The bird sanctuary of Kesonsuo, a raised bog in North Karelia: its breeding bird assemblages, summer visitors and spring migrants

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Kesonsuo, a mire area in North Karelia, supports unusually many bird species, both breeders and migrants. The breeding birds of Kesonsuo were censused in 1969 (supporting data from 1964–80); the 9.5 km^2 area studied was estimated to have about 1400 pairs and 34 species of breeding birds. The waterfowl assemblage is particularly rich (about 340 pairs, with *Anas crecca, A. acuta, A. platyrhynchos* and *Aythya fuligula* as dominants). The shorebirds include eight wader species (*Philomachus pugnax, Vanellus vanellus* and *Numenius arquata* as the three most abundant species) and five larids (colonies of *Larus ridibundus, L. argentatus* and *L. canus*). The most abundant passerine is *Motacilla flava*.

The birds breeding in an area of 1.7 km^2 were censused by the mapping method. The census area represents a sample of the different habitats in Kesonsuo. The species composition and species abundances vary considerably among the habitats, presumably owing to differences in the tree cover (sparsely wooded and open treeless habitats) and in the pool area.

Kesonsuo is an important area for migrating birds, because it lies on the flyway of many arctic migrants. The observations of migrants are summarized; they include strikingly many northern waders (e.g. a mass migration of *Calidris canutus*, and also many resting waders) and unusually many *Anthus cervinus*. Apart from the northern guests, the species composition of both the breeders and the occasional visitors resembles that of the bird assemblages of eutrophic "bird lakes" in Finland.

The assessment of the conservation value of mires is discussed. The following points seem to be particularly relevant: number of breeding species, biomass of the breeding birds, number of endangered species, the migrants and the species of surrounding habitats that use the mire for foraging or as display areas.

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Introduction

The bird sanctuary of Kesonsuo in Ilomantsi (62°48′ N, 30°50′ E), North Karelia, is one of the best-developed raised bogs in Finland, and it has the reputation of being one of the most important breeding places of mire (peatland) birds in the southern half of Finland. The topographical conditions, especially the location of the area in a river bend, have led to the development of a fairly regular, nearly concentric pool system on Kesonsuo, though botanically Kesonsuo is an eccentric raised bog (Tolonen 1967).

As peat formation on Kesonsuo started about 9500 years ago, soon after the Würm glaciation (Tolonen 1967, 1975), the area is one of the oldest raised bogs in the Finnish interior. The unique structure and diversity of its mire types have made Kesonsuo one of the best-known Finnish mires, and it has been included not only in the national program for conserving mires (Anon. 1979) and the Nordic program for the conservation of waterfowl habitats (Anon. 1973), but also in the international program for conserving mires, *Project Telma,* and the program for conserving wetlands and waterfowl habitats, *Project Mar.* Kesonsuo became a nature reserve on 17 August 1976 (Borg & Kaipiainen 1975, Anon. 1976). Visits to the area are now strictly forbidden between 1 April and 30 November.

In this article we shall describe the structure of the breeding bird assemblages of Kesonsuo on the basis of censuses made in 1964–1969 and, with special permission, in 1979 and 1980. Descriptions of bird assemblages breeding in exceptionally valuable conservation areas are necessary for the purposes of conservation and environmental monitoring, but also broader ecological aspects will be examined. In particular, we intend to study variation in the bird assemblages within Kesonsuo. A large mire area is usually a mosaic of different *mire types* (German: *Moortypen;* e.g., Ruuhijärvi 1960, Eurola 1962, Pakarinen 1976, 1978, Eurola & Kaakinen 1979a, 1979b), but in the older ornithological literature mires have been dealt with as units, a notable exception being the study by Sammalisto (1957) on edge effect. Two recent studies have paid some attention to the effect of various habitat variables on bird densities on mires. Using data from Sweden, Boström & Nilsson (1983), examined the correlation between wetness and total bird density (see also Seiskari 1954, Sammalisto 1955, Järvinen & Väisänen 1976, 1978), and Niemi (1983) correlated a number of vegetation variables with the structure of bird communities on Finnish

and North American mires. Several authors (e.g. Häyrinen 1970, Järvinen & Sammalisto 1976, Korpimäki & Rajala 1985) have pointed out differences among the bird assemblages of various mire complex types (German: *Moorkomplextypen*).

In addition to breeding birds, our data throw light on (spring) migrants and casual visitors on Kesonsuo. As will be evident from our observations, mires may be very important for this non-breeding element, and therefore assessments of conservation value should not be restricted to breeders.

The study area

Kesonsuo is located in a bend of the River Koitajoki. The area, measuring about 15 km^2, is bordered on three sides by water: in the east by Lake Säkäjärvi and the River Säkäjoki and in the north and in the west by the broad River Koitajoki. In the south-west Kesonsuo is bordered by mineral soil and by Kurenharju and other ridges. The following description is based on Tolonen's publications (1967, 1975) and on our own experience.

Kesonsuo is exceptionally clearly divisible into three vegetational zones: the marginal lagg, the marginal slope and the bog plane. The vegetation of the minerotrophic marginal lagg is lush. The marginal fens along the Rivers Koitajoki and Säkäjoki are water-fens, swamps (abundant *Carex aquatilis* and *C. acuta*) and flooded areas, which support numerous *Carex* spp., *Eriophorum vaginatum, E. angustifolium*, grasses (e.g. *Juncus filiformis*) and different willow (*Salix* spp.) species. Towards the inner parts of the bog the vegetation becomes drier and sparser. The dominant mire types are oligotrophic sedge fen (*Seggenweissmoore* in German; for terminology see Reinikainen et al. 1984) and oligotrophic *Sphagnum papillosum* fen. In addition, there are two quite peculiar oligotrophic sedge/hardwood swamp complexes with some birches and abundant *Eriophorum vaginatum*. The southern areas of the marginal lagg are covered with continuous *Sphagnum* vegetation (*S. apiculatum* and *S. papillosum*).

The ombrotrophic marginal slope, which is about (20–) 400–600 m wide, consists mainly of dwarf shrub (*Ledum*) pine bog. This area is wooded, the main tree species being pine and the average canopy height about 4 m. The main species in the shrub layer are *Betula nana, Ledum palustre* and *Chamaedaphne calyculata*. The dwarf shrub pine bog is bordered, without a clear margin, by a *Sphagnum fuscum* pine bog, a more barren mire type, in which *S. fuscum* and *S. balticum* are more common and the trees are smaller.

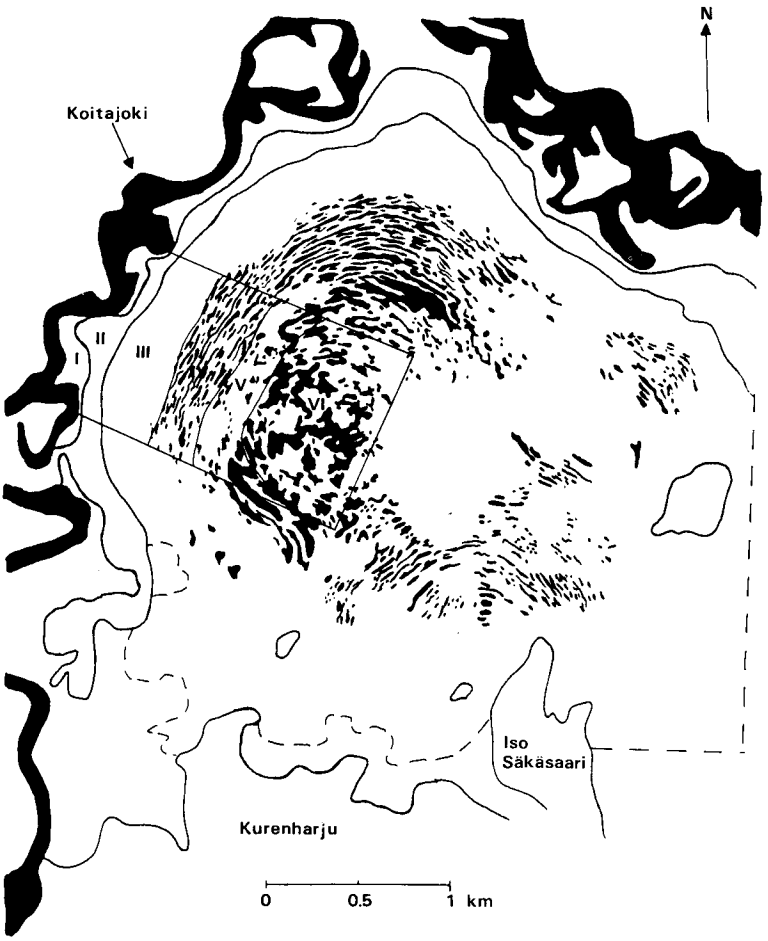

Fig. 1. Location of the study areas on Kesonsuo. The broken line indicates the southern and eastern border of the study area of 1969 (9.5 km^2). The mapping area of 1969 (1.7 km^2) is in the western half of the bog. The different zones (I–VI) are marked on the mapping area (for botanical details, see text). Black areas indicate pools (note the mosaic-like structure of the pool areas).

Fig. 2. A general view of zone IV. The open-water pools are arc-shaped and only a few pines grow on the drier hummocks in the zone.

The ombrotrophic bog plane of Kesonsuo can be divided into three zones. The outermost zone is formed by mossy hollows and arc-shaped hummocks. In the second zone the hollows are wet. The innermost part is covered by a great number of ponds of different shape and size. The zone of the mossy hollows is 100–500 m wide and the main bog type in the hollows is *Scheuzeria–Sphagnum balticum* fen. The drier hummocks bear pine stands of varying density. The zone of the wet hollows is clearly different from the previous one, mainly due to the open water. The ponds are usually less than one metre deep. On the hummocks between them grow *Betula nana* and pines (the tallest trees 6–7 m). The open part of the bog plane is fringed by a narrow birch zone. The pond labyrinth in the centre is very heterogeneous, because the humidity of the hummocks varies markedly. Only scattered trees grow here.

In 1969 the birds in an area of almost 1.7 km^2 were mapped (see Sect. 3). The mapping area coincided as closely as possible with Tolonen's vegetational study areas, as judged from an aerial photograph (scale 1:5000). Using mainly Figs. 53 and 56 in Tolonen (1967), we distinguished the following zones in the mapping area (see Fig. 1):

Zone I. Minerotrophic flooded fens and sedge fens dominated by *Carex lasiocarpa* near the shore of the River Koitajoki. Area 7.0 ha (zones A–B in Tolonen 1967: Fig. 56).

Zone II. Dwarf shrub (*Ledum*) pine bog and cottongrass (*Eriophorum*) pine bog. Area 16.3 ha (Zones C–D in Tolonen 1967).

Zone III. Sphagnum fuscum pine bog, largely open. Area 22.5 ha (Zone E in Tolonen 1967).

Zone IV. The area of the arc-shaped hollows. The hummocks bear scattered pines. Area 36.5 ha (Zone F in Tolonen 1967). A general view of this zone is shown in Fig. 2.

Zone V. The outermost part of the pond area with pine trees (part of Zone G in Tolonen 1967). Area 17.5 ha.

Zone VI. The treeless areas of the bog plane. Area 68.0 ha. The effect of the Herring Gull colony on the vegetation is clearly evident; on the breeding grounds are many plants demanding more nutrients than are normally available on raised bogs, e.g. *Epilobium angustifolium* and *Dryopteris filix-mas* are abundant and there are scattered occurrences of *Epilobium palustre, Carex canescens, Eriophorum angustifolium, Oxalis acetosella, Menyanthes trifoliata, Comarum* sp., *Trientalis europea, Carex aquatilis* and *Poa annua* (zone H and part of zone G in Tolonen 1967).

Zone I coincides with the lagg, zone II with the marginal slope, and zones III–VI lie on the bog plane area.

Material and methods

The breeding birds of Kesonsuo have previously been studied only in broad qualitative outline (Hytönen 1930, Eskelinen 1972). The brief summary by Järvinen (1979) is largely based on the present records. The data used in this paper have been collected as follows.

1963. The bog was visited between 9 and 11 July by Juhani Rinne and Ilkka Sténn (unpubl. data supplied by IS).

1964. Census work by UH, Karno Mikkola and Pertti Sulkava on 12–16 June; counts of waterfowl broods on 11–13 July.

1965. Census work (UH and Timo Reunala) on 16–17 May.

1966. Excursions and censusing (UH) on 24–30 May and 23 June.

1967. Census work by UH and Pekka Salminen on 18–23 May.

1969. Census work and excursions by OJ (partially also by UH) on 10–27 May. Intensive mapping censuses (see Anon. 1969) by Ilpo Kuronen and Mantsi Rapeli on 3–24 June (aided by UH, OJ, P. Salminen and Matti Soini).

1979. Excursions by Ilkka Heikkinen, UH, Ilpo Kuronen, Jukka Ojala and Mantsi Rapeli on 2–6 June and 19–20 June.

1980. Excursions by UH on 15–18 June.

The total number of observer days amounts to about 160 (two-thirds in 1969). As the observers camped by the River Koitajoki or in small wood-lots on the bog itself, many occasional records were made from the camps. In Finland the best period for censusing mire birds is June (e.g. Järvinen 1974); the data from May do not cover all species (e.g. tropical migrants). On the other hand May is the proper time for censusing waterfowl (Kauppinen 1983). For seasonal variation in the efficiency of mire bird censuses, see Nilsson (1982).

In addition to the above records from excursions and censuses on Kesonsuo, we had access to data collected mainly from the southern margin of the area by the guardians of the sanctuary: Kari Koskela (1976), Juhani Aaltonen and Tapani Missonen (1977) and Kari Takamäki (1978). These data were obtained from WWF/Finland.

On short visits to Kesonsuo, quantitative field-work has mainly been done on the bog plane (see Fig. 1). In 1969 sparse species were censused in the whole area, and the abundant species in the representative mapping area of 1.7 km^2 (Fig. 1). Most censuses were made in the morning before noon, but the censuses on the *Ledum* pine bog (resembling forests with respect to its bird community) were made earlier, between 5.00 and 9.00. No censuses were made in very warm weather, in strong wind or in heavy rain.

The following principles were used in assessing the pair numbers of different taxa (see also Järvinen 1974).

Waterfowl. Various ducks were censused by recording the greatest number of males observed in one census (Linkola 1959, Kauppinen 1980, 1983). As the sex ratio may not be even, the figures may not accurately represent the number of breeding pairs. The best census was made in 1969, when almost the whole area was censused, mainly on 11 May (some separate areas on later days, but these have little effect on the final result). For a number of species breeding later (*Anas penelope, A. clypeata, Aythya fuligula, Bucephala clangula*), the numbers are based on a census made on 26 May. Geese were counted by recording the number of pairs observed. The Red-throated Divers and Slavonian Grebes were counted by recording the permanent residents and nests.

Hawks. Nest counts.

Tetraonids. A Willow Grouse *Lagopus lagopus* population lives on the pine bog areas (Zone II) near the edges of Kesonsuo and Black Grouse *Tetrao tetrix* use the bog as a display area during the spring. However, these species have been omitted from the census, as they probably breed in the surrounding forests or along the river, and they are not dependent on Kesonsuo even during the fledgling period.

Waders. Censusing the waders was laborious because many species were abundant. Lapwings *Vanellus vanellus* were counted by observing displaying pairs at a distance. These birds may be remarkably secretive, and they were observed to leave the nest-site when the observer was still as far away as 0.5 km. In 1969 almost the whole of Kesonsuo was censused on excursions in May. Later censuses in June would have yielded a lower estimate due to nest failures and adult mortality (Peregrine!). The numbers of the Golden Plover *Charadrius apricarius* were estimated on the basis of clusters of observation from June censuses and excursions. Earlier counts would have inflated the numbers, since many migrants were present in May. The Curlew *Numenius arquata* and the Whimbrel *N. phaeopus* were censused in the same way as the Lapwing. As the Whimbrel is a relatively late migrant, we also used June records. The Wood Sandpiper *Tringa glareola*, the Greenshank *T. nebularia* and the Ruff *Philomachus pugnax* were censused on 16–17 June 1969, when the fledglings had hatched and the females were easily alarmed. The Broad-billed Sandpiper *Limicola falcinellus* is a very difficult species to census accurately in a large area. It is evidently sparse on Kesonsuo, and confusion is caused by late migrants. We also used the observations and experience gained from the mapping area of 1.7 km^2.

Larids. Gulls and terns were usually censused by counting incubating individuals from the top of a tall tree. In 1969 the nests in the colony of the Black-headed Gull *Larus ridibundus* were counted on 4–5 June. At that time there were no signs of hatching. The Herring Gull *L. argentatus* population was censused on the same days, but the census was probably incomplete because some nests were scattered in places difficult to census; there are literally thousands of miniature peat islets that are possible nest sites. It is, however, most unlikely that we missed more than 10 pairs. The Common Tern *Sterna hirundo* was censused by counting mobbing pairs in mid-June.

Passerines. The Skylark *Alauda arvensis* was censused by observing singing birds. This is often difficult on mires, but the Skylark is sparse on Kesonsuo and the territories were therefore fairly easy to locate. The Hooded Crow *Corvus corone cornix* and the Starling *Sturnus vulgaris* were censused by counting nests (Starling: a few nest-boxes on the bog). The densities of the other passerines come from the mapping area. The mapping estimates (Enemar 1959, Anon. 1970) were usually based on 7–9 visits (the densely wooded Zone II was examined 9 times). The rate of censusing was usually 4–5 ha/hour. The number of visits was only 4–5 in the central parts of the bog (Zone VI), but this is acceptable on open mire areas (cf. also Dyrcz et al. 1974 and Svensson 1978). Moreover, only a few species which could be censused by the mapping method breed in Zone VI, where access is difficult and the rate of censusing was lower than in other zones.

The interpretation of the species maps was difficult in some cases (e.g. the Yellow Wagtail), because detailed notes on simultaneous observations were lacking. The field observers did make an attempt not to include other than simultaneous records from neighbouring territories (following bird movements is fairly easy in open habitats).

Abundance and distribution of birds in the open habitats

Table 1 shows density estimates for the years 1964–1969. These estimates are not directly comparable because of methodological differences between the years. In the following we shall discuss all the breeding species in detail. If not otherwise mentioned, the general notes on the avifauna of mires are based on Häyrinen (1970), Raitasuo (1973) or Järvinen & Sammalisto (1976).

Gavia stellata. The Red-throated Diver breeds on the ponds of the treeless central plane. Two pairs were observed in 1964 and 1979, and three pairs in 1980, but only one pair in 1966, 1967 and 1969. As the ponds on Kesonsuo are so numerous and poorly accessible, the divers easily escape attention unless they happen to call. Therefore, the pair numbers do not necessarily reflect population changes accurately, but the numbers have clearly not decreased during the study period (see also Pakarinen & Järvinen 1984).

Podiceps auritus. The Horned Grebe is rather uncommon on Finnish mires; fewer than 10 places are known to us (cf. von Haartman et al. 1963–1971: no mire records). On other mires the Horned Grebe tends to breed close to colonies of the Black-headed Gull *Larus ridibundus* (pers. obs.), but on Kesonsuo the pairs are fairly evenly spaced over the area of larger pools (Fig. 3). The population was estimated to be 7 pairs in 1964, 5 pairs in 1965, 6 pairs in 1966 and 1969, and 4 pairs in 1971. In 1977 the species was observed in the area (Juha Aaltonen) but in 1979 and 1980 it was absent. Only 1–2 pairs were observed in 1967, but the census was incomplete. Hytönen (1934) does not mention the species in his account of Kesonsuo, but he apparently did not visit the central parts of the bog. The disappearance in 1979 agrees with the recent decline of the species in Finland (Rassi 1977).

Anser fabalis. The breeding range of the Bean Goose is restricted mainly to *aapa* fen areas (Hyytiä et al. 1983), and breeding on raised bogs, such as Kesonsuo, is exceptional (see also Häyrinen 1970). We estimated 26 pairs for 1969 and this is consistent with the estimates for 1965 and 1966: more than 20 pairs and 20 pairs, respectively. Only five pairs were seen in 1964, but the geese are very secretive in June. For example, only 6 adult individuals, all in one flock, were seen between 10 June and 16 June 1969, despite numerous censuses and excursions. A very extensive census on 14 June 1969 failed to reveal any geese! On the other hand, 23 individuals were excluded from the pair estimate in the census of 11 May 1969. Fig. 3.

Anas penelope. The Wigeon population was estimated at 20 pairs in 1964 (4 broods in July) and at 14 pairs in 1969. Estimates of the density of the Wigeon depend closely on the census time (Tiussa 1963, Kauppinen 1980, 1983), and the difference in census dates between 1964 and 1969 prevents any conclusions about population trends. Fig. 3.

Anas crecca. The Teal is the most abundant duck on Kesonsuo, with its 78 pairs in 1969 (8.3 pairs/km^2). The estimate for 1964 was 49 pairs (9 broods in July). Less complete censuses (other years) grossly underestimate the Teal, because the species often visits small pools and is not so easily flushed as other ducks. Fig. 3.

Anas platyrhynchos. The population estimate for 1969 is as high as 65 pairs (6.8 pairs/km^2). Although the census period was less suitable, the estimate for 1964 was also high, 42 pairs. For comparison, the number of broods seen in July 1964 was only 8, which indicates the difficulty of brood censusing in mosaic-like waterfowl habitats such as Kesonsuo. No estimates are available from the other years. Fig. 3.

Anas acuta. The Pintail population of 1969 was estimated at 66 pairs. The estimate in 1964 was much smaller: only 9 pairs (3 broods in July). On the other hand, a census on 17 May 1965 yielded 33 males, and in 1967 the Pintail seemed to be the most common duck on Kesonsuo. This inconsistency is probably due to non-optimal census dates in many years (see Methods), this conclusion being supported by our observations on 26 May 1969, when 35 Pintail males, but only 17 Mallard males and 10 Teal males were recorded (cf. Table 1). Fig. 3.

Anas querquedula. Some pairs of Garganeys have bred in the biological province of North Karelia since 1957 (von Haartman et al. 1963–1972). The species is known for its irregular fluctuations (cf. Hyytiä et al. 1983), but it also easily escapes attention, so that the lack of observations in 1964, 1965 and 1967 need not indicate absence. In 1966 (a nest) and 1969 (several observations) the minimum estimate was one pair. No previous records have been published of Garganeys breeding on Finnish mires, but according to our unpublished observations (cf. also Häyrinen 1970), the Garganey belongs to the bird fauna of a few mires in Finland.

Anas clypeata. Eight pairs were recorded in both 1964 and 1969. The Shoveler is a rare denizen of raised bogs (Häyrinen 1970); other mire populations known to us comprise 1–2 pairs only.

Aythya fuligula. Together with the Goldeneye, the Tufted Duck is the most abundant of the diving ducks on mires (Häyrinen 1970). The population estimate for 1969 was 55 pairs (5.8 pairs/km^2); 12 nests were found. In 1964 the population was estimated at 44 pairs (15 broods in July), which is comparatively high for that year, perhaps because

Table 1. Numbers of the breeding bird species on the open areas (see Fig. 1) of Kesonsuo (area 9.5 km^2) in the years 1964–1969. Two dots indicate missing data. For the interpretation of apparent fluctuations, see text.

Species	1964	1965	1966	1967	1969
Gavia stellata	2	1	1	1	1
Podiceps auritus	7	5	6	(2)	6
Anser fabalis	5	>20	20	10–15	26
Anas penelope	20	..	..	(1)	14
A. crecca	49	..	..	(6)	78
A. platyrhynchos	42	..	..	(17)	65
A. acuta	9	33	..	(22)	66
A. querquedula	–	–	1	(–)	1
A. clypeata	8	1	4	(1)	8
Aythya fuligula	44	..	..	(16)	55
Bucephala clangula	7	..	..	(12)	25
Falco peregrinus	1	1	1	1	1
Grus grus	5	5	4	5–7	3
Pluvialis apricaria	2	..	2	..	4
Vanellus vanellus	36	..	40	30–40	39
Limicola falcinellus	1	..	(–)	..	> 1
Philomachus pugnax	22	..	..	..	43
Numenius phaeopus	3	..	> 6	5	16
N. arquata	24	..	20–40	< 30	35
Tringa nebularia	8	..	..	8	16
T. glareola	14	..	> 10	(15)	24
Larus ridibundus	73	100	140	n.50	158
L. fuscus	–	1	1	1	2
L. argentatus	161	225	220	(>)200	190
Sterna hirundo	9	..	4	..	3
Alauda arvensis	2	..	2	2	2
*Anthus pratensis**	..	..	..	..	201
*Motacilla flava**	..	..	..	..	381
*M. alba**	..	..	..	..	118
*Saxicola rubetra**	..	..	..	20–30	51
*Phylloscopus trochilus**	..	..	..	..	77
Corvus cornix	1	..	..	2–3	6
Sturnus vulgaris	..	..	..	1–2	1
*Emberiza schoeniclus**	..	..	..	..	31

*) Numbers in 1969 extrapolated from the density in the mapping area (zones III–VI; total area 1.44 km^2).

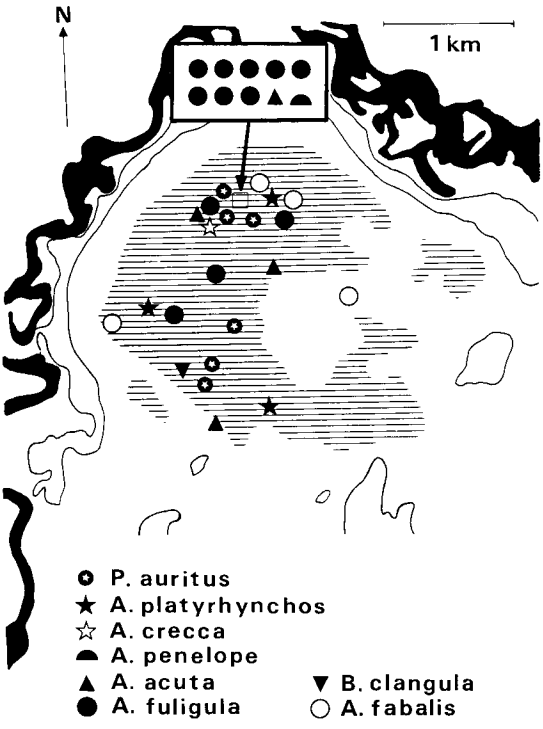

Fig. 3. Approximate nest-sites of the different waterfowl species. Note the concentration of the Tufted Duck population near the gull colonies (cf. Fig. 7).

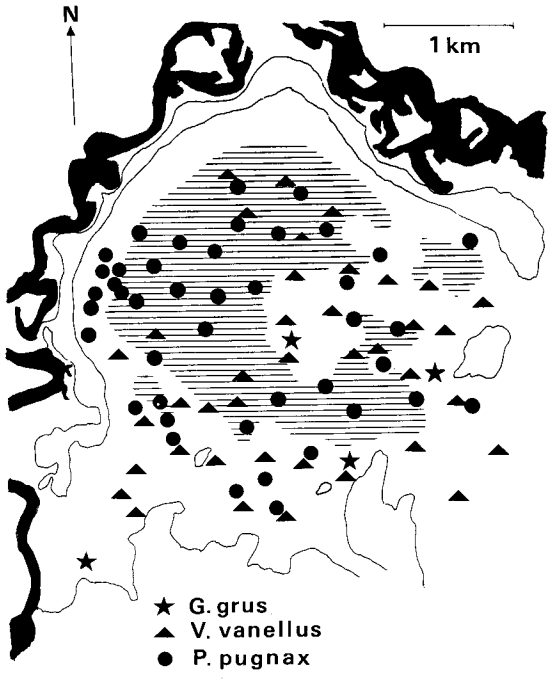

Fig. 4. Locations of the territories of the Crane, the Lapwing and the Ruff. The high density of the Ruffs in the western parts of the area is probably due to the differences in census efficiency (mapping area). Note that the Lapwing avoids the wettest bog plane area, probably because of spring flooding.

the census period favoured the Tufted Duck. Fig. 3 reveals concentration of this species close to the gull colonies shown in Fig. 7 (cf. also Fabricius 1937, von Haartman 1937, Bergman 1957, Hildén 1964, Väisänen 1974).

Bucephala clangula. Being an easily observed species, the Goldeneye has in some years (e.g. in 1967) seemed to be one of the three most abundant duck species of Kesonsuo. The population estimate for 1969 was 25 pairs (2.6 pairs/km^2). This is rather surprising, because we have not been able to find more than a few suitable natural holes and nest-boxes in the vicinity. Seven pairs were observed in 1964, and seven broods were seen in July 1964. Fig. 3.

Anseriformes: summarizing remarks. The duck and goose populations of Kesonsuo totalled about 340 pairs in 1969, being much more abundant than on any other of the several hundred Finnish mires known to us personally or from the literature. The number of species is nine, and includes four species which occur only as rarities on other raised bogs in southern Finland (*Anas querquedula, A. penelope, A. clypeata* and *Anser fabalis*). The total density of ducks and geese breeding on Kesonsuo is 35.7 pairs/km^2, which represents (see below) roughly 19 per cent of the total bird assemblage of Kesonsuo, a very high proportion for a mire bird assemblage. This emphasizes the uniqueness of Kesonsuo as a natural resource for waterfowl.

Falco peregrinus. Owing to pesticides, Peregrines almost disappeared from Finland between 1950 and 1970 (e.g. Linkola 1959, Häyrinen & Salminen 1974, Wikman 1983). One pair bred on Kesonsuo up to 1969, but then disappeared.

Grus grus. The Crane is easily observed, but rather difficult to census because of a variable proportion of "floating" individuals, i.e. non-breeders. The population estimate was 3 pairs in 1969 (Fig. 4), with an additional pair in the SW corner outside the study area. All previous estimates had been higher: 5 pairs in 1964–1965, 4 pairs in 1966, and 5–7 pairs in 1967. This variation may be misleading, for in 1969 the study period was long and included careful observation of the floaters, while the other numbers may include non-breeders or cranes breeding outside the study area. Flocks of non-breeders, most often comprising 6–8 individuals, but sometimes as many as 15, were observed almost daily in 1969.

Pluvialis apricaria. In general, the Golden Plover is one of the most abundant waders on raised bogs, particularly in western Finland (Hyytiä et al. 1983). On Kesonsuo the population is small: no more than 4 pairs in 1969 (2 pairs in 1964 and 1966). This scarcity can presumably be attributed to the dense growth of shrubs or to excessive wetness. Migrating flocks (up to 33 exx.) are abundant in May.

Vanellus vanellus. During this century, the Lapwing has colonized almost the whole of Finland (Kalela 1955, von Haartman 1973, Hyytiä et al. 1983), and it is one of the most common waders on the southern Finnish mires (Häyrinen 1970). In spite of the late census period in 1964, the estimate was as high as 36 pairs. In 1969 the estimate was only 39 pairs, although the census was much more thorough. Despite the exceptionally cold spring of 1966 (see Vepsäläinen 1968), the estimate for that year was high, but it is based on a rather inaccurate census. The observations in 1979 indicate that the population was as large as in 1964–1966.

The distribution of the Lapwings is shown in Fig. 4. The bulk of the population breeds in the relatively dry parts of the area. The species avoids wooded areas; the few pairs located among the pools were living in sites where the tree cover was sparsest. It is remarkable that no Lapwings were observed breeding in the central pool area, where there are only a few trees. The area may be too densely covered by *Betula nana, Chamaedaphne calyculata* and other shrubs. It

is known to be flooded in spring, however (Kivinen & Tolonen 1972), since it is lower than its surroundings. As Klomp (1953) and Seiskari (1956) have shown, Lapwings select their breeding habitats in spring on the basis of the visual appearance of the habitat and avoid areas where there is a risk of flooding.

Limicola falcinellus. The observations of the Broad-billed Sandpiper in the Finnish bird atlas were all made farther north than Kesonsuo (Hyytiä et al. 1983), but according to our unpublished observations, it breeds on two raised bogs in southern Finland (Kesonsuo and Pilvineva in W Finland); and it has also been observed on Vionneva (W Finland; Korpimäki & Rajala 1985). The species presumably needs open muddy surfaces to breed. It is commonly seen on Kesonsuo during the migration in late May and early June (see below).

Philomachus pugnax. Being a semi-colonial breeder (Dyrcz et al. 1970, Järvinen 1974), the Ruff is a difficult species to census. It seems to be most abundant in the area mapped in 1969 (Fig. 4), but this is most certainly an artefact due to varying census accuracy. The real size of the Ruff population may thus amount to as many as 60–80 pairs.

Gallinago gallinago. The Snipe occurs in the minerotrophic marginal fen along the River Koitajoki, but is absent from the southern marginal fens; this difference was noted not only in the censuses but also on numerous excursions. The Snipe has been reported from some raised bogs in western Finland (Korpimäki & Rajala 1985; but cf. Lahti 1983), but Korpimäki & Rajala (pers. comm.) have informed us that most of the observations were from bog margins.

Numenius phaeopus. The Whimbrel population probably increased during the 1960s. It was estimated at 16 pairs in 1969, but the previous estimates were only 3 (1964), at least 6 (1966), and 5 (1967). As the species is not difficult to spot, even at longer distances (see Järvinen & Väisänen 1983), an increase in numbers seems likely. This conclusion is in accordance with the general increase of the Whimbrel in its southern breeding range (Hyytiä et al. 1983). Most pairs breed in the marginal fen (Fig. 5).

Numenius arquata. With its 35 pairs (1969), the Curlew is the third most abundant wader on Kesonsuo, next only to the Ruff and the Lapwing. No fluctuations seem to have occurred, since the estimates for the earlier years, based on less complete censuses, are 24 (1964), 20–40 (1966), and under 30 (1967). It is fairly evenly distributed over the whole area (Fig. 5), though the margins appear to be less favoured.

Lack (1971:315) reported that the two *Numenius* species are strictly separated by habitat in their zone of geographic overlap. There seems to be a tendency for the Whimbrel to breed mainly on the minerotrophic areas, while the Curlew occurs everywhere in the bog area, but this is not strictly separation by habitat. The pattern is the opposite in the Martimoaapa mire (Väisänen & Järvinen 1977), where the Curlew was found on *aapa* fens and the Whimbrel in the raised bog parts of the area (see also Järvinen & Sammalisto 1976). In western Finland the pattern seems to be exactly the same as on Kesonsuo, and there is even a positive correlation between the numbers of the two species on different raised bogs (Korpimäki & Rajala 1985).

Tringa nebularia. The Greenshank seems to favour places with some trees and open water (Fig. 6). Its density

Fig. 5. Locations of the territories of the Whimbrel and the Curlew. The Curlew occurs fairly evenly throughout the bog, whereas the Whimbrel is clearly most abundant on the minerotrophic fen areas near the edges.

Fig. 6. Locations of the territories of the Wood Sandpiper and the Greenshank. The high density of the Wood Sandpiper in the western area is possibly due to the differences in census efficiency (see also the map of the Ruff).

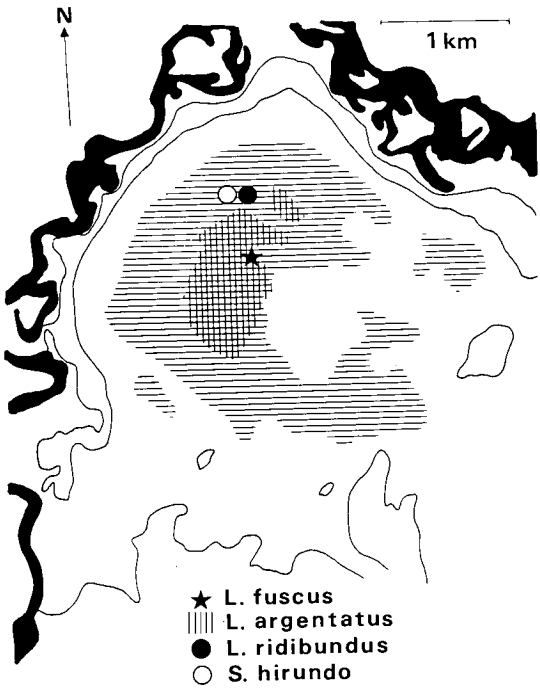

Fig. 7. Locations of the gull colonies. The colony of the Black-headed Gulls breeds in a small area, whereas the Herring Gulls have spread over the open bog plane.

Fig. 8. The distribution of the Skylark, the Crow, the Whinchat and the Starling. The symbols indicate single territories. Note preference of the edges by the Whinchat.

has presumably been stable. The species nests on mineral soil outside the study area, but adults feed and display on the bog and the fledglings come regularly to the bog after mid-June.

Tringa glareola. The Wood Sandpiper is one of the most abundant waders on Finnish mires, but its densities on Kesonsuo are clearly lower than those of the Lapwing, the Curlew and the Ruff. A total of 24 pairs was estimated in 1969; previous (probably incomplete) estimates range from at least 10 (1966) to about 15 (1967). The species favours areas with pools and sufficient tree cover (Fig. 6).

Larus ridibundus. The nest-count in 1969 was probably complete, for the colony was restricted to a small well-defined area (Fig. 7). As the Black-headed Gulls often fly in large flocks over different parts of Kesonsuo, estimates of the breeding population should not be based on foraging flocks (cf. also Järvinen 1978a). The colony seems to have increased during the 1960s, although the number of nests counted in 1969 was surprisingly large compared with the number of bird records. The estimates for the 1970s were as follows (no nest-counts): over 100 pairs (1976; from the edge of the bog), 100–150 pairs (1977 and 1978) and 70–80 pairs (1979). The numbers in 1979 seem to have been lower than before, even when allowance is made for the inaccurate census. However, a veritable population crash took place in 1980: only 10 pairs were recorded, breeding near the Herring Gulls. Mire populations of the species are known to fluctuate erratically (Järvinen 1978a).

Larus canus. The Common Gull colonized Kesonsuo in the 1970s. In 1963–1978 there were no signs of possible breeding. Three pairs bred in 1979, and in 1980 40 individuals were observed uttering alarm calls and corresponding to at least 20 pairs.

Larus fuscus. A rare breeder in the Herring Gull colony (Fig. 7). The proportion of the Lesser Black-backed Gull has been 0–1 % of the Herring Gulls. According to our unpublished observations, the species breeds only occasionally in mires.

Larus argentatus. The greater part of the breeding population (140–150 pairs in different years) is scattered over the pool area. The rest of the Herring Gulls (40–100 pairs) breed in the area of arc-shaped pools (Fig. 7). A total of 177 nests plus one nest in the eastern edge of the Black-headed Gull colony were found in 1969. The earlier estimates average about 200 pairs, which is close to the more accurate estimate of 1969, based mainly on nest counts. In 1976–1979 the population was 150–200 pairs, but 250 pairs were counted in 1980, in two different colonies. The breeding birds do not forage only in the bog area, but also visit, e.g., rubbish dumps (one of their finds carried to Kesonsuo being a necktie!).

Sterna hirundo. The largest population estimate was made in 1964: 9 pairs. In 1969 three pairs were observed (Fig. 7) and the Common Tern bred on the bog in 1979 and 1980 also (at least one pair and 3 pairs, respectively). The species seems to have decreased but this is hard to prove, since floating individuals occur (e.g. 15 on 24 May 1969).

Alauda arvensis. The Skylark is a difficult species to census on large open mires. On dry raised bogs it is usually abundant. The small size of the Kesonsuo population is probably due to the scarcity of dry and open areas (cf. also *Pluvialis apricaria*). Fig. 8.

Anthus pratensis. The Meadow Pipit is generally the most abundant bird species on Finnish mires, but on Kesonsuo it is outnumbered by the Yellow Wagtail. There are relatively

few observations from pool areas (Fig. 9; see also Sammalisto 1955).

Motacilla flava. The Yellow Wagtail is the most abundant bird on Kesonsuo. It seems as if the species has found an oasis on this bog, since its density there (ca. 120 pairs/km^2 in Zone III) exceeds all the values for the species recorded by us or reported in the literature, except for Siikaneva (S Finland), where the best habitat supports a similar density (Lahti 1983). The Yellow Wagtail avoids very open habitats (Fig 10, cf. also Finnilä 1915, Auer 1916, Sammalisto 1957). Counts made in May are unreliable because of numerous migrants.

Motacilla alba. The White Wagtail avoids the most wooded sites in the area of arc-shaped pools, but it also avoids very open areas (Fig. 10). The population on Kesonsuo is larger than that of the Whinchat or the Willow Warbler.

Saxicola rubetra. The Whinchat favours edge areas (Kalela 1938, Sammalisto 1957), which is also the case on Kesonsuo (Fig. 8). Four passerines outnumber the Whinchat on Kesonsuo, which may partly be due to the lack of suitable habitats (cf. the Wood Sandpiper).

Turdus pilaris. The Fieldfare usually breeds on the *Ledum* pine bog, but in 1969 an old nest was found near the central plane. In 1980 one bird uttered continuous alarm calls on the western edge of the area of wet hollows.

Acrocephalus schoenobaenus. Four singing males were observed on the bog in 1979. No previous records.

Phylloscopus trochilus. On Kesonsuo the Willow Warbler seems to depend on birch trees (Fig. 9). The species becomes more common on mires towards the north, probably due to the northward increase of the birch and willows on mires.

Corvus cornix. The Hooded Crow breeds in small pines on the bog (Fig. 8). In 1964–1980 the population size ranged from 1 to 2 pairs, except that 6 pairs were observed in 1969 (a complete census).

Sturnus vulgaris. One pair in a nest-box in 1969 (Fig. 8).

Emberiza schoeniclus. The territories fringe open areas where dwarf shrub vegetation is high (Fig. 9). Like the Willow Warbler, the Reed Bunting is more typical on northern mires; its population on Kesonsuo is exceptionally large for a raised bog.

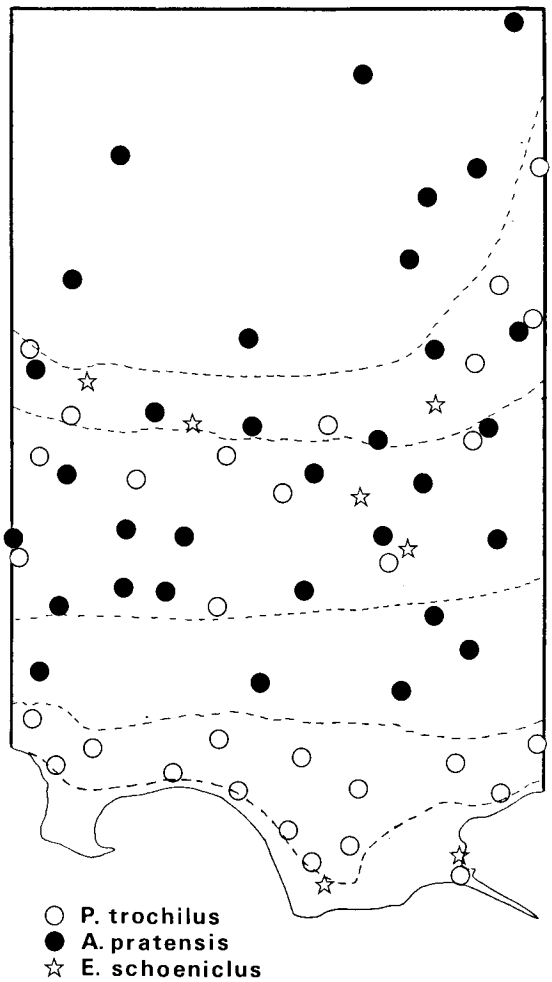

Fig. 9. The territories of the Willow Warbler, the Meadow Pipit and the Reed Bunting within the mapping area of 1969 (see Fig. 1). The Willow Warbler occurs mainly in Zone II, where the tree layer is relatively dense.

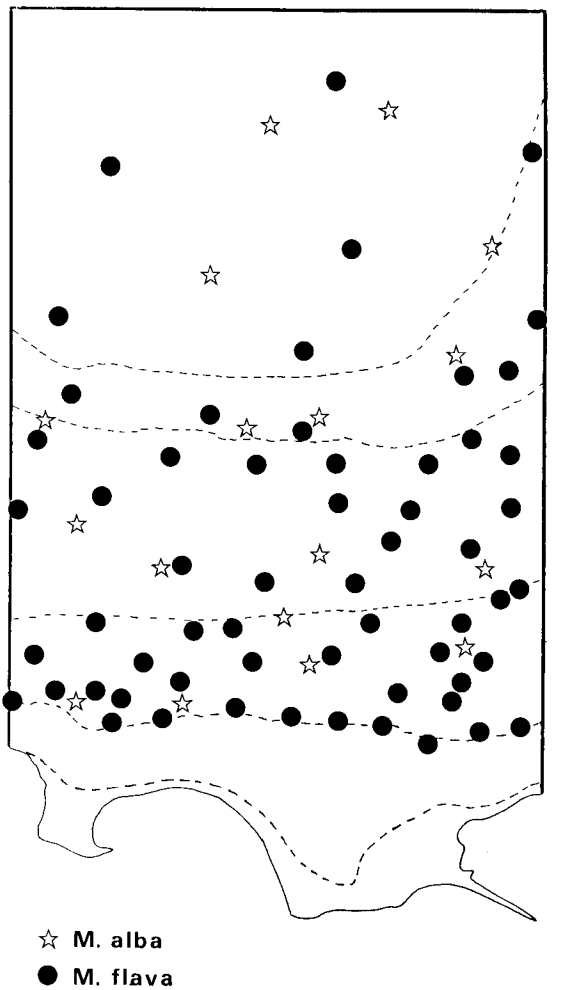

Fig. 10. The territories of the White and the Yellow Wagtail. The Yellow Wagtail prefers Zones III and IV, with moderate tree density and some open water. The White Wagtail occurs uniformly in each zone of the open area.

Table 2. Densities (pairs/km^2) of the breeding species in different zones (see "The study area") of the mapping area (year 1969). The waterfowl (Gaviiformes, Podicipediformes, Anseriformes, Laridae) are not included in the table.

Zone:	I	II	III	IV	V	VI
Area (ha):	7.0	16.3	22.5	36.5	17.5	68.0
Vanellus vanellus	–	–	–	–	6	–
Philomachus pugnax	–	–	27	14	–	7
Gallinago gallinago	14	–	–	–	–	–
Numenius phaeopus	–	–	9	–	–	–
N. arquata	–	–	4	3	6	4
Tringa glareola	–	–	4	22	–	4
Cuculus canorus	–	12	–	–	–	–
Anthus trivialis	–	55	–	–	–	–
A. pratensis	–	–	22	36	34	12
Motacilla flava	–	6	120	49	40	9
M. alba	–	–	22	16	17	6
Saxicola rubetra	14	–	27	8	6	–
Phylloscopus trochilus	14	86	–	19	40	–
Muscicapa striata	–	18	–	–	–	–
Ficedula hypoleuca	–	6	–	–	–	–
Corvus cornix	–	–	–	3	6	2
Fringilla coelebs	29	55	–	–	–	–
F. montifringilla	–	49	–	–	–	–
Emberiza schoeniclus	29	–	–	6	17	–
Total (pairs/km^2)	100	288	235	175	171	46

Bird assemblages in different zones of Kesonsuo

The best data on the bird assemblages in different habitats in Kesonsuo come from the mapping area (cf. also Fig. 1).

The densities of the land bird assemblages (Table 2, waders included) ranged from 44 to 288 pairs/km^2 in the different zones, but the minimum value (in the central pool area) increases markedly if waterfowl and gulls are taken into account. The maximum density of the open areas in the outer margin of the bog plane (Zone III) is 235 pairs/km^2, largely due to the Yellow Wagtail. Here the densities are probably increased by the edge effect, for the narrow open zone is bordered by two zones with pines.

The assemblages can also be characterized by the total biomasses. Using the average individual weights given by Järvinen & Väisänen (1977), we obtained the following total biomasses for the land bird pairs in the different zones:

Zone	kg/km^2	Zone	kg/km^2
I	5.7	IV	18.9
II	12.2	V	22.5
III	27.8	VI	11.6

If the waterfowl and gulls were included, the totals for the open mire types would in each case clearly exceed that in the *Ledum* pine bog (Zone II).

The biomass values for Kesonsuo are difficult to compare with those for other areas, because few such data have been published. Järvinen (1976) calculated that the biomass of a very dense (over 300 pairs/km^2) bird assemblage on a *palsa* peat bog in northern Finland was 23 kg/km^2.

In order to compare assemblages in different zones, we calculated percentage similarity indices. The results are shown in Table 3. The assemblages can be divided into three groups: those of zone I, zone II and zones III–VI. The pattern thus coincides fairly well with the pattern of tree densities (see Study areas). Comparison is difficult, however, because the different zones vary markedly in area (e.g. zone I is only 7.0 ha). One largely qualitative conclusion can be drawn: the bird assemblages in Kesonsuo vary with the habitat type. Since we lack exact habitat measurements, however, it is hard to infer the reasons for the differences observed. The mire type seems to be of importance, but we suggest that the tree density and vertical density of the vegetation also have a clear impact on the bird assemblages (see also Niemi 1983 and Niemi et al. 1983).

In Table 4 we have compared assemblages in different habitats in 1964 and 1969. The study areas in 1964 included parts of the marginal fen (corresponding to Zone I), the marginal slope (similar to Zone II but fewer trees) and the bog plane (Zones III–VI). The marginal fen censused in 1964 was situated in the southern part of Kesonsuo, where the marginal fen is well developed. Its bird assemblage was quite different from that of the marginal fen along the River Koitajoki censused in 1969. Another marginal fen resembling Zone IV in its habitat structure was censused north of Iso Säkäsaari in 1969.

The results from the central plane were similar in 1964 and 1969 (most differences can probably be accounted for by methodological differences). The low density of the Yellow Wagtail in 1964 is noteworthy. Järvinen (1978b) suggested that the species increased

markedly from 1954–1955 to 1968–1974 on Heikinjärvenneva, a mire area in western Finland. Its density has also increased in the raised bog areas of Satakunta (W Finland) between 1953 (Seiskari 1954) and 1968 (Pihlasalo 1968), and there are other data indicating an increase of the species in Finland and Sweden (Roos 1978, Järvinen & Väisänen 1979).

Non-breeding species recorded on Kesonsuo

The diversity of the birdlife of Kesonsuo is enhanced by migrants and by species that do not breed on the bog but forage there. In the following we present the most interesting observations on the non-breeders (cf. also *Tringa nebularia*, above). In addition, many passing migrants have been recorded (e.g. arctic waterfowl, such as *Branta leucopsis, B. bernicla, Melanitta nigra* and *Clangula hyemalis*). In evaluating the records, the reader should note that autumn migration was not closely observed and that spring migration was followed fairly well only in 1969.

Table 3. Percentage similarities ($\sum \min (j_i, j_k)$, where j_i and j_k correspond to the frequencies of species j in zones i and k) of the bird assemblages in the different zones.

Zone	II	III	IV	V	VI
I	33	11	19	27	0
II		2	13	25	2
III			63	46	53
IV				73	71
V					56

Cygnus cygnus. At least 10 exx. on the bog on 5 and 20 June 1979. No observations in 1963–1977, but 2–3 exx. several times in June 1978.

Anser fabalis. In addition to the breeding population, many non-breeding individuals use the area for foraging and resting, e.g. flocks of 65 exx. (18 May 1969), 25 exx. (4 June 1969) and 70–80 exx. on 16 May 1978 (Kari Takamäki). A total of 750 *Anser* sp. was observed on 21–25 May 1978.

A. albifrons. 3 ad., 10 May 1975 (Kari Takamäki).

Mergus albellus. On 9 July 1963, a female in a pool on the central plane.

Pernis apivorus. A common visitor in June.

Milvus migrans. Two observations (1965 and 1969, both in May).

Haliaeetus albicilla. Several observations.

Circus cyaneus. Many observations of foraging females (or immature birds), but few males.

Accipiter gentilis. Some observations.

A. nisus. Many observations on the bog.

Buteo buteo. A frequent visitor.

B. lagopus. 1 ex. in June 1969.

Aquila chrysaetos. Many observations of both juvenile and adult birds. In the 1950s the species seems to have bred near Kesonsuo.

Pandion haliaetus. Forages on Kesonsuo and along the River Koitajoki.

Falco tinnunculus. A common visitor.

F. vespertinus. A male on 10 and 14 June 1969.

F. columbarius. Some observations.

The number of diurnal birds of prey thus amounts to 15 species, if we include the Peregrine *F. peregrinus* (an earlier breeder) and the Hobby *F. subbuteo* (a regular breeder in the forest islands).

Lagopus lagopus. Displaying birds. Breeds on pine bogs.

Tetrao tetrix. The eastern and southern parts of the bog are especially important as display grounds.

Porzana porzana. Reported by Eskelinen (1972) from Kesonsuo, no date given.

Charadrius dubius. One individual on 19 May 1967.

Ch. hiaticula. Almost 10 observations of migrants in May and June (the latest record 12 June 1969).

Table 4. The densities (pairs/km^2) of land-bird species in different areas in 1964 and 1969. The table is based on the single-visit censuses. For details of the areas, see text.

Species	1964, 132 ha marginal lagg	1964, 424 ha central plane	1969, 40 ha central plane
Falco peregrinus	–	0.2	–
Grus grus	–	1.2	–
Pluvialis apricaria	1.0	0.2	–
Vanellus vanellus	2.0	8.5	–
Limicola falcinellus	–	0.2	–
Philomachus pugnax	2.0	4.7	7.5
Numenius phaeopus	2.0	0.2	5.0
N. arquata	4.0	4.5	–
Tringa nebularia	1.0	1.7	2.5
T. glareola	1.0	3.1	–
Alauda arvensis	1.5	–	–
Anthus pratensis	10.6	16.3	17.5
Motacilla flava	2.0	5.2	32.5
M. alba	–	10.9	12.5
Saxicola rubetra	1.0	1.7	–
Corvus cornix	–	0.2	2.5
Sturnus vulgaris	–	0.2	–
Emberiza schoeniclus	–	0.9	2.5
Total	29.0	60.0	84.0

Pluvialis apricaria. Migratory flocks until at least 20 May. One observation of autumn migration: two flocks totalling over 200 exx. on 19 August 1978 (Kari Takamäki).

P. squatarola. In 1969 migrating birds were observed between 11 May and 10 June, the peak being on 24 May, when 12 + 18 exx. rested on the central plane.

Calidris canutus. Mass migration on 9 June 1969. As the migration of this arctic wader in the interior of the country is poorly known, we report our observations in detail (communicated orally to the Finnish Ornithological Society in 1969). On 9 June the weather was half-cloudy before the noon, and between 12.00 and 14.00 hours there was heavy rain. The weather cleared up towards the evening. The temperature was about + 20°C. The following flocks were observed: (1) About 400 exx. (NE or ENE) at 14.05 hours. (2) About 400 exx. to ENE at 18.50. (3) About 250 exx. to ENE at 19.20. In addition, a flock of *Calidris* sp. of about 250 individuals was observed at about 14.00. No flocks landed on Kesonsuo. On 10 June, one or perhaps two Knots rested on the central plane. Late spring migration is characteristic of the Knot (Lammin-Soila 1976).

C. minutus. Three spring observations (e.g. 6 + 3 exx. on 5 June 1979).

C. temminckii. 1 ex. on 18–21 May 1967 and 3 exx. on 26 May 1969.

C. alpina. Migrating birds (single birds and small flocks of up to about 20 exx.) have been seen between 17 and 25 May in different years. One autumn migrant on 21 July 1976 (Kari Koskela).

Limicola falcinellus. Migratory flocks (up to 20 exx.) in late May. In early June it is practically impossible to separate the breeding population from late migrants.

Philomachus pugnax. Kesonsuo is an important resting place for spring migrants, e.g. 200 Ruffs on 18 May 1967.

Lymnocryptes minimus. Displaying birds on 10–18 May 1969.

Limosa limosa. 1 ex. on 4 June 1979 on the bog. The species is a rarity in eastern Finland during the breeding season (cf. Hyytiä et al. 1983).

L. lapponica. Single individuals and small flocks (max. 11 exx.) between 16 May and 3 June in different years.

Tringa erythropus. The species does not breed on the bog, but migrants are seen throughout the summer. In 1969, when almost daily observations could be made, the latest spring migrants were seen on 3 June and the earliest autumn migrants on 10 June (cf. Hildén 1979; see also Järvinen 1977). The peak was on 13 May: 26 exx. (e.g. a flock of 14 exx.).

T. totanus. One observation on 3 June 1979. The species has recently colonized many raised bogs in southern Finland (Hyytiä et al. 1983).

Arenaria interpres. 1 ex. on 26 May 1966 and 2 exx. on 20 June 1967 resting on the bog.

Phalaropus lobatus. Migrating birds (1–4 exx.) almost daily between 25 May and 12 June in 1969. An exceptionally late individual, seen on 20 June 1979, may have been breeding. The species breeds in at least one mire area near Kesonsuo (JK, unpubl.).

The wader data emphasize the great value of Kesonsuo as a resting place to many northern, particularly arctic, species. Comparable data from other mires in Finland are largely lacking, but at least on Heikinjärvenneva (Järvinen 1977) and Martimoaapa (Väisänen & Järvinen 1977) the quantities of migrating waders are smaller, because, unlike Kesonsuo, they do not lie on the main migration route of many arctic species in the interior of Finland.

Larus minutus. Non-breeding individuals observed on 11–26 May 1969 (1–7 exx.) and on 18 June 1980 (1 + 7 exx.).

L. canus. "Floaters" in several years. First breeding in 1979 (see above).

Asio flammeus. Single observations in many years, also display calls.

Anthus cervinus. The Red-throated Pipit is observed on Kesonsuo each spring. Since the spring migration of the species is poorly known in Finland, the records from 1969 are given in detail. At the beginning of the observation period, on 11 May, 7–9 exx. were seen. The numbers peaked on 16 May, when there were 18 individuals (e.g. 3 singing males and 3 other individuals in an area of less than 1 ha). The latest observation was made on 3 June. Altogether about 70 observations were made (observations made on different days, often at different sites, were counted separately).

Luscinia svecica. Two observations: on 12 May 1969 a male by the River Koitajoki, and on 3 June 1979 a male on Kesonsuo.

Acrocephalus scirpaceus. A male singing eagerly in the wet hollows area of the central plane on 17–18 June 1980. No breeding records are known from Finnish mires.

In addition to the above-mentioned passerine species, this is an important foraging area for hundreds of swifts, swallows and martins (*Apus apus, Hirundo rustica, Delichon urbica* and *Riparia riparia*), for thrushes (*Turdus* spp.) and for migrating Willow Warblers.

Concluding remarks

The number of species is known to increase with the area (e.g. Palmgren 1915–1917) and this is also true of the avifauna of mires. The habitat diversity tends to be greater in larger areas and this increases species richness. Also, many large species require large territories (Schoener 1968). Järvinen & Sammalisto (1976) constructed the species-area curves for ordinary mires in Finland and their curve for raised bogs predicts no more than about 6.5 species for the whole Kesonsuo area. This value is far too small, however, partly due to different census methods, but mostly to the greater habitat diversity in our study area. The same conclusion can be drawn from comparisons with, for example, Pihlasalo's (1968) data from western Finland and Hakala's (1971) data from the *aapa* fen region in Ostrobothnia. In the following we discuss probable reasons for the unusual richness of the birdlife on Kesonsuo:

(1) The geographical location of Kesonsuo enhances diversity. The area is situated in a region where the northern and southern elements of mire birds meet (for the Finnish breeding ranges of different species, see Hyytiä et al. 1983 and Järvinen & Sammalisto 1976). This clearly increases the chances of the co-occurrence of such species as the Garganey, the Curlew, the Whimbrel, the Bean Goose and the Broad-billed Sandpiper on Kesonsuo.

(2) The exceptional diversity of available habitats also contributes to the diversity of the birdlife. Kesonsuo is known to be exceptionally well developed and thus quite an atypical peat bog (see Introduction and Tolonen 1967). From the ornithological point of view, important factors are the vertical stratification of the vegetation and the numerous open-water areas.

The pool mosaic is presumably the main reason for the high waterfowl densities, which place Kesonsuo in the same category as many eutrophic "bird lakes" in southern Finland. Good examples of the typical

"bird lake" fauna are the Horned Grebe, the Garganey and the Shoveler. The high densities of the more common waterfowl species and the Black-headed Gulls are also typical of the avifauna of eutrophic lakes. We estimated the conservation value of Kesonsuo using the index system presented in the national program for the conservation of "bird lakes" (Anon. 1981). The result, approximately 100 points, classified Kesonsuo as an internationally important area in this respect, even though some species breeding on Kesonsuo lacked a conservation index.

Only a few papers published so far have examined the distribution of bird populations within a mire. From the above (see Section 5) it is clear – albeit not surprising — that a single bog consists of ornithologically quite different parts (see also the species maps). The bird assemblage of the open areas differs from that of the pine bog parts almost as much as from the assemblage of forests. It seems that the vegetational mire type classification could be a good basis for the ornithological classification, but this cannot be confirmed without the necessary data on various habitat variables (but see Niemi et al. 1983). In addition to the mire type, the distribution of open water and trees seems to be of great importance (see also Seiskari 1954, Sammalisto 1955 and Lahti 1983).

Finally, we would like to list six ornithological points that should be taken into account when assessing the conservation value of a mire:

1) The number of the breeding species is clearly very important. The occasional breeders may cause some uncertainty, especially if the count is based only on a single visit (see Järvinen 1977).

2) The biomass of the breeding birds could be another useful variable, because it weights the large species, which also tend to have great conservation value, at least in the popular image (e.g. the Bean Goose and the Red-throated Diver).

3) The number of endangered species is of extreme importance but not necessarily correlated with the total number of breeding species (see Järvinen 1982). Two species endangered in Finland breed or have bred on Kesonsuo: the Red-throated Diver and the Peregrine.

4) The quality and quantity of the migrating species is a factor that has largely been neglected in conservation programs.

5) The importance of the area to foraging non-breeding species (e.g, many birds of prey) deserves to be considered.

6) The number of displaying tetraonids is also of importance.

When all these factors are taken into account, Kesonsuo ranks very high from the conservation point of view. We urge that in future more attention be paid than previously to our points 3–6.

Tiivistelmä: **Kesonsuon pesimälinnusto ja muutonaikaiset vieraat**

Kesonsuo on linnustollisesti Suomen tärkeimpiä kosteikkoalueita. Se on mukana monissa kansallisissa ja kansainvälisissä suojeluohjelmissa (mm. Project Mar ja Project Telma). Vuodesta 1976 alue on ollut luonnonsuojelualueena, jolla liikkuminen kesäaikaan on kielletty. Kesonsuon pesimälinnustoa ja kevätmuuton aikana alueella levähtäviä muuttajia on seurattu noin 20 vuoden aikana. Tässä kirjoituksessa esitellään Kesonsuon linnusto vuosina 1964–1969 ja 1979–1980 tehtyjen lintulaskentojen perusteella. Hajahavaintoja on myös muilta vuosilta.

Kesonsuo sijaitsee Pohois-Karjalassa ja on suoyhdistymätyypiltään keidassuo. Kesonsuo (kokonaisuudessaan noin 15 km^2) rajoittuu vesistöihin kolmelta suunnalta. Laskenta-alueet on esitetty kuvassa 1. Alueen pesimälinnuston kattavin laskenta on vuodelta 1969, jolloin suon länsiosassa kartoitettiin 1.7 km^2:n alue (kuva 1). Kesonsuolla voidaan poikkeuksellisen selvästi havaita suon vyöhykkeisyys (vyöhykkeet on rajattu kuvaan 1 ja merkitty roomalaisin numeroin). Eri linturyhmien laskemiseksi käytettiin eri menetelmiä. Varpuslinnut laskettiin käyttäen kartoitusmenetelmää, vesilintujen laskennassa noudatettiin lähinnä Linkolan (1959) ja Kauppisen (1983) esittämiä suosituksia ja ohjeita. Kirjoituksessa tarkastellaan ensi sijassa suon aukeiden osien linnustoa.

Kesonsuon pesimälinnusto eri vuosina on esitetty taulukossa 1. Vuonna 1969 Kesonsuon pesivän vesilinnuston parimääräksi arvioitiin noin 340 paria, joka on selvästi suurempi kuin muilla suomalaisilla suoalueilla. Vesilinnustoon kuului yhdeksän lajia, joista neljä pesii muilla keidassoilla harvoin: heinätavi, haapana, lapasorsa ja metsähanhi. Vesilinnuston kokonaistiheys oli noin 36 paria/km^2, joka vastaa noin 19 prosenttia koko linnustosta. Muihin suoalueisiin verrattuna vesilinnuston osuus on huomattavan suuri.

Kahlaajia Kesonsuolla pesii yhdeksän lajia, joista runsaslukuisimpia ovat suokukko, töyhtöhyyppä, isokuovi ja liro. Jänkäsirriäinen elää Kesonsuolla levinneisyysalueensa eteläreunassa. Pikkukuovi ja isokuovi näyttävät keskittyvän jossakin määrin suon eri osiin (kuva 5).

Lokkilinnuista alueella pesivät naurulokki, kalalokki, selkälokki ja harmaalokki sekä kalatiira. Naurulokki näyttää vähentyneen selvästi 1960-luvun jälkeen: 1969 pesi 158 paria, mutta 1980 vain 10 paria.

Suon monipuolisuuden vuoksi alueella pesii monia varpuslintulajeja, jotka yleensä kuuluvat suolinnustoon vasta pohjoisempana (pajulintu ja pajusirkku). Lisäksi tavallisimmat lajit ovat runsaita. Esimerkiksi keltavästäräkin tiheys on paikoin noin 120 paria/km^2, joka on korkeimpia soilta tunnettuja tiheyksiä.

Linnusto vaihtelee huomattavasti suon eri osissa. Maalinnuston tiheys on eri vyöhykkeillä on 44–288 paria/km^2 ja biomassa 5.7–27.8 kg/km^2. Linnuston rakenteen muutosta tarkasteltiin prosenttisen samankaltaisuuden avulla (taulukko 3), jonka mukaan suo näyttää jakautuvan vyöhykkeeseen I (laide), vyöhykkeeseen II (reunaluisu) ja vyöhykkeisiin III–VI (keskustasanne). Rakenteen muutos näyttää siten noudattelevan muutoksia puuston tiheydessä ja korkeudessa, mutta on vaikea sanoa, mikä osuus esim. suotyypeillä on.

Pesimälinnuston lisäksi muutonaikaiset vieraat ovat Kesonsuolla runsaita. Aluehan sijaitsee mm. monien arktisten muuttajien muuttoreitin varrella. Kevätmuuton aikana levähtäviin lajeihin kuuluvat mm. tundrakurmitsa, karikukko, punakuiri, mustaviklo ja vesipääsky. 9.6.1969 suon yli muutti yhteensä 1050 isosirriyksilöä iltapäivän aikana. Mielenkiintoinen kevätvieras on lapinkirvinen, jota havaitaan Kesonsuolla vuosittain (mm. 11.5.–3.6.1969 noin 70 havaintoa).

Kesonsuon poikkeuksellisen rikkaaseen linnustoon on ilmeisesti monia syitä. Alueen maantieteellisellä sijainnilla on ilmeisesti merkitystä, jotta monet eteläiset ja pohjoiset

lajit esiintyvät yhdessä (esim. lapasorsa, isokuovi, pikkukuovi, metsähanhi ja jänkäsirriäinen esiintyvät levinneisyysalueidensa laidoilla). Toinen merkittävä tekijä lienee suon rakenteellinen monipuolisuus. Kesonsuohan tunnetaan epätavallisen hyvin kehittyneenä suona. Linnustollisesti tärkeitä tekijöitä ovat ainakin kasvillisuuden suuri vertikaalinen vaihtelu sekä avointen vesialueiden runsaus. Valtakunnallisen lintuvesiensuojeluohjelman pisteytysjärjestelmää soveltaen Kesonsuo voitaisiin luokitella kansainvälisesti arvokkaaksi lintuvedeksi, vaikka kaikille Kesonsuon lajeille ei olekaan suojelupisteitä määritelty!

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