Breeding success of Finnish birds in the bad summer of 1981

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In Finland summer 1981 was exceptionally cold and rainy. The effects of the bad weather on breeding in birds varied widely between both species and localities.

In the archipelago, particularly heavy losses were suffered by *Sterna paradisaea, S. hirundo, S. caspia* and *Larus canus,* locally also by *Somateria mollissima.* In inland waters, very poor breeding success was noted in *Larus canus, L. ridibundus, S. hirundo* and *Podiceps cristatus,* and most species seem to have suffered greater than average losses. Of the box-nesting species, *Parus major* and *P. caeruleus* experienced high mortality of young, while *Ficedula hypoleuca* showed striking geographical differences in its breeding success: about normal in the southern half of Finland but extremely poor in Lapland. Of the other species studied in Lapland, *Phoenicurus phoenicurus* and *Luscinia svecica* managed as well as normal, but *Fringilla montifringilla* produced very few young. Scattered notes on other species revealed low production of young in tetraonids and local deaths of adults in *Apus apus, Delichon urbica* and *Hirundo rustica,* whereas relatively few open-nesting passerines seem to have suffered from the bad weather.

The poor summer obviously affected the breeding in many ways, both directly by destroying nests and chilling young, and indirectly by reducing the food supply.

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Introduction

'The years are not brothers' says an old Finnish proverb. A book-learned modern scientist would express the same observation in another way: Due to the confrontation of the Atlantic and the continental air masses, our climate varies considerably from year to year.

A connection between bad weather and poor breeding success in birds has been suggested by many ornithologists, and may well have been evident to laymen for many hundreds of years. In his famous book *Seitsemän veljestä (Seven brothers),* the first and perhaps the best novel ever written in the Finnish language, Aleksis Kivi (1870) observes that "the cold spring badly hindered the reproduction of creatures in the woodland".

In Finland long periods of bad weather coinciding with the breeding season occur once or twice in a decade. In 1977, the weather was cold and rainy from mid-June onwards and the breeding success of many bird species was found to be poor, but unfortunately, no comprehensive survey was made of the observations.

During the breeding season of 1981 we saw deserted nests, dying young and even dead

adults of different species in both the south and north of Finland. A request published in this journal furnished many more observations by other ornithologists and enabled us to make this report on the weather and breeding success in 1981.

Weather conditions

The warm period in Finland in the latter half of May 1981 came to a sudden end at the beginning of June (Fig. 1). Throughout the country the June weather was unsettled and rainy. An area of low pressure arriving from the southwest caused especially heavy rain and snow on 12—13 June. In Lapland 1—15 cm of snow fell on 12 June, and 1—20 cm of snow fell on 15 June in NE Lapland, though not in NW Lapland.

The country had fine summer weather on only one day in the whole of June: on 24 June a heat wave moved rapidly across Finland. The June temperature failed to rise above normal (period 1931—1960) in any part of the country and in places, especially in northern Finland, it was 2—3°C lower than normal (Table 1). In southern and central Finland and NE Lapland the precipitation in June was two to three times as high as normal, whereas in NW Lapland it was a little lower than normal (80—100 %).

On the coast and in N Finland the mean July temperature was 0.5—1 degrees below normal, but elsewhere 0—1 degrees above. The weather was unsettled and the daily mean temperature varied greatly, especially in the north. In contrast to the pattern in June, the precipitation was highest in NW Lapland (2—3 times as high as normal), whereas in the rest of the country July was not so rainy (about 1.5 times the normal level). The geographical differences in the weather caused corresponding variation in the nesting success of birds.

Archipelago birds

The observations that follow are mainly from the villages of Anavainen and Lypertö in the commune of Kustavi, SW Finland (M. Soikkeli).

The temperature fell in early June; on 3 June it sank to 1.8°C in Mariehamn, Åland, and 2.5°C in Turku. On 4 June it began to rain. On 13—14 June a NW wind with a speed of 30 m/s caused the sea level to rise exceptionally high. The weather improved for only a few days in late June.

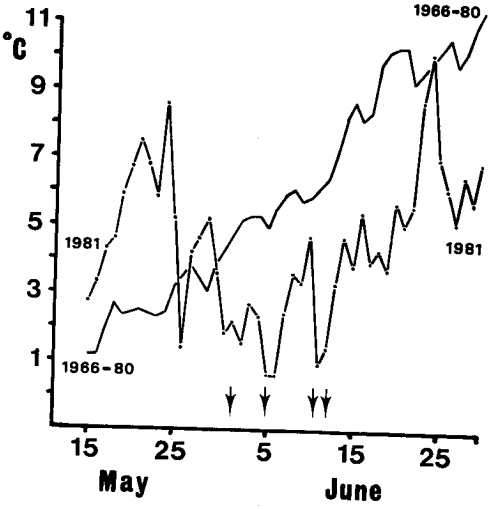

FIG. 1. Mean daily temperature (°C) at Kilpisjärvi (69°03′N, 20°50′E) between 15 May and 30 June 1981, compared with long-term averages (1966—1980, continuous line) for the same period. Arrows indicate snowfalls in 1981.

Ducks. The most remarkable observation in the study area was the small number of Eider *Somateria mollissima* young. In normal years one can see hundreds of Eider ducklings when travelling for some hours by boat, but by late June almost all the young hatched in May or early June had died. In July some small ducklings from later nests were observed, but they also disappeared one by one.

In the archipelago of Rauma, c. 50 km to the north, R. Sundelin noted that Eider young were clearly fewer than in earlier years, but in Kirkkonummi not far from Helsinki G. Bergman recorded moderate production of young and in Söderskär M. Hario found that the breeding success was good.

Young of the Goldeneye *Bucephala clangula* were also scarce in Kustavi. From the Rauma archipelago R. Sundelin reported "very few young" of the Tufted Duck *Aythya fuligula.*

Compared with the diving ducks, the Mallard *Anas platyrhynchos* did well in Kustavi; its broods were seen more often than Eider broods, although the Mallard population is at most one tenth of the number of Eiders. Similarly, the broods of the Goosander *Mergus merganser* succeeded well.

Gulls and terns. The most accurate data concern the Common Gull *Larus canus.* The

TABLE 1. June and July were cold and rainy in Finland in 1981. Long-term average temperature (°C) and precipitation (mm) compared with those in 1981 at selected Finnish meteorological stations.

	Helsinki 60°09'N 24°58'E	Jyväskylä 62°14'N 25°44'E	Kuopio 62°54'N 27°40'E	Vaasa 63°04'N 21°46'E	Kemi 65°44'N 24°35'E	Sodankylä 67°45'N 27°00'E	Kilpisjärvi 69°03'N 20°50'E
Mean temperature							
June 1931—60[1]	+14.5	+13.3	+14.0	+12.8	+12.1	+11.3	+8.0
June 1981	+12.7	+12.3	+12.6	+12.1	+9.9	+8.6	+4.3
July 1931—60[1]	+17.8	+16.3	+17.1	+16.2	+16.1	+14.7	+10.9
July 1981	+17.0	+16.7	+17.8	+16.1	+14.9	+14.3	+10.2
Mean precipitation							
June 1931—60[1]	47	54	59	44	40	56	37
June 1981	136	157	131	119	99	104	29
July 1931—60[1]	62	81	68	62	60	74	63
July 1981	70	146	57	48	111	92	122

[1] Kilpisjärvi 1966—80.

first young hatched in the second week of June, but in the storm and rain the small chicks died in the nest or the eggs disappeared from the nest before hatching.

The following numbers of half-grown young show how poor reproduction was in 1981:

	Young per pair	Pairs observed
1979	2.4	12
1980	1.1	19
1981	0.3—0.4	20

In Söderskär near Helsinki M. Hario estimated that only 0.06 Common Gull young fledged per nest in 1981, but this was not much less than in the former summer. A colony of 100—150 pairs of Black-headed Gulls *L. ridibundus* nested on the western edge of Lypertö village, near the island Malör. On 17 June, after the storm, dozens of dead or dying young were seen, wet and chilled after the rain. Most of these chicks were more than one week old. In late June no dying young were observed, and in early July the number of fledglings was estimated at c. 230. Compared with the Common Gull, the Black-headed Gulls did well. From the Rauma archipelago, R. Sundelin reported that the production of young was good.

One of the largest colonies of the Caspian Tern *Sterna caspia* breeds on the skerry of Gadden, Brändö, Åland. On 2 June, 109 nests were counted and the first young were hatching. On 22 June only 10—15 young were seen, and next day J. Virtanen could ring only 22 chicks after a careful search. Thus, the number of young was only 0.2 per pair in 1981, which is the lowest value ever recorded in this colony. At the beginning of the 1970s, the average number of young per pair was 1.5 in the same colony (Soikkeli 1973).

Like the Eider, the Arctic Tern *Sterna paradisaea* produced almost no young. In Kustavi there are several small colonies of up to 30—40 pairs and many single pairs. Due to the high sea level, rain filling the nest cup or other reasons, nests were destroyed or the young died. In spite of this, the adults remained on the breeding islets until early July. The first full-grown chick was seen as late as 12 July. The first juveniles were not recorded before August, when the more northern populations passed the area on migration.

M. Rautkari found a similar lack of success among the Arctic Terns nesting in the Gullkrona area, south of Turku. I. Lahtonen, who has ringed "all" the young terns on a few skerries south of Rymättylä, SW of Turku, gave the following statistics:

	No. of young ringed per year	
	Arctic Tern	Common Tern
1966—70	36	196
1973—75	33	192
1976—80	21	94
1981	9	25

The number of young ringed in 1981 is the smallest since 1966 in the Common Tern *S.*

TABLE 2. Breeding success of the Black-throated Diver, Lesser Black-backed Gull, Common Gull, Black-headed Gull and Common Tern on Lake Suonteenjärvi, SE Finland, in 1980 and 1981.

	Gav arc		*Lar fus*		*Lar can*		*Lar rid*		*Ste hir*	
	80	81	80	81	80	81	80	81	80	81
Nests	18	17	11	7	67	69	37	57	56	57
Eggs	34	34	28	19	183	192	88	143	136	148
Young hatched	10	7	11	5	89	36	33	23	71	40
Young fledged	4	4	5	3	39	4	12	5	33	8
Total nesting success (%)	12	12	18	16	21	2	14	3	26	5

hirundo and the second smallest in the Arctic Tern (in 1980 only five Arctic Terns were ringed). Clearly, the breeding success of these two tern species was poor in this area.

To conclude, the breeding success was exceptionally poor in many archipelago species. The actual reasons for the losses of eggs and young remained obscure, but the direct or indirect effects of cold and rain seem most probable.

Lake birds

The bulk of observations come from the oligotrophic lake Suonteenjärvi, SE Finland (61° 41'N, 26°32'E), whose breeding birds have been studied systematically since 1962 (e.g. Lehtonen 1970, 1981).

The study area comprises the eastern part of the lake, whose water area totals about 35 km². In spring 1981 the water level was nearly a foot above the average for 1962—80 and remained high throughout the summer. An exceptionally cold, rainy and windy period on 6—21 June coincided with the hatching of the young of most water and shore birds. The temperature of the surface water was also unusually low. The most accurate data are available for the Black-throated Diver *Gavia arctica,* the Common Tern *Sterna hirundo* and the gulls *Larus fuscus, L. canus* and *L. ridibundus.* Nearly all the nests of these species were found and the nesting was followed continuously throughout the breeding season (Table 2). Hence, the overall breeding success could be calculated as the percentage of the eggs producing fledglings. In the case of the ducks only a general idea could be obtained of the fate of the broods.

The nesting of the Black-throated Diver did not suffer from the bad weather: the pairs produced as many young as in the preceding summer, which was warm and fine. The nests are usually situated on shores protected from wind, and the broods also stay in sheltered bays and on the leeward sides of islands; the food supply can hardly have been affected by the weather. The observation of two broods by P. Mättö on the neighbouring lake Puulavesi, where none had been seen for more than 10 years, also suggests that the species is not sensitive to bad weather (most losses are caused by interference by man).

In the Lesser Black-backed Gull, too, the fledging success was about the same as in 1980, but the material is scanty. It may be that the location of most nests in the shelter of trees, usually 5—30 m from the shore, makes them less susceptible to adverse weather than the more exposed nests of the two other gull species. In general, the reproduction of the Lesser Black-backed Gull on Suonteenjärvi is poor, due to interference by man.

The breeding success of the Common Gull was only one tenth of that of the preceding summer. The high water level was fatal to many nests situated on low rocks surrounded by water or close to the shoreline; during the storm they were washed away by the high waves. Even in nests located out of the reach of the waves, rain and cold caused large-scale mortality of eggs and chicks. The breeding success was also partly impaired by competition with the Black-headed Gull, which has increased strongly in recent times and displaced the Common Gull from its best nesting sites.

The reproduction of the Black-headed Gull on Suonteenjärvi has always been poor, but in 1981 it was lower than ever before. Although the nests were sheltered from the waves, many chicks died, as they were blown down to the water by the wind and were not able to get back to the nesting rock. Otherwise, the reasons for the high losses of eggs and young in 1981 are unknown.

The nests of the Common Tern are part-

icularly exposed to rain and storm. High winds may sweep the eggs out of the nests situated on smooth rocks, or the nest scrape may be filled with rain. This frequently happened in 1981, resulting in almost complete failure of the first nests. Most of them were lost during the storm on 9—11 June, but intensive display and renesting took place on 19—23 June. The majority of the eggs or chicks of the second nests were also destroyed, and the total production of young was less than a quarter of that of the previous summer.

The data on ducks are meagre, but the very few broods and their small size in late summer suggest that the losses were exceptionally high. The following tabulation shows the number of ducklings in individually known broods when the young were small (= S) and nearly full-grown (= Fg) in 1980 and 1981:

	1980		1981	
	S	Fg	S	Fg
Anas platyrhynchos	31	16	2	—
A. crecca	7	4	—	—
Bucephala clangula	24	7	23	2
Mergus serrator	43	12	16	4
Total	125	39	41	6

Complementary data have been reported from different parts of southern and central Finland by the following persons: K. Degerstedt, B. Ekstam, S. Jussila, M. Kallela, J. Knuutinen, L. Lehtonen, M. Linkola, A. Marjakangas, P. Mättö and R. Pakarinen. Although sparse, the material shows that the losses suffered by the birds of inland waters were everywhere greater than average. The following general conclusions can be drawn:

(1) The breeding success was usually less than 50 % of the normal. Locally, some species experienced nearly complete failure, e.g. the Common Gulls in Karkkila (K. Degerstedt), Black-headed Gulls in Rautalampi (J. Knuutinen & R. Pakarinen), Common Terns in Viitasaari (S. Jussila) and Great Crested Grebes *Podiceps cristatus* in Helsinki (L. Lehtonen) and Vihti (M. Kallela).

(2) A considerable part of the losses in gulls, terns and grebes were caused during the egg stage by the high water level. High water also destroyed several nests of the Marsh Harrier *Circus aeruginosus* (B. Ekstam).

(3) The number of young in newly-hatched broods of ducks (usually 1—5) and grebes (usually 1—3) was only 20—50 % of that in average years.

TABLE 3. Frequency (%) of nests with dead young in three box-nesting species in Kirkkonummi, S Finland.

	All fledged		Some dead		All dead	
Parus major						
1972—80 (*N*=512)						
Lowest	13.2	(1977)	21.4	(1975)	0.0	(1975)
Highest	78.6	(1975)	83.8	(1978)	18.6	(1974)
Mean	31.1		18.9		6.0	
1981 (*N*= 48)	4.2		77.1		18.8	
Parus caeruleus						
1972—80 (*N*=171)						
Lowest	28.6	(1979)	28.6	(1975)	0.0	(6×)
Highest	71.4	(1975)	71.4	(1979)	10.0	(1978)
Mean	46.0		51.8		2.2	
1981 (*N*= 27)	25.9		63.0		11.1	
Ficedula hypoleuca						
1975—80 (*N*=273)						
Lowest	44.1	(1977)	23.1	(1978)	2.2	(1980)
Highest	71.1	(1980)	42.6	(1977)	15.4	(1978)
Mean	55.9		34.4		9.7	
1981 (*N*= 60)	48.3		41.7		10.0	

TABLE 4. Fledging success in three box-nesting species in Kirkkonummi, S Finland.

	1972—80[1]						1981
	Lowest		Highest		Mean		
Parus major							
Fledglings/brood[2]	5.57	(1974)	8.94	(1975)	6.96		5.69
Fledglings/pair[3]	4.55	(1974)	8.94	(1975)	6.59		4.63
Parus caeruleus							
Fledglings/brood[2]	7.69	(1972)	10.79	(1975)	9.38		8.25
Fledglings/pair[3]	7.69	(1972)	10.79	(1975)	9.17		7.52
Ficedula hypoleuca							
Fledglings/brood[2]	5.11	(1977)	5.82	(1978)	5.50		5.43
Fledglings/pair[3]	4.43	(1977)	5.65	(1980)	5.07		4.94

[1] For *F. hypoleuca* 1975—80.
[2] No. of fledglings in successful broods (at least one chick fledged).
[3] No. of fledglings per pair, exclusive of robbed or deserted nests.

(4) The frequent renesting of ducks resulted in exceptionally late broods, still unfledged at the beginning of the hunting season in early September.

(5) Large numbers of adult birds (ducks, grebes, gulls and terns) were seen throughout the summer, either singly or in flocks, which indicates that many pairs failed to breed or were unsuccessful.

(6) Birds that had lost their nests or young disappeared from their breeding areas 3—6 weeks earlier than usual. On Suonteenjärvi, for example, more than 90 % of the Black-headed Gulls had left the lake by 25—30 June, 85—90 % of the Common Gulls by 5—9 July, and c. 90 % of the Red-breasted Mergansers *Mergus serrator* by 28 June — 1 July (L. Lehtonen).

Box-nesting species

Reliable data on the breeding success are especially easily obtained for box-nesting species. Four to five correctly timed checks during the breeding cycle reveal all the important parameters: the onset of egg-laying, clutch size, number of young hatched and number of fledglings. In Kirkkonummi, about 30 km west of Helsinki, a long-term study on box-nesting passerines has been in progress since the middle of the 1960s (e.g. Hildén 1981). Three of the species are sufficiently common to yield enough material for calculation of the annual breeding success, namely the Great Tit *Parus major*, Blue Tit *P. caeruleus* and Pied Flycatcher *Ficedula hypoleuca*. In the following, the breeding success in 1981 has been compared with that in the period 1972—80, during which the number (c. 250) and distribution of boxes have remained almost constant. For the tits, only the first clutches are considered.

One way of measuring the effect of weather on the breeding is to calculate the frequency of young dying in the nest (Table 3). In addition to the young actually found dead in the boxes, the "missing" young are considered to have died and been removed from the nest by the parents. Another way is to calculate the numbers of fledglings leaving the nest per brood or per pair (Table 4). In this treatment, the last-mentioned parameter does not include robbed or deserted nests, as their frequency is not related to the weather factor but mainly to the abundance of the Great Spotted Woodpecker *Dendrocopos major* (the worst nest-predator in the area) and competition between the box-nesting species (some Great Tits also desert their nests when taken from the eggs).

The breeding success of the tits in 1981 was exceptionally low. In only two broods of the Great Tit did all the young leave the nest, while in most nests some and in almost 20 % all the young died (Table 3). The mean number of fledglings was clearly lower than in any previous season during 1972—80,

except for 1974 (Table 4). The Blue Tit was somewhat more successful, as in general, but nevertheless the number of young produced was the lowest in the 10-year period. In contrast, the Pied Flycatcher did fairly well. Both the frequency of dead young and the fledging success in 1981 lie near the mean values for 1975—80, and the production of young was significantly higher than in 1977 (Tables 3 and 4; the years 1972—74 have been omitted since the data are incomplete).

Do the reports from other areas agree with the above results from Kirkkonummi? Nowadays, studies on box-nesting birds are popular in Finland, and since 1975 about 40 localities have participated in a joint scheme. Table 5 gives information on the breeding success of the Great Tit and the Pied Flycatcher in those areas from which sufficiently detailed reports have been received so far. For the Great Tit, breeding success was poor (less than 5 fledglings/pair) in six areas, all of them in southernmost Finland. In Lohja, Valkeakoski and Kuhmoinen, the three areas with very low values, all the young died in half of the 34 nests! In seven areas the result was about normal or slightly below normal (5—7 fl./pair), and in two areas it was high (more than 7 fl./pair).

The Pied Flycatcher coped with the rainy summer well. Only Lohja experienced poor breeding success (4.09 fl./pair); in all the other localities the result was either normal or even high. In Liperi, where no less than 6.04 young fledged per pair, the production of young was clearly the highest during the 6-year period (1976—81). For both species, breeding was markedly more successful in the central and northern parts of the country, except Lapland (p. 28), than in southernmost Finland.

Of the box areas outside Kirkkonummi, only Helsinki has a good population of Blue Tits. In the following tabulation, these two areas are presented separately and the others combined:

	No. of nests	Fledglings/pair
Kirkkonummi	34	7.52
Helsinki	30	7.00
Other areas	37	6.35

The results show that the breeding success of this species was below normal everywhere.

The Coal Tit *Parus ater* is a still scarcer inhabitant of boxes, so all 15 nests in the material were combined. Not a single chick died in these nests and the number of fledglings/pair was as high as 9.27! It seems to be typical of this species that the losses of young are minimal: if only the nests are spared by

TABLE 5. Nesting success of the Great Tit and Pied Flycatcher in different parts of Finland in 1981, expressed as the number of fledglings per pair (exclusive of robbed or deserted nests).

Area	Location	Observer	*P. major*		*F. hypoleuca*	
			No. of nests	Fledgl. per pair	No. of nests	Fledgl. per pair
Rymättylä	60°17'N 21°56'E	L. Saari	6	3.83	28	5.07
Turku	60°22'N 22°10'E	K. Grönkvist	9	5.33	9	5.44
Dragsfjärd	60°07'N 22°26'E	M. Rautkari	5	6.20	35	4.89
Karkkila	60°31'N 24°13'E	K. Degerstedt	8	4.75	13	4.69
Lohja	60°15'N 23°57'E	A. Magnusson	13	3.23	24	4.09
Kirkkonummi	60°06'N 24°35'E	O. Hildén	49	4.63	60	4.92
Helsinki	60°10'N 24°57'E	M. Hildén	36	5.53	5	4.60
Pori	61°28'N 21°48'E	P. Korhonen	30	8.37	36	5.86
Valkeakoski	61°14'N 23°58'E	P. Nikkanen	7	2.71	16	4.63
Kuhmoinen	61°34'N 25°13'E	R. Nieminen	14	3.00	16	5.63
Mäntyharju A	61°15'N 26°45'E	A. Reinikainen	3	6.88	13	5.45
Mäntyharju B	61°34'N 26°40'E	H. & S. Pöysä	5		16	
Vaasa	63°04'N 21°38'E	T. Hurme	8	7.00	22	4.55
Liperi	62°37'N 29°28'E	J. & V. Pusa	13	8.08	46	6.04
Liminka	64°48'N 25°20'E	J. Hirvelä	32	6.56	37	5.22
Yli-Ii	65°22'N 25°50'E	S. Jussila	—	—	15	5.73
Kemi	65°47'N 24°42'E	P. Rauhala	7	6.71	18	5.83

predators and competitors (many are robbed by the Great Spotted Woodpecker or occupied by the Pied Flycatcher), all the young usually fledge.

One report (P. Siitonen from the area of Salo, SW Finland) concerns a population of Treecreepers *Certhia familiaris* nesting in boxes of special construction. According to the number of fledglings/pair, the production of young was clearly lower in 1981 than in the previous year (both first and second clutches are included): 1980 5.21 (*N* 28), 1981 4.41 (*N* 17).

How can the striking differences between the areas be explained? One factor which was found to influence the breeding success in Kirkkonummi was the exposure of the nest-box to rain. This is dependent on the tree species to which the box is attached, the placing of the box relative to the inclination of the trunk, the shelter provided by the branches, the method of attachment, the material and quality of the roof, etc. In deciduous trees and pines, most of the rain flows down the trunk and penetrates easily into the box, especially if this is attached directly to the trunk, or if the roof is broken. In the rainy summer of 1981, the nests in such boxes were soaking wet and the young usually in poor condition or dead. In spruces, on the other hand, the rain flows and drips down along the branches, leaving the trunk dry. Consequently, the boxes on spruce trunks remained dry and the broods experienced much smaller losses.

This may be an important reason for the local differences in breeding success. In Yli-Ii, for example, the high production of young in the Pied Flycatcher was attributed to the location of the boxes "in spruces or other sites protected against rain" (S. Jussila). More conclusive evidence is provided by the exceptionally high breeding success in Pori. In this area, the investigator has experimented for years with the model and material of the boxes and their location in the terrain, in an effort to minimize penetration of rain into the boxes (P. Korhonen). Even in the rainy summer of 1981 his boxes remained dry, which may explain why so few young died. An unusual example of the harmful effect of rain on nesting was reported from Nokia, central Finland (H. Karhe). On 31 May, a pair of Blue Tits had a nest with 12 eggs in a natural hole in a white willow. On 21 June the hole was full of water and dead chicks were floating on the surface! Two Blue Tit nests with all the young dead, reported from Lahti, were "literally swimming in rain water" (H. Kolunen).

TABLE 6. Nesting success of the Pied Flycatcher and the Redstart at Kilpisjärvi, NW Finnish Lapland, in 1966—80 and 1981. Number of nests given in parentheses.

Species	1966—80	1981
Pied Flycatcher		
Eggs laid/nest	5.51 (403)	5.97 (31)
Young hatched/nest	4.52 (403)	2.00 (35)
Young fledged/nest	3.64 (403)	1.54 (35)
Nesting success	66.1 %	25.8 %
Redstart		
Eggs laid/nest	6.42 (91)	6.40 (10)
Young hatched/nest	5.34 (91)	5.00 (10)
Young fledged/nest	4.92 (91)	4.70 (10)
Nesting success	76.6 %	73.4 %

At least three other factors have played a part in the local differences in breeding success. First, microclimatic differences between the nesting sites may be important under adverse weather conditions (e.g. whether the box is exposed to wind on the shore or in a more sheltered position in the interior of the forest). Second, the habitats in which the boxes are placed vary with respect to the food supply, occurrence of parasitic insects and shelter against adverse weather. Third, the differences between areas are certainly accentuated by regional variation in temperature and precipitation, especially during the most critical period of nesting.

Birds of Lapland

The annual nesting success of the Pied Flycatcher *Ficedula hypoleuca* is known to vary considerably at Kilpisjärvi (about 69°03'N, 20°50'E), NW Finnish Lapland, but the Redstart *Phoenicurus phoenicurus* seems to be relatively well adapted to harsh northern conditions (Järvinen 1978, unpubl.). The main factor affecting mortality is the weather (Valanne et al. 1968, Järvinen 1980, 1982). Predation is negligible: in 1966—1979 about 1 % of the Pied Flycatcher nests and about 5 % of the Redstart nests were lost to predators (Järvinen 1980), and in 1981 there was no predation at all.

This difference in the adaptedness of these

two hole-nesting passerines was also evident in 1981. The Pied Flycatcher — a southern newcomer, which colonized subarctic Kilpisjärvi in the 1950s — suffered great losses, whereas the Redstart — a native inhabitant of the Lappish mountain birch forest — managed as well as normal. In 1981, 73.4 % of the Redstart eggs produced fledglings, as compared with the long-term average of 76.6 %. The corresponding values for the Pied Flycatcher were 25.8 % and 66.1 %, respectively. The results are summarized in Table 6.

The cold summer was clearly responsible for the poor breeding success of the Pied Flycatcher. In contrast to the situation further south, most of its losses were due to hatching failures. In 21 (60 %) out of 35 nests no eggs hatched. In four nests the parents (3 ♀♀ and 1 ♂) died in the nest; in 13 nests the females disappeared early during the incubation phase, and in four nests the females incubated, but no eggs hatched. In those 14 nests in which eggs hatched (5.0 ± 1.2/nest; *SD*), six suffered losses, so that the number of fledglings/nest was 3.9 ± 1.7.

Early Flycatcher clutches (first egg laid before 11 June), which were in the incubation phase during the coldest period (see Fig. 1), suffered greater losses than late ones (commenced after 10 June): total nesting success 20 % ($N=24$) and 64 % ($N=7$), respectively. During the cold spells the females probably either perished or they stopped incubating. At Kilpisjärvi the Pied Flycatcher does not incubate when the ambient temperature drops to about +2°C (Järvinen, unpubl.). In many cases eggs were left unincubated for 1—3 days, but some fresh eggs survived this interruption.

In 1966 and 1967 the total nesting success of the Pied Flycatcher at Kilpisjärvi was as poor as in 1981 (26.1 % and 28.3 %, respectively), although the factors responsible for the losses varied between those two years: in 1966 many eggs never hatched, apparently due to cold weather during the second half of June, whereas in 1967 there was high nestling mortality, because the whole nestling period (July) was exceptionally rainy (Valanne et al. 1968).

The year 1981 was the first in a period of 16 study years when adult birds were found dead in the nests. The females probably failed to find enough food to maintain their metabolic rate and fulfil the energy requirements of egg-laying and incubation. The three females died while incubating during the last cold "peak" between 11 and 13 June, when the weather was extremely cold and snowy (see Fig. 1).

It is suggestive that in 1981 Flycatcher females were about 7 % lighter than in the favourable season of 1980, and that their eggs were about 5 % lighter than in 1980:

1980	1981
Mean female weight	
15.32 ± 1.06 g ($N=36$)	14.25 ± 1.36 g ($N=24$)
$t=3.41$, $P<0.005$	
Mean egg weight/clutch	
1.62 ± 0.10 g ($N=24$)	1.71 ± 0.11 g ($N=32$)
$t=3.18$, $P<0.005$	

The females and eggs were weighed a couple of days after the clutches were completed. There was no difference in the average clutch size between the years, because the warm period in late May 1981 (see Fig. 1) induced approximately as early laying as in 1980.

According to I. Mäkisalo, the Pied Flycatcher suffered relatively great losses at Kittilä also (about 67°40′N, 24°54′E) in 1981: in 1980 5.5 young fledged per nest ($N=17$), but the corresponding figure for 1981 was 3.9 ($N=20$). At Kittilä most losses occurred during the nestling period in early July, when the weather was cold and rainy. In southern Lapland at Meltaus (about 66°54′N, 25°20′E) the nesting success of this species did not differ from the long-term average (H. Lindén).

Two typical open-nesting passerines of mountain birch forest, the Brambling *Fringilla montifringilla* and the Bluethroat *Luscinia s. svecica*, seemed to show an analogous dichotomy in nesting success to that in the hole-nesters discussed above. According to the ringing statistics (A. Järvinen, H. Pietiäinen, J. Piiroinen and A. Rajasärkkä), the Brambling produced very few young in 1981. In regular mist-nettings at Kilpisjärvi Biological Station between 15 July and 8 September, the ratio of juveniles to adults was 1:1.4 ($N=68$) in 1980, but 1:6.3 ($N=87$) in 1981 ($\chi^2=14.95$, $P<0.001$). As we do not have enough nesting data, the reasons for the poor success remain unknown.

During the heavy snowfall in NE Lapland in June 1977, about 87 % of the 23 Brambling nests were lost, probably owing to the snow (Pulliainen 1978). Snow was evidently not the main factor at Kilpisjärvi in 1981, since there were only a few days with a couple of centimetres of snow. It seems possible that the failure of the Brambling was indirectly due to the low temperature (in June about 3.7°C below the long-term average of +8°C), which forced the females to leave their nests unattended for long periods. Compared with that of the Bluethroat, for instance, the nest

of the Brambling is exposed, and thus vulnerable to predation. Three Brambling nests found at the end of May were robbed by crows during the cold period 1—5 June.

The Bluethroat, a close relative of the Redstart, with a covered nest, managed well at Kilpisjärvi in 1981: its nesting success was about 73 % ($N=25$), and the early clutches did as well as the late ones (A. Järvinen & H. Pietiäinen, unpubl.). Thus its nesting success was nearly the same as the average of about 74 % for 1969—80 (Järvinen & Pryl 1980). Apart from the fact that the cold tolerance of the Redstart and the Bluethroat seems to be better than that of the Pied Flycatcher, the former species feed mainly on the ground and are able to find food more easily during cold spells, when no flying insects are available.

Other species

We only have scattered notes on the breeding success of other bird species in 1981.

Tetraonids. According to the annual route-censuses organized in August by the Finnish Game and Fisheries Research Institute, the reproduction of tetraonids in 1981 was low, in S Finland even extremely low (Rajala & Lindén 1981). The cold and rainy weather also retarded the development of the chicks, many of them being only half-grown at the beginning of the hunting season in September (Marjakangas 1981, H. Lindén).

Waders. From Kemi, N Finland, P. Rauhala reports that the high water level, caused by heavy rains, destroyed many waders nests. In Rytikari, for instance, seven of the eight nests of Temminck's Stint *Calidris temminckii* were flooded and deserted, and the same fate was suffered by a nest of the Redshank *Tringa totanus* and a nest of Terek's Sandpiper *Xenus cinereus*. Newly hatched wader chicks are known to be sensitive to cold and rain. Thus, the bad weather in 1981 probably also reduced the production of young in waders, but data on this are lacking.

Swifts, martins and swallows. Throughout its life the Swift *Apus apus* is greatly dependent on the weather. However, the summer of 1981 does not seem to have affected its breeding seriously. In Kirkkonummi, for instance, the young fledged normally in 10 of the 18 nests under observation, while two pairs failed to incubate successfully and six did not breed at all (M. Puntila, O. Hildén). In a Swift colony in Virolahti, SE Finland, only late breeders suffered heavy losses but early pairs usually raised three young (H. Kolunen). Further north, nesting may have been less successful, judging from several adults found dead on the ground in Nivala, c. 100 km south of Oulu (Marjakangas 1981).

At least locally in central and northern Finland, the bad weather in mid-June caused heavy mortality among House Martins *Delichon urbica,* both adults and young. In Nivala, for example, 29 adult Martins were found dead in nests in three houses, and in a colony of c. 20 nests only seven produced nestlings (Marjakangas 1981). From the nearby commune of Temmes, several dead House Martins and Swallows *Hirundo rustica* were reported during the worst spell on 13—14 June (J. Hirvelä).

Open-nesting passerines. Most data are available for the Spotted Flycatcher *Muscicapa striata* in the province of Oulu (Marjakangas 1982). In this area, Spotted Flycatchers seem to have been faced with the same situation as Pied Flycatchers in subarctic Kilpisjärvi (p. 28): most nests were deserted, probably due to the inability of the females to secure enough insect prey. In the Kemi area, P. Rauhala noticed unusually few Spotted Flycatchers during September, the latter part of the migratory period, which he ascribed to the scarcity of juveniles after unsuccessful breeding.

For the Chaffinch *Fringilla coelebs,* there is a report on the breeding success in a small wood in Ylivieska (64°N, 25°E; Marjakangas 1981). Of the 18 nests found in 1981, two were deserted, five robbed, one probably destroyed by wind and rain during incubation, and in four all the nestlings died; young fledged in only six of the nests (33 %). In 1980 breeding was successful in 9 nests of 14 (64 %), and no dead young were recorded.

The Rock Pipit *Anthus spinoletta* also seems to have suffered from the rainy summer, although the data are scanty. In the island group of Söderskär, about 25 km east of Helsinki, the breeding success of this species in 1976—80 was excellent: of the 19 nests found, not a single one was lost, and the mean number of fledglings was 4.0. In 1981, however, two of the six nests under observation were destroyed, both being flooded by rain, and the number of fledglings averaged only 2.3 (Hario 1982).

From Tornio, N Finland, O. Ylimaunu reports that all five nests of the Scarlet Rosefinch *Carpodacus erythrinus* were deserted after heavy rain, three just before egg-laying and two during the egg stage. In earlier years no nests were deserted.

The records for these four species (and the Brambling, p. 28) do not tell much about the breeding success in open-nesting passerines in general, and the ringing material from the bird stations is not yet available. But scattered reports from bird ringers in different parts of S Finland indicate that many species experienced a good nesting summer, e.g. *Turdus* sp., *Sylvia* sp., *Phylloscopus trochilus, Saxicola rubetra, Lanius collurio* and *Prunella modularis* (P. Ahola, B. Ekstam, O. Hildén, L. J. Laine, P. Linkola, A. Magnusson). In particular, surprisingly few nests seem to have been robbed, in contrast to the numbers in the preceding fine summer. Linkola has suggested that in rainy summers the corvids *(Corvus corone, Pica pica, Garrulus glandarius),* which are responsible for the main part of all robbed nests, concentrate on the easy and plentiful food supply provided by slugs, snails and earthworms. This idea appears worth testing!

Similarly, the general impression at the Finnish bird stations was that most passerines were abundant during the autumn migration, and that the proportion of juveniles was normal or even above average. This was true of, for instance, the *Phylloscopus* and *Sylvia* species. It thus seems probable that there were relatively few open-nesting passerines whose breeding was seriously affected by the bad weather in 1981.

Conclusions

The following conclusions may be drawn from the above material:

— Many bird species reproduced poorly in 1981.

— Some, possibly many species, like the Pied Flycatcher in the south and the Redstart in the north, did not suffer from the bad weather.

— The poor breeding success was found in different taxa and ecologically different species.

— The reasons for the poor reproduction are complicated, but in most cases bad weather seems to be involved.

What is bad weather from the point of view of a bird? For a breeding adult and also for the eggs and young, three factors are harmful: low temperature, rain and wind, and these commonly occur together. They may act directly, e.g. by breaking down the insulation of a nest or a bird, or indirectly by reducing the food supply.

Water may destroy the nest or prevent the adult from incubating. Apparently many nests of ducks, grebes, gulls and terns were flooded, especially on the lakes, where the water level was exceptionally high. Rain in the nest cup or nest-box was found fatal for breeding.

In smaller amounts, in the form of rain or moisture, water readily breaks down the insulation. This, together with low temperature and wind, probably affected eggs and young, and adult birds as well. The increased heat loss and decreased food supply forced the adults to spend prolonged periods off the nest, searching for food for themselves and the chicks, and this also contributed to loss of the young through chilling.

The roles of insulation and food are not easy to separate. Many tits suffered from water or moisture in the nest-box, but the Pied Flycatcher managed well, although breeding in similar boxes. In thrushes and warblers, production of young seemed to be unaffected by rain or food shortage, while in the House Martin, nesting in well-covered places, food possibly became a limiting factor.

Our observations show that in Lapland the Pied Flycatcher suffered much more than some better adapted northern species, like the Redstart and the Bluethroat. In the north adult birds of hole-nesting species apparently starved to death, leaving untended chicks or unhatched eggs.

How long will the disaster of 1981 appear in breeding populations? For long-lived, slowly reproducing species one year's poor breeding success, or even total failure, does not have much effect on the population size. Good examples are some arctic species and food-specialists, which do not nest at all in years when conditions are unfavourable. Populations of short-lived species are more dependent on regular recruitment, and a decrease in the numbers of several species may be expected in 1982.

However, previous poor breeding summers have taught us that bird populations usually recover within one or two years, owing partly to their high reproductive rate, partly to the reduced effect of other limiting factors. Breeding densities seem to be more critically affected by exceptionally high mortality during migration and wintering, as has been shown by the crash in some species after severe winters in NW Europe during recent decades.

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Selostus: Lintujen pesintätuloksesta Suomessa sadekesänä 1981

Kesä 1981 oli Suomessa poikkeuksellisen kylmä ja sateinen, etenkin pesinnän huippuvaiheessa kesäkuussa (taul. 1, kuva 1). Kirjoituksessa käsitellään epäsuotuisan sään vaikutusta pesintään kirjoittajien omien havaintojen ja kyselyvastausten perusteella.

Merensaaristossa etenkin kala- ja lapintiiran, räyskän ja kalalokin pesimätulos oli heikko, paikoin olematon. Kustavissa myös lähes kaikki haahkanpoikaset kuolivat, kun taas Söderskärillä lajin poikastuotto oli hyvä. Sisävesillä varsinkin kala- ja naurulokin, kalatiiran ja silkkiuikun pesintä onnistui hyvin huonosti (taul. 2), mutta useimmat muutkin lajit näyttivät kärsineen keskimääräistä suurempia tappioita.

Pönttölinnuista tali- ja sinitiainen menestyivät heikosti, kun taas kirjosiepon pesintätulos oli maan eteläpuoliskossa suunnilleen normaali ja kuusitiaisen hyvä (taul. 3—5). Alueelliset erot olivat huomattavia, mikä ilmeisesti johtui pönttöjen kunnosta ja sijoituksesta (sadeveden pääsy pönttöön todettiin tuhoisaksi) sekä säätekijöiden erilaisuudesta maan eri osissa. Lapissa kirjosiepon pesintä epäonnistui pahoin ja jopa kuolleita emolintuja löytyi pesistä, kun taas leppälintu menestyi normaalisti. Avopesijöistä vastaavasti järripeippo selvisi huonosti, sinirinta hyvin.

Hajahavainnot muista lajeista osoittivat metsäkanalintujen lisääntymistuloksen jääneen heikoksi, korkean veden tuhonneen kahlaajien pesiä, ja aikuisia terva-, räystäs- ja haarapääskyjä paikoin menehtyneen pahimpien sääjaksojen aikana. Huonon sään aiheuttamiin tavallista suurempiin pesätuhoihin viittaavia havaintoja saatiin harmaasieposta, peiposta, luotokirvisestä ja punavarpusesta, mutta useimmat muut avopesijät näyttivät selvinneen hyvin.

Epäsuotuisa sää ilmeisesti vaikutti pesintään monin tavoin, osaksi suoranaisesti tuhoamalla pesiä ja poikasia, osaksi epäsuorasti vaikeuttamalla ravinnonsaantia. Tuhojen vaikutukset pesimäkantoihin jäänevät lyhytaikaisiksi.

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