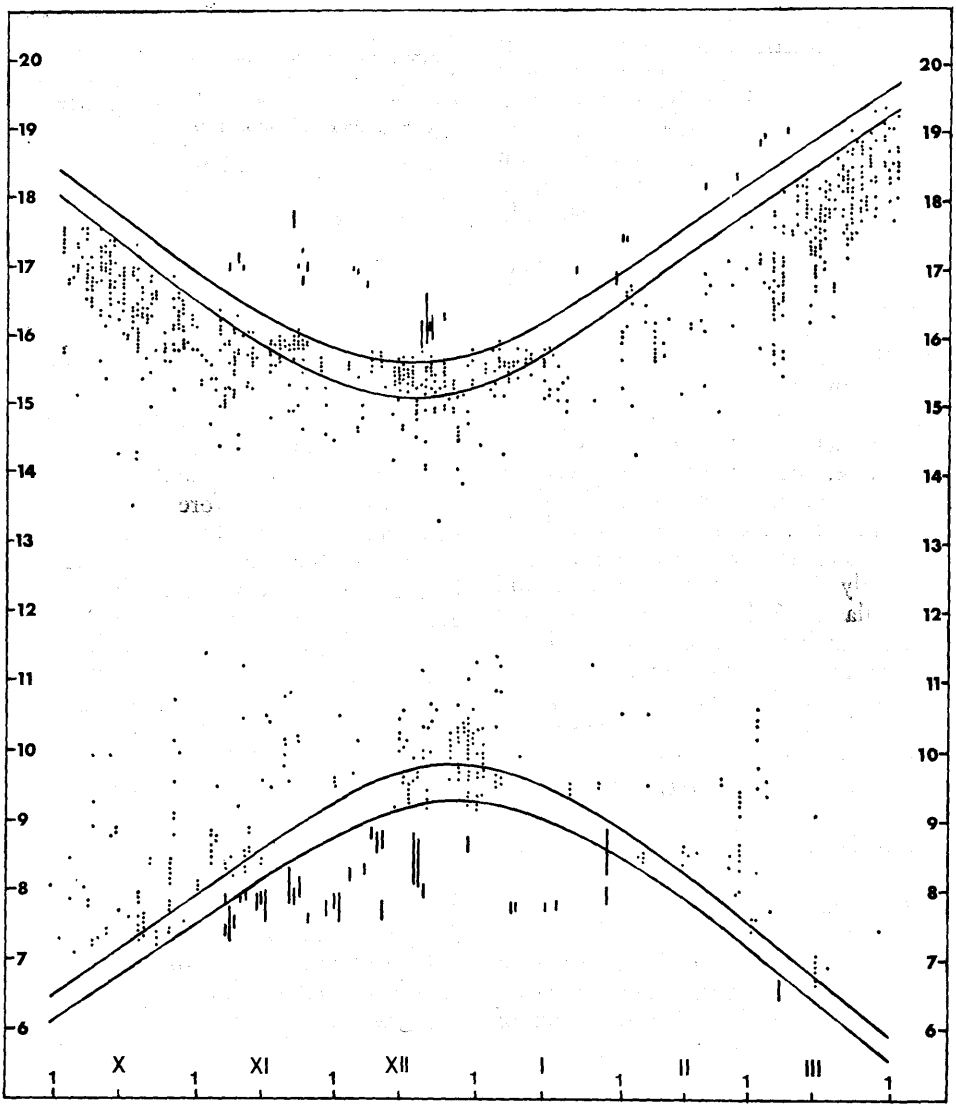

FIG. 2. Times of arrival and departure of Jackdaws at their roost (columns) and times of flocks passing the Kangasala observation line during the flights to and from the roost (dots). Continuous lines show the times of sunrise and sunset and, respectively, beginning and ending of the twilight.

6, 8 and 9) the Jackdaws arrived at the roost just at the time, when illumination fell to 2 lux, or even some minutes before.

However, exceptional weather conditions also had an effect on roosting. When there was mist or a heavy snow storm, birds began to roost earlier than usual, and left later. The same was observed by BORGVALL (1952) at Gothen-

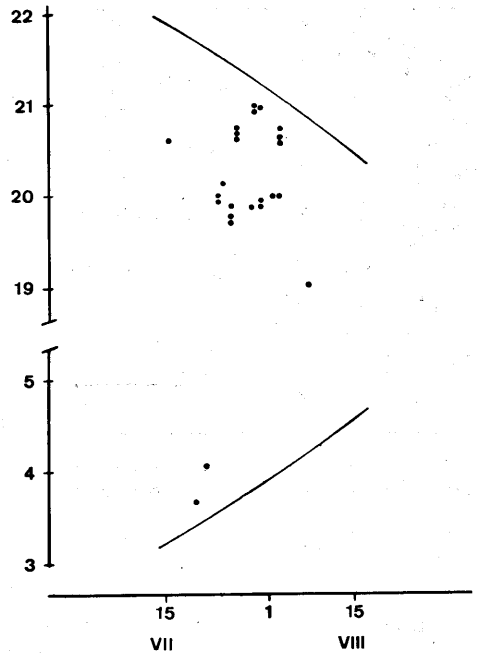

FIG. 3. Times of arrival and departure of Jackdaws at a summer roost at Kangasala. The continuous lines show the times of sunrise and sunset.

burg, Sweden and by LINT (1971) at Tarto, Estonia.

ASCHOFF & V. HOLST (1960) described two different ways of departing from the roost. Both were also observed at Tampere. Sometimes all the birds left the roost simultaneously ("Katapult-start"), otherwise they left it over a prolonged period, lasting up to almost two hours, in a leisurely manner.

Roosting Jackdaws apparently do not all awake at the same moment. Gradually more and more of them become active. They perform several activities before departure, flying short distances from their perches and becoming noisier. All the time some of birds preen themselves.

The following may serve as examples:

On January 29, 1969, recording took place from 7.40 to 9.00. Illumination was at 7.40 2 lux., 8.10 3 lux., 8.25 8 lux., 8.30 8 lux. and 8.37 17 lux. Temperature was —12°C.

When recording started, there were some 1400 birds in the roost. The birds were noisy and some of them flew to and fro from one branch to another. They began to leave the islet in small groups, but at 8.10 most of them were still present. Small groups continuously departed, but at 8.30 some 500 were still sitting in the trees where they had roosted. Surprisingly enough, they did not leave in spite of the fact that a man tried to scare them away. At 8.40 300 birds were still in the roost, at 8.45 150 and at 8.50 25 birds.

The other example is from December 4, 1968. Illumination was from 7.40 to 8.15 2 lux., and at 8.20 3 lux. Temperature was 0°C.

The roosting flock consisted of some 1200 birds at that time. As usual, the birds were noisy throughout the observation; from 7.40 onwards, they hopped from one tree to another, but none was seen to leave the roost. Between 8.06 and 8.12 three small flocks departed, and then within two minutes 8.12—8.14 the total flock left the area almost simultaneously.

Two different habits of flying were also observed when the Jackdaws came to their roost in the evening. They either came all together or flew in small groups over a longer period. A single example may suffice:

On February 25, 1968, observation started at 17.30. At that time there were several groups of some hundreds of Jackdaws in the central parts of the City. Every now and then small flocks joined some of the groups. Flocks flew to and fro and were rather noisy. They also passed the roost islet. These assembling flights continued more than half an hour. Although birds flew near the roost, none of them settled. At 18.11 a large flock came towards the islet and within two minutes more than a thousand birds had settled in the trees. During the next following 7 minutes small flocks continued to arrive at the roost, but now they flew directly towards their roost without the usual assembling flights, as did those birds which arrived earlier.

In the roost the birds moved incessantly during the first minutes, flying to and fro, settling and then suddenly leaving the perch to go elsewhere. They called noisily for more than 10 minutes. While the number of birds sitting to-

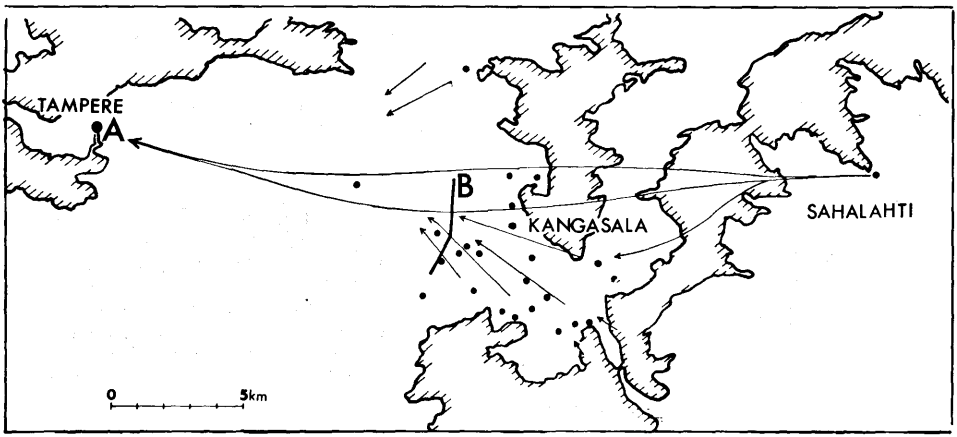

FIG. 4. The flight routes of Jackdaws from Kangasala and Sahalahti to the roost in the evenings. Black dots show observed feeding grounds. A=Roost at Tampere, B=Kangasala observation line.

gether in pairs steadily increased, the noise slowly died down. Usually it is almost completely dark, when birds fly in (p. 33). However, although Jackdaws are not able to see well in the dark, they settle in the trees within some minutes. The majority of the Jackdaws roosted in pairs (also during the day they were mostly seen in pairs). According to LORENZ (1931) pair formation takes place in the first autumn, and pairs keep together as long as they are alive. As suggested by COOMBS (1961), calling apparently enables each bird to locate its mate and as paired birds find each other, the need for calling gradually ceases.

Roosting flights

Jackdaws did not abandon their regular feeding places, when they began to roost in Tampere City. Consequently, they began to fly regularly between their feeding and roosting places every morning and evening. In Fig. 2 observations concerning these flights at Kangasala, about 14 km east of the roost, are given. As can be seen, most roosting flights in the evening occurred within approx. 90 minutes throughout the period. Roosting flights tend to occur at lower light intensity from November to January, i.e. at the darkest time of the year.

There is fairly a long time lag between the time of roosting flights and the actual beginning of roosting and, correspondingly, in the morning between departure and these flights. The time lag between flights and roosting is due to assembling behaviour, a characteristic feature of Jackdaws (p. 32) and other Corvidae, as pointed out in several investigations (e.g. BORGVALL 1952, ASCHOFF & V. HOLST 1960, COOMBS 1961, LUNDIN 1962, LINT 1964, 1971, TUOMINEN 1968).

Jackdaws, when moving between roosts and feeding places, fly rather fast; our estimates are from 50 to 60 km/h. The flight from Kangasala to the roost takes from about 10 to 20 minutes.

Sometimes, Crows could be seen flying towards their roosts simultaneously with Jackdaw flocks. The Jackdaws flew at a clearly higher speed, although when Crows and Jackdaws fly together during

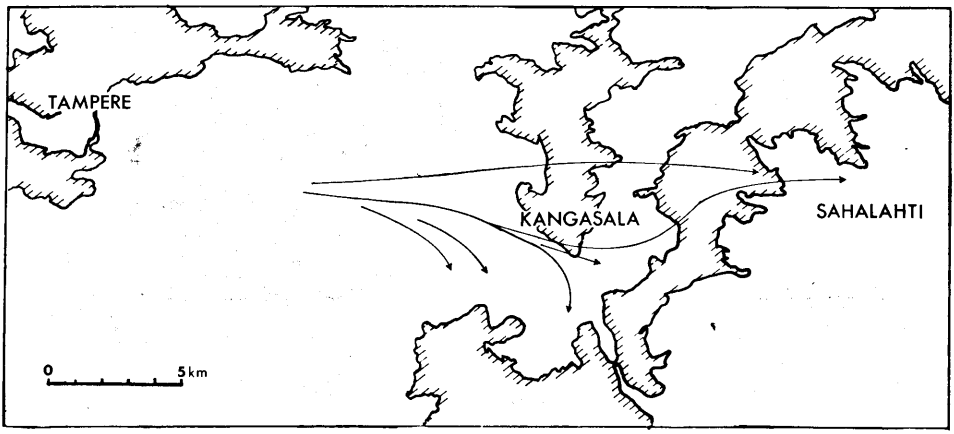

FIG. 5. The routes of morning flights of Jackdaws from their roost to feeding grounds in Kangasala and Sahalahti communes. The east-west directioned ridge is used as a guidance line.

migration in autumn or spring they do it at the same speed.

In the morning, flying Jackdaw flocks passed the Kangasala observation line over a longer period than in the evening. The first flocks were seen relatively early, but flocks were sometimes seen till noon, due to the fact that some of the flocks settled on a suitable feeding ground before reaching Kangasala and then continued their flight.

Usually, Jackdaws flew at a rather high altitude during roosting flights, so it was easy to distinguish them from those only changing their feeding place. However, in a strong headwind the migrating flocks usually flew low seeking shelter from the wind.

The flocks feeding at Kangasala and Sahalahti flew along regular lines following the W-E chain of ridges. As shown in Fig. 4, birds feeding to the south of this main line, in the evening first flew north or northwest, and then, when reaching the line, curved sharply in their flight west towards the City. Similarly, in the morning Jackdaws flew longer along this line and, when approaching their feeding grounds, turned sharply south (Fig. 5).

Feeding area

The area from which the Jackdaws gathered to their common roost is according to our estimations about 1000 sq. km. The size of it was estimated on the basis of observations made of roosting flights in many directions and of observations of feeding flocks in winter in the neighbourhood of Tampere. Some flights were as much as some 30 km. Beyond this distance, Jackdaws were not seen regularly in winter, as revealed e.g. by the winter bird censuses.

However, although the feeding area is so large, it contains suitable food resources only in a fairly few places, as can be seen from Fig. 6. Jackdaws mostly feed in open terrain, and most of our study area is covered by forest.

During the snowless period most Jackdaws fed on large fields, but in winter they were forced to seek their food from settled areas, e.g. from rubbish heaps.

At Sahalahti and Kangasala, there have been up to 600 Jackdaws in the winters, i.e. about one third of the total roosting population. Most of these birds, at most some 400 ones, have regularly

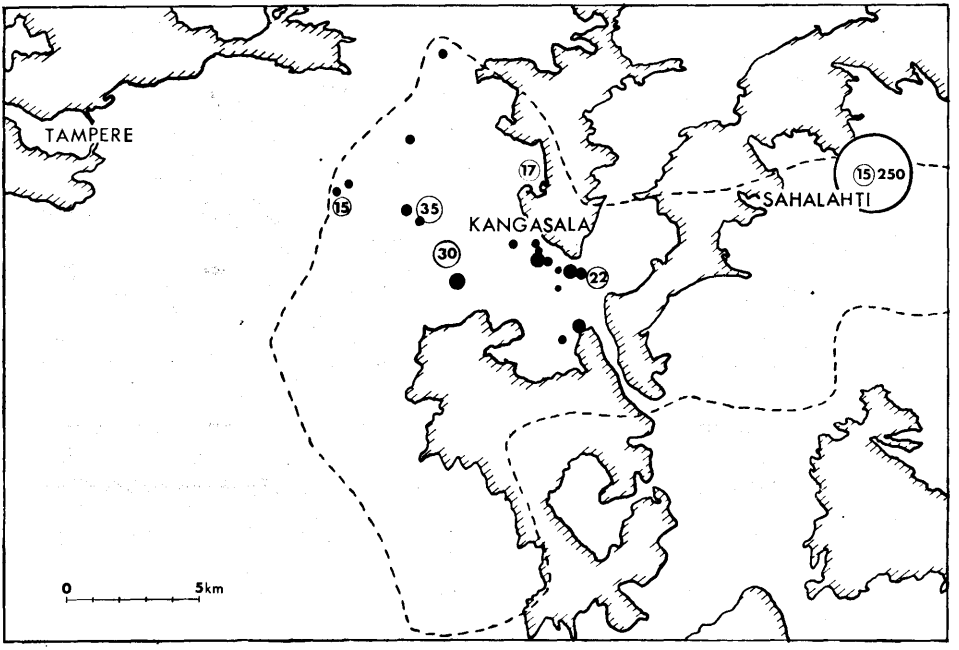

FIG. 6. The Jackdaws observed during the winter bird censuses of 1967/68 in Sahalahti and Kangasala communes. The area covered by census routes is shown by the broken line. The sizes of flocks are given by figures, for smaller flocks with black dots.

fed at the Sahalahti foodstuff factory, about 30 km from the winter roost.

Sizes of flocks during roosting flights and during feeding

Observations of flock sizes during feeding and during roosting flights are summarized in Tables 1—3. Records of these flocks were made at Kangasala and Sahalahti.

There exist great seasonal differences in the sizes of the flocks ($\chi^2=82.29$, $P<0.001$, d.f. 16 for the total sample). In the autumn Jackdaws usually fed in a few relatively large flocks. In the winter, birds changed to feed on yards, rubbish heaps, etc. in many small flocks. The differences between feeding flocks in autumn and winter are statistically highly significant ($\chi^2=48.04$, $P<0.001$, d.f. 8). Again in the spring feeding flocks became larger, but as some birds had already moved to their breeding areas, as large flocks as in the autumn were not formed. Differences between winter and spring flocks are highly significant ($\chi^2=31.34$, $P<0.001$, d.f. 8). On the other hand, there are no significant differences between autumn and spring flocks.

In Fig. 6 the sizes and location of Jackdaw flocks observed during the winter bird census in 1967/1968 are given. Within the area shown by the broken line there were 23 census routes totalling some 250 km. Apparently almost all flocks were seen during the census days, and flocks were relatively small with the exception of that feeding at the Sahalahti foodstuff factory.

The sizes of flocks performing roosting flights also show seasonal differ-

TABLE 1. Size distribution of observed feeding flocks of Jackdaws at Kangasala and Sahalahti (IX = September, etc.).

Size of flocks	1-2	3-4	5-8	9-16	17-32	33-64	65-125	126-250	251-500	N
IX—XI	3	1	5	6	8	18	10	12	5	68
%	4.4	1.5	7.4	8.8	11.8	26.5	14.7	17.6	7.5	
XII—II	31	22	23	21	25	13	5	7	4	151
%	20.5	14.6	15.2	13.9	16.5	8.6	3.3	4.6	2.6	
III—IV	11	6	7	19	33	15	10	1	1	103
%	10.7	5.8	6.8	18.4	32.0	14.6	9.7	1.0	1.0	

ences. In respect to evening flocks differences are highly significant throughout the period ($x^2=49.92$, $P<0.001$, d.f. 14). The sizes of flocks became smaller from autumn to spring.

Flocks observed in the morning are smaller than those met with in the evening, differences being highly significant in the autumn ($\chi^2=35.40$, $P<0.001$, d.f. 7) and in the winter ($x^2=54.06$, $P<0.001$, d.f. 7). This indicates that some Jackdaws stop at suitable feeding places and flocks are therefore split up.

Flying flocks are, on an average, distinctly smaller than feeding flocks. Differences are most significant in the autumn, differences between flying evening flocks and feeding flocks being highly significant ($\chi^2=79.20$, $P<0.001$, d.f. 8), and so also are those between morning flocks and feeding flocks ($x^2=78.55$, $P<0.001$, d.f. 8). However, in the winter there do not exist significant differences between the sizes of flying evening flocks and feeding flocks ($x^2=12.18$, d.f. 8); between morning flocks and feeding flocks differences in winter months are also significant ($\chi^2=29.69$, $P<0.01$, d.f. 8). In the spring the differences again become greater, there being highly significant differences between evening flocks and feeding flocks ($\chi^2=36.88$, $P<0.001$, d.f. 8). Spring observations of morning flights are too few for statistical comparisons.

The observed seasonal differences can be interpreted as follows. In the autumn and spring, although feeding flocks are large, birds do not leave their feeding places simultaneously, but in small groups over a rather long period. In the winter, when food conditions are not so good, birds have to spend most of the daylight period foraging. Therefore feeding flocks leave for the roost in their entirety, and hence feeding flocks and flocks flying towards roost are of almost

TABLE 2. Size distribution of Jackdaw flocks in flight towards their roost in the evenings at Kangasala.

Size of flocks	1-2	3-4	5-8	9-16	17-32	33-64	65-125	126-250	251-500	N
IX—XI	68	45	45	44	74	56	46	10	0	388
%	17.5	11.6	11.6	11.3	19.1	14.4	11.8	2.6		
XII—II	52	33	34	50	45	34	14	9	0	271
%	19.2	12.2	12.6	18.4	16.6	12.6	5.2	3.3		
III—IV	65	39	47	56	54	26	7	0	0	294
%	22.1	13.3	16.0	19.0	18.4	8.8	2.4			

TABLE 3. Size distribution of Jackdaw flocks observed in flight from their roost in the morning at Kangasala.

Size of flocks	1-2	3-4	5-8	9-16	17-32	33-64	65-125	126-250	251-500	N
IX—XI	53	18	22	18	17	13	3	2	0	146
%	36.3	12.3	15.1	12.3	11.6	8.9	2.1	1.2		
XII—II	64	40	43	27	18	11	3	0	0	206
%	31.1	19.4	20.9	13.1	8.7	5.3	1.4			
III—IV	15	6	4	1	0	2	0	0	0	28
%	53.6	21.4	14.3	3.6		7.1				

equal size. As to the flocks flying from the roost in the morning they differ also in the winter from feeding flocks in respect of size due to the fact that some flocks split up before passing Kangasala observation line, as some birds stop to feed before it, and so pass it in several groups.

Conclusions and discussion

Our investigations show that Jackdaws at Tampere change their roosting habits seasonally. These changes take place at approximately the same dates as the migrating Jackdaws leave our country in the autumn and return here in the spring, i.e. at the end of October and of March. The Jackdaws form one large roost in the winter; in the summer they roost in numerous smaller groups scattered over a wide area. In the winter they feed in many small groups within an area of about 1000 sq. km.

These results agree with those obtained in other study areas. For example, it has been generally noticed that Jackdaws change their roosts seasonally (BORGVALL 1952, ASCHOFF & V. HOLST 1960, COOMBS 1961, LUNDIN 1962, LINT 1964, 1971). These changes take place at approximately the same dates in all populations studied despite considerable latitudinal differences. Although Tartu in Estonia lies about 3° south of Tampere, the winter roost was there established in the period of 1961 to 1966 in mid-October (LINT 1971), about a fortnight earlier than at Tampere.

At Uppsala LUNDIN (1962) found that in autumn the numbers of roosting Jackdaws in the city area increased, reaching a maximum by the end of September. At the same time a rural roosting place studied was abandoned. In this place roosting was observed in the late summer and early autumn. In principle the latter observations correspond to those made at Kangasala, and the former with those made at Tampere. Similar records about changes in the numbers of roosting Jackdaws have been made elsewhere, e.g. at Heidelberg (ASCHOFF & V. HOLST 1960) and at Tartu (LINT 1971). At Tartu the numbers of local Jackdaws roosting collectively before the winter roost in the central parts of the city was established, was the same, about 100, as at Tampere.

In all areas, Jackdaws tend to begin their daily activities in the winter at much lower light intensity than in the summer. In Fig. 7 the length of the period between the departure from the roost and the flight to it during winter months at Heidelberg and at Tampere are compared. Throughout the winter the active period is clearly shorter at Tampere. In mid-winter the difference is about 3 hours. In the late summer (July and August) Jackdaws are active

roughly as long a period at Heidelberg as at Tampere, about 16 hours, although the day is much longer at Tampere.

It is likely that day length in high latitudes limits the wintering of birds which are hardy enough to resist severe climatical conditions. Jackdaws must be able to adjust themselves to greatly varying light conditions at different seasons and also in different areas. Some Finnish Jackdaws migrate, wintering in more southerly areas; most foreign banding recoveries are from Denmark and southernmost Sweden (v. HAARTMAN et al. 1968, BUSSE 1969). Apparently, however, our Jackdaws do not belong to two genetically differing groups in respect of their light responses, as migrating habits seem to change with age, juveniles migrating more commonly than adult birds.

In all areas, Jackdaws start their activity during summer months after sunrise, and cease before sunset. In the winter period, they begin their daily activities while darkness, or at least twilight, still prevails, and finish them under corresponding light conditions in the evening. Latitudinal differences exist, however, as at Tampere and at Uppsala activity begins and ends at lower light intensity than at Heidelberg. The Jackdaws apparently need a longer period for foraging in the North. However, at Tampere some Jackdaws can often be seen sitting inactive for long periods even during winter days. For this reason it seems justified to conclude that there is enough food available even at that time, at least for the most successful individuals. Some man-made habitats obviously abound with food throughout the year. Reference may be made to observations made by PAATELA (1948) at Vitele village, Soviet Karelia. Almost half of the Jackdaws' active period on March 14 was spent in sitting.

The numbers of Jackdaws in winter roosts studied elsewhere have been much larger than at Tampere. In Finland the Jackdaw population is rather small, according to MERIKALLIO (1955, 1958) only about 11 000 pairs.

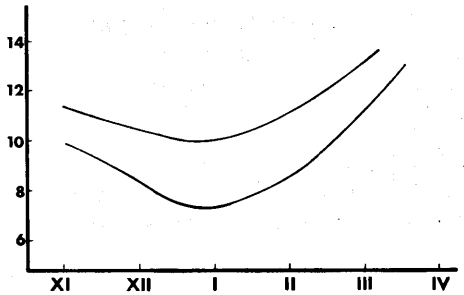

FIG. 7. The length of the period between the departure from the roost and the flight to it at Heidelberg (ASCHOFF & v. HOLST 1960) and at Tampere during the winter months.

On the other hand, the feeding area of the Jackdaws roosting at Tampere is exceptionally large. Only in Uppsala according to LUNDIN (1962) was the feeding area covered by Jackdaws of a single roost of equal size. However, there were in the Uppsala roost some 40 000 birds and at Tampere at most about 2 000. British investigations of Jackdaws (COOMBS 1961) have shown that the feeding areas of 13 roosts with 2 000 — 11 000 Jackdaws in each ranged from 75 to 650 sq. km. In all these British roosts there were in addition great numbers of Rooks competing with the Jackdaws for more or less the same food.

Food resources in Finland are apparently much smaller and more scattered than in Western Europe, and hence the Jackdaws have to seek their food over greater distances.

In the breeding season, too, Jackdaws may fly to distant feeding places. A. Haapanen and J. Tast (unpubl.) found Jackdaws breeding in a virgin wood at Evo in 1958 rather far from human settlement. The Jackdaws in this case, were seen flying about 10 km to the village when searching for food.

Why do the Jackdaws roost in winter in cities and not in rural areas where most of them feed? Recently NUORTEVA (1971) has shown that the bird biomass in Helsinki City exceeds that of more natural forested and cultivated habitats by about ten times throughout the year. According to him "the density of urban birds indicates, however, only the degree of 'leakage' of biological material from the human community to the immediate urban environment." Surely, this generally holds true, although it cannot be an explanation for the roosting of Jackdaws in urban habitats, as only a small proportion of birds feeds in cities and most birds have to fly tens of kilometers daily to their rural (although man-made) feeding grounds. The study areas of NUORTEVA almost totally lacked Jackdaws.

There are controversial opinions of the function of communal roosts. According to WYNNE-EDWARDS (1962 pp. 298—299) the primary function of the roost is to bring members of the population-unit together with resulting adjustment of population density through emigration. ZAHAVI (1971) is of the view that the significance of communal roosting is in acting as information centres of food location. Several investigators (e.g. LACK 1966, GADGIL 1972) assume that predator avoidance is an essential advantage of communal roosting. LACK (1966 p. 306) states: "Further synchronized flights prior to entering the roost . . . , are identical with the behaviour of starlings when a falcon attacks, so are presumably a form of behaviour evolved to confuse birds of prey to which otherwise the assembling starlings might be especially vulnerable."

With respect to the roosting of Jackdaws and their assembling flights prior to, it seems unlikely that this behaviour could have a function of confusing birds of prey, as Jackdaws are very noisy not only during assembling flights but also in their roosts (p. 35). However, in the roosting of Jackdaws some aspects of defence against birds of prey may be involved, as winter roosts are situated in cities where birds of prey are rarely met with.

In other circumstances the roosting assemblages of Corvidae surely form a good target for birds of prey. Thus, TUOMINEN (1968) several times found Goshawks *Accipiter gentilis* attacking Crows in their roosts and he found remains of 7 Crows killed by Goshawks. Once he also observed a Ural owl *Strix uralensis* attacking roosting Crows. TUOMINEN states that the Goshawk has better sight in twilight than Crows. LINT (1964) recorded predatory attacks of Goshawks on roosts of different species of Corvidae in Estonia.

Although a large and noisy roost is easily detected by a predator, for the individual bird it may be safer than solitary roosting, as it has a chance of escaping a predatory attack by seeking shelter among members of the same species, as pointed out recently by GADGIL (1972). He also states that "birds which inhabit open country may not be able to render themselves very inconspicuous even when roosting solitary, and therefore may not lose much by roosting in large groups." In fact, Jackdaws are birds of relatively open country. BRAESTRUP (1963) stresses that in the case of large roosts there would have to be a heavy concentration of predators in order to cause any significant mortality. As yet, there is no evidence that this is actually the case.

BRAESTRUP (1963) points out that "communal roosts are generally situated in very protected places, not only in respect to predators, but also with regard to climatic conditions." This view is supported by Swiss observations about winter roosts of the Brambling *Fringilla montifringilla* (GUÉNIAT 1948), and it fits in well with our observations. During the most severe cold periods Jackdaws have roosted on roofs of some

houses round the Central Market (p. 31) near to chimneys indicating that microclimatic factors are also to be taken into consideration. The winter 1972/1973 was unusually warm and the mid-winter roosting on roofs was observed during a very short period only, as roosting was re-established at Konsulinsaari almost a month earlier than during normal winters.

As a matter of fact, the city climate is throughout the winter milder than the average. During a ten-day period, February 3rd through 12th, 1973, temperatures were registered on a roof in Tampere City about 1 km from the Konsulinsaari winter roost. In the following some of the results are compared with those taken at the Tampere Meteorological Station at Tampere Airport about 5 km from Konsulinsaari:

	mean	minimum	maximum
Airport	—4.3°	—18.6°	+1.3°
City	—4.1°	—14.0°	+1.8°

As to the wintering of the Jackdaws, in microclimatic conditions obviously the minimum temperatures, i.e. the coldest nights, are the most critical, and differences on such nights are considerable. Differences in means, too, would surely be remarkably greater during a cold period than in the above.

In conclusion, we quote the following from BRAESTRUP (1963): "Even if it is reasonably certain that the chief survival value of communal roosts consists in reduced mortality during the night . . . this does not necessarily mean that communal roosts have no social significance." Probably roosting behaviour has a function in synchronizing various activities, for instance.

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Selostus: **Tampereella talvehtivien naakkojen yöpymisestä ja yöpymislennoista.**

Tampereen kaupungin City-alueelle naakka on asettunut pesimään 1940- ja 1950-lukujen vaihteessa. Sitä ennen lajin tapaaminen varsinaisessa kaupungin keskustassa on ollut satunnaista sekä kesällä että talvella. Samanaikaisesti kun naakka alkoi pesiä kaupungissa, siitä tuli myöskin säännöllinen talvilintu. Talvehtiva kanta kasvoi nopeasti, ja nykyisin kaupungissa yöpyy talvisin 1000—2000 naakkaa säännöllisesti.

Käsillä olevassa tutkimuksessa selvitetään talviparven yöpymistä ja yöpymis- sekä ruokailupaikkojen välistä säännöllistä aamu- ja iltalentoa, joka ulottuu 30 km:n päähän yöpymispaikasta. Talvehtiva parvi liikkuu ruokailemassa ainakin 1000 km²:n laajuisella alueella. Missään ulkomaisessa tutkimuksessa ei ole todettu vastaavankokoista ruokailualuetta huolimatta siitä, että Tampereella talvehtiva (= yöpyvä) parvi on kooltaan selvästi pienempi kuin Ruotsissa ja Keski-Euroopassa tutkitut kaupungeissa yöpyvät parvet. Suomessa on naakalle sopivia ruokailupaikkoja verraten niukasti ja ne sijaitsevat hajallaan, joten parven yksilöiden on liikuttava laajalla alueella.

Pesintäkaudella linnut yöpyvät pesiensä välittömässä läheisyydessä; loppukesällä ja alkusyksystä useina suurehkoina parvina laajalla alueella, mutta talvisin yhtenä suurparvena keskikaupungilla, missä on todettu lintujen käyttävän kolmea yöpymispaikkaa 400 m:n etäisyydellä toisistaan (kuva 1). Talviset yöpymistavat alkavat loka—marraskuun vaihteen tienoilla (s. 32) ja päättyvät maalis—huhtikuun vaihteessa, jolloin parvi hajoaa. Molem-

mat ajankohdat sattuvat yhteen muuttavien naakkojen muuttoaikojen kanssa.

Talvella lintujen 'työpäivä' alkaa ennen auringonnousua ja päättyy illalla hämärän vallitessa auringon laskun jälkeen (kuva 2). Kesällä lintujen liikkeelle lähtö tapahtuu vasta auringonnousun jälkeen ja illalla naakat asettuvat yöpuulle ennen auringonlaskua (kuva 3).

Lentäessään aamuin ja illoin ruokailu- ja yöpymispaikkojen väliä naakat käyttävät maastossa esiintyviä johtolinjoja. Kangasalle ja Sahalahteen suuntautuva lentoreitti seuraa itälänsi suuntaista harjujaksoa (kuvat 4 ja 5). Kun esimerkiksi ne linnut, jotka ruokailevat k.o. linjan eteläpuolella, illalla lähtevät kohti Tamperetta, ne lentävät ensin kohti e.m. harjua ja sitten kääntyvät jyrkästi lentäen harjun suuntaisesti kaupunkiin. Lentonopeus on noin 50 km/t. Linnut saapuvat iltaisin kaupunkiin kokoontumispaikkoihin jo paljon ennen yöpymisen alkua ja suorittavat äänekkäitä kierrelentoja.

Yöpymislentoja suorittavien ja ruokailevien naakkaparvien kokoa on tarkkailtu Kangasalla ja Sahalahdella ja todettu niissä tilastollisesti merkitseviä eroja eri vuodenaikoina (taulukot 1—3). Talvella ruokailevat parvet ovat yleensä pieniä, linnut ovat levittäytyneet pikku parvina laajalle alueelle (kuva 6), syksyisin ja keväisin naakat sitävastoin ruokailevat muutamana suurparvena.

Kun verrataan naakkojen työpäivän pituutta Tampereella ja Heidelbergissä, etelä-Saksassa, todetaan, että Suomessa talvehtivat linnut joutuvat selviytymään 2—3 tuntia lyhyemmässä ajassa ruokailusta ja muista tehtävistä (kuva 7). Monien ilmastollisesti karaistuneiden lajien talvehtimista pohjoisilla leveyksillä rajoittaa valoisan ajan pituus: linnut eivät lyhyenä talvipäivänä ehdi hakea riittävästi ravintoa.

Tuloksien tarkastelun yhteydessä pohditaan kysymystä siitä, miksi naakat talvella yöpyvät yhtenä suurparvena keskikaupungilla ja joutuvat päivittäin lentämään jopa 60 km tästä syystä. Lintujen ryhmäyöpymisen merkityksestä eivät tutkijat ole vielä päässeet yksimielisyyteen. Aivan ilmeisesti ryhmäyöpyminen jollain tavoin vähentää lintujen kuolleisuutta yöllä: kaupunkien yöpymispaikoilla on vähemmän petolintuja ja vaikka suuri, äänekäs parvi on helposti havaittavissa, ei ainakaan toistaiseksi ole voitu osoittaa, että yöpymisparvi vetäisi petoja puoleensa, joten petojen aiheuttama kuolleisuus olisi todennäköisesti suurempi, jos linnut yöpyisivät pikku ryhminä useampien petolintuyksilöiden saalistusalueilla. Myös kaupunkien yöpymispaikat ovat ilmastollisesti edullisempia, koska kaupungeissa on lämpöisempää kuin maaseudulla. Varmasti ryhmäyöpymisellä on myös sosiaalisia tehtäviä, esimerkiksi erilaisten elintoimintojen samanaikaistaminen.

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