Agriculture and birdlife in Finland. A review

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Arable land in Finland covers about 2.5 million hectares, distributed among cereals (47 %), sown grasslands (37 %) and other crops (e.g. potato, sugar-beet). Agricultural habitats in Finland support a total of about 50 bird species, but most of these use other habitats as well. About 15 species nest and forage on cultivated fields, whereas the others use them only as foraging grounds. Most bird species of agricultural habitats feed upon soil invertebrates (c. 40 %) or insects (c. 30 %), but there are also a few mainly herbivorous species and some carnivorous predators preying upon birds and mammals. The short-distance and long-distance migrants each form nearly 40 % of the species, while the rest are more or less sedentary species.

In recent decades, the area of cereals has increased steadily, whereas that of sown grasslands, natural meadows and pastures has decreased. Fields have become more uniform owing to increasing subsurface drainage and specialization. Intensification of land use by mechanization and use of fertilizers and pesticides has been drastic. According to rather circumstantial evidence, 14 (27 %) of the 52 species considered have increased widely, and 8 (15 %) have decreased in recent decades. Locally decreasing or increasing trends are shown by at least 25 species (48 %). Some species are evidently harmed by the drainage, decrease of grasslands, earlier timing of mowing, mechanization and pesticides, since these have decreased their nesting places, cover or food, and the pesticides may have various directly harmful effects on birds. On the other hand, some other species have probably benefitted from the recent changes, e.g. these may have increased their favoured habitats, and improved the availability of some food items.

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Introduction

Man's agricultural activities have brought an extension of open habitats, originally found only under marginal, extreme conditions or scattered in the original forest area. This, together with destruction and modification of natural open habitats, has made many bird species adapt to using secondary agricultural habitats for breeding and/or foraging. The traditional agricultural landscape in Finland, as also in many other countries (e.g. Robertson & Skoglund 1985), is a mosaic of pastures, meadows and arable fields surrounded by woodlands. The stones cleared from the fields were commonly gathered together in piles, thus forming "islands" of various size, often covered later by scrub or trees. The birds of agricultural habitats are in continuous contact with man and therefore especially affected by human activities. Over the last hundred years there have been considerable changes in farming practice, and many bird species which formerly accepted extensive low-intensity agriculture nowadays seem to be adversely affected by modern intensive methods (e.g. Murton & Westwood 1974, Bezzel 1982, de Molenaar 1983, O'Connor & Shrubb 1985).

In this paper, I review data on agriculture and birdlife in Finland. The data are mostly rather fragmentary, but they serve to reveal gaps in our knowledge. Possible causal relationships between agricultural activities and birds will be discussed.

Birds of agricultural habitats

About 9 % of the Finnish land area is cultivated, but the proportion varies largely regionally (National Board of Agriculture 1983). In densely inhabited southwestern Finland it is 30 %, in central Finland c. 5 %, and in Lapland less than 1 %. The area of arable land in Finland, about 2.5 million hectares, is distributed among cereals (47 %), sown grasslands (37 %), and other crops, such as potato and sugar beet. About 10 % of the whole arable land consists of bare fallow, reserved fields, and other arable land such as natural meadows and pastures. Two-thirds of the Finnish farms (total number about 225 000) are small, with less than 10 ha of arable land, but large farms generally provide the most important habitats for birds (e.g. Soveri 1940). In fact, the proportion of large field areas is bigger than indicated above, because the fields of different farms are often situated side by side.

The bird communities of agricultural habitats in Finland comprise about 50 species, but most of them also use other habitats (e.g. v. Haartman et al. 1963–72) (Table 1). Fifteen species both nest and forage on cultivated fields. The others use fields only as foraging grounds, nesting in the edges or in the vicinity of arable land, or even further away. Other species could also be included, but in this connection those species at present largely dependent on agricultural habitats are the most important.

Table 1. Birds of agricultural habitats in Finland and their ecology: general feeding, nesting and migratory habits (compiled from general sources, e.g., v. Haartman et al. 1963–72). R = resident, P = partial migrant, S = short-distance migrant, L = long-distance migrant. The general population changes in recent decades (according to data in v. Haartman 1973, 1978, v. Haartman et al. 1963–72, Hildén & Koskimies 1984, Järvinen & Väisänen 1978, 1979, Tiainen et al. 1985, Vickholm & Väisänen 1984, and Vickholm et al. 1984) are presented as follows: + = widely increasing, – = widely decreasing, (+)/(–) = locally increasing or decreasing, and no sign = no definite trend. Species whose total Finnish population is entirely or largely dependent on agricultural habitats are denoted by a star (*).

Feeding habits (No. of species)	Nest location								
		Agricultural ground			Edges or vicinity of arable land			Near to fields or elsewhere	
Herbivorous (8)				(±)	*Columba oenas* *	S		*Fringilla coelebs*	SP
				+	*C. palumbus* *	S		*F. montifringilla*	SP
				+	*Streptopelia turtur* *	L	+	*Carduelis chloris*	RP
				(–)	*Carduelis cannabina*	SP	+	*Carpodacus erythrinus*	L
Omnivorous (6)				(±)	*Pica pica*	R	–	*Grus grus*	L
				(–)	*Corvus monedula* *	RP			
				+	*C. frugilegus* *	SP			
				(±)	*C. corone*	RP			
				(±)	*Passer domesticus*	R			
Soil invertebrate-feeders (11)	–	*Perdix perdix* *	R	+	*Turdus pilaris*	S	–	*Larus ridibundus* *	S
	–	*Coturnix coturnix* *	L	+	*T. iliacus*	S	(–)	*L. canus*	S
	+	*Phasianus colchicus* *	R	–	*Sturnus vulgaris* *	SP			
	–	*Crex crex* *	L						
	(±)	*Vanellus vanellus* *	S						
	(±)	*Numenius arquata* *	S						
Insectivorous (17)	(±)	*Alauda arvensis* *	S	(–)	*Hirundo rustica*	L	(–)	*Pernis apivorus*	L
	(–)	*Anthus pratensis*	L	+	*Locustella naevia*	L			
	(±)	*Motacilla flava*	L	+	*Acrocephalus schoenobaenus*	L			
	+	*M. alba*	S	+	*A. dumetorum*	L			
	(–)	*Saxicola rubetra* *	L	+	*A. palustris*	L			
	(–)	*Oenanthe oenanthe*	L	(–)	*Sylvia communis*	L			
	(±)	*Emberiza citrinella*	RP		*Lanius collurio*	L			
	(±)	*E. hortulana* *	L	(+)	*Passer montanus*	R			
Carnivorous (10)	(–)	*Asio flammeus*	S	(±)	*Buteo buteo* *	S		*Circus cyaneus*	S
				–	*Falco tinnunculus* *	S	(–)	*Accipiter gentilis*	RP
					Asio otus *	S	(+)	*A. nisus*	RP
							–	*Falco subbuteo*	L
							+	*Bubo bubo*	R
							(±)	*Strix aluco*	R
No. of species		15			23			14	

In the breeding season, most bird species of agricultural habitats feed upon insects or soil invertebrates (Table 1). About 30 % of the species belong to each of these feeding groups, if the omnivorous species are included in soil invertebrate feeders. There are also a few mainly herbivorous species and some carnivorous predators preying upon birds and mammals. Outside the breeding season, especially in winter, birds of agricultural habitats are largely herbivorous. As regards their migration habits, the short-distance and long-distance migrants form the largest groups, nearly 40 % of the species each, while the rest are chiefly sedentary species.

Trends in agriculture

In recent decades, the area of cereals has steadily increased, whereas that of sown grasslands, natural meadows and pastures has decreased (Fig. 1). Fields have become more uniform owing to increasing subsurface drainage and specialization. Mechanization and the use of fertilizers and pesticides have increased drastically. For example, since 1960, the number of tractors has about tripled and the number of combine-harvesters has grown 10-fold (Ympäristönsuojeluneuvosto 1982). The use of artificial fertilizers (N, P_2O_5, K_2O) has about doubled in 20 years, from less than 100 kg/ha to about 200 kg/ha. In the 23 years following 1953, the use of pesticides grew 11-fold (Raatikainen & Tenovuo 1977), and between 1960 and 1980 it grew fourfold.

In the years 1953–1975, the pesticides sold contained 21 445 tonnes of active ingredients, the proportions of herbicides, insecticides, and fungicides being 85 %, 10 %, and 5 %, respectively (Raatikainen & Tenovuo 1977). In the 15 years 1953–1967, 402 tonnes of chlorinated hydrocarbons were sold, and the proportion of DDT used in agriculture was about 25 % (more than 100 tonnes). The use of DDT reached a peak in the beginning of the 1960s, and then gradually decreased and was stopped in 1971. Simultaneously, the use of organophosphates increased, in the 1950s chiefly parathion, which was later replaced by dimethoate and malathion. Thus, the general trend has been a gradual shift from persistent chlorinated hydrocarbons to more readily degradable organophosphates. Mercurial fungicides were used in Finland as seed dressings as early as the 1920s, but their use did not increase significantly until the 1950s. Methyl mercury compounds (a total of 3.8 tonnes) were used only in 1956–1969, mainly in southwestern Finland.

In the 1970s, 40 % of the arable land, or 80 % of the cultivated area, was treated with pesticides (Raatikainen & Tenovuo 1977). In the beginning of the 1970s, pesticides were used at the rate of about 500 g of active ingredients per ha of arable land in a year, and at the end of the decade this value was more than 800 g/ha/yr (Ympäristönsuojeluneuvosto 1982). It is estimated that the total amount of various pesticides used in Finnish fields since 1953 is about 11 kg/ha. Herbicides form 9.5 kg of the total, insecticides and other animal pesticides 1.0 kg, and fungicides 0.5 kg.

In 1981, the agricultural herbicides sold for the treatment of grain fields were mainly phenoxyacetic acids, and the sales were sufficient to treat 896 000 ha, which is 73 % of the total grain acreage (Tiittanen & Blomqvist 1982). The amount of agricultural insecticides sold, mainly organophosphates, was sufficient to treat 239 000 ha, or 9 % of the total arable area. Sales of mercury-containing seed dressings were 241 tonnes, containing 5.4 tonnes of active ingredients, and the dressed seeds were sufficient to sow 482 000 ha, or nearly 20 % of the whole arable land.

Major changes took place within farming in Finland in 1969–1975 (Varjo 1984). This is seen in the number of farms, which decreased from around 400 000 in 1969 to only 250 000 in 1975. The economic structure of farming altered very sharply over this period, animal husbandry being replaced by forestry as the principal element. This may explain the severity of the decline in the number of farms and the marked increase in the areas left uncultivated in the less productive agricultural regions of the country.

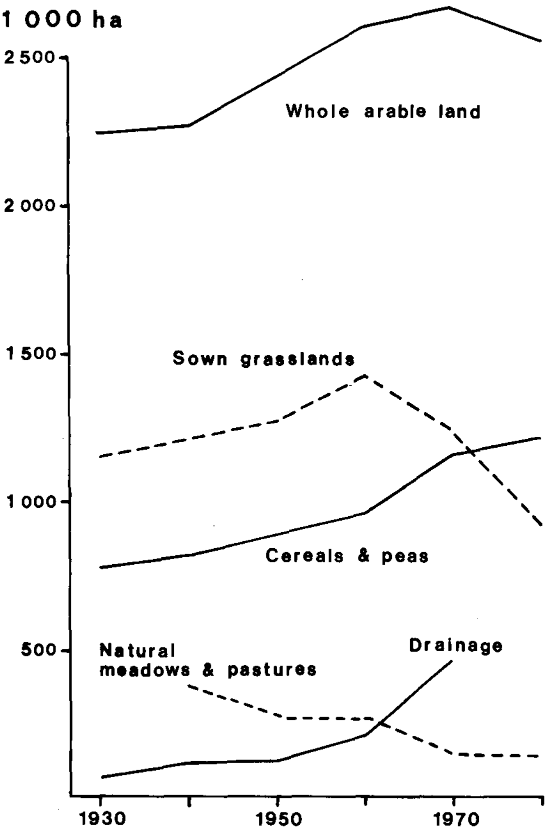

Fig. 1. Trends in agricultural land use in Finland (National Board of Agriculture 1945–1983).

Changes in bird populations

According to rather circumstantial evidence, 14 (27 %) of the 52 bird species considered here have increased widely, and 8 (15 %) have decreased in recent decades (Table 1). Locally increasing or decreasing trends are shown by at least 25 species (48 %). These trends are generally evident in the entire Finnish population of the species, but in many cases they also reflect the situation in the populations of agricultural habitats. In many increasing species, the recent population changes reflect general long-term trends in the species, which are expanding in North Europe (Table 2; v. Haartman 1973, 1978a), but in some species the situation has recently changed, at least locally (cf. Table 1). The total density of the bird community of Finnish farmland seems to have increased from the 1920–30s to the 1970s, mainly due to the increase of the Skylark *Alauda arvensis* population (Haila et al. 1979, Järvinen & Väisänen 1979, Halenius 1980, Tiainen & Ylimaunu 1984, see also Bezzel 1982; cf. however Tiainen et al. 1985). Proportionally, the Skylark has increased most in northern Finland, where its range has expanded (v. Haartman et al. 1963–72).

Some decreasing species show long-term changes in the population size; e.g. the Corncrake *Crex crex* has declined since th(first decades of the 20th century (v. Haartman 1958, 1973), the Partridge *Perdix*

Table 2. Expansion or increase of birds of agricultural habitats in Finland (according to v. Haartman 1973, v. Haartman et al. 1963–72, additional data: Järvinen & Väisänen 1978, Sammalisto 1978). – denotes a recent change in the trend (cf. Table 1).

Species	Main expansion
Phasianus colchicus	After 1950
Vanellus vanellus –	After 1950
Larus ridibundus –	1920–
Columba palumbus (–)	1900–
Streptopelia turtur	1970–
Strix aluco –	1900–
Alauda arvensis (–)	After 1940
Locustella naevia	After 1950
Acrocephalus schoenobaenus	After 1900
A. dumetorum	1950–
A. palustris	1950–
Corvus frugilegus (–)	1880–1930
Sturnus vulgaris –	1900–
Carduelis chloris	1920–70–
Carpodacus erythrinus	1945–
Emberiza hortulana –	After 1910–20

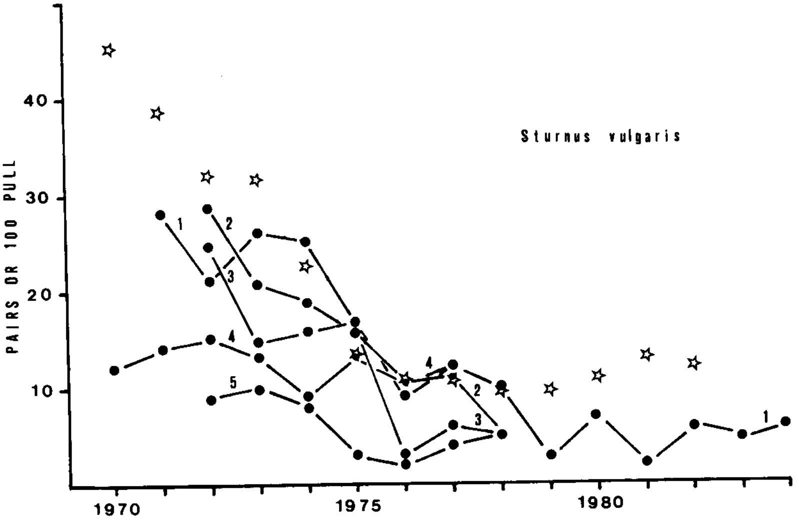

Fig. 2. Trends in numbers of Starlings in Finland according to annual counts of pairs nesting (mainly) in boxes in five areas in different parts of the country: 1. Lammi, S Finland (T. Solonen, P. Saurola & J. Tiainen, unpubl.), 2. Oulu, N Finland (Ojanen et al. 1978, Orell & Ojanen 1980), 3. Lemsjöholm, SW Finland (v. Haartman 1978b), 4. Kauhava, W Finland (Korpimäki 1978), 5. Salo, SW Finland (v. Knorring 1978); and according to the annual numbers of Starling nestlings (stars) ringed in Finland (Saurola 1978, pers. comm.).

perdix especially after the 1940s (v. Haartman et al. 1963–72, Sammalisto 1974, 1977) and the Kestrel *Falco tinnunculus* from the first half of the century (v. Haartman et al. 1963–72, Kuusela 1979a). Many agricultural bird species, however, show recent signs of a population decline (e.g. Hildén & Koskimies 1984, Vickholm & Väisänen 1984, Vickholm et al. 1984) (Tables 1 and 2). The increase of the Skylark also seems to be levelling off, and local declines have been reported (Hildén & Koskimies 1984, Tiainen & Ylimaunu 1984). The Wheatear *Oenanthe oenanthe* and the Ortolan Bunting *Emberiza hortulana* have decreased in Åland during the last few decades (Haila et al. 1979), and the Curlew *Numenius arquata* has declined in southern Finland (v. Haartman 1975, 1978a, Järvinen & Väisänen 1981; but see also Tiainen et al. 1985). In Lammi, southern Finland, the Wheatear has disappeared from the smallest fields as the total population size has decreased (Tiainen et al. 1985).

The best documented of the recent population declines is probably that of the Starling *Sturnus vulgaris*. Annual counts of pairs nesting in boxes in different parts of the country and of the numbers of nestlings ringed in Finland have shown a considerable decline throughout the 1970s (Fig. 2). The recent decline of the Black-headed Gull *Larus ridibundus* is exemplified by the data from two large colonies in southern Finland, an inland (Häme) and a coastal one (Uusimaa), where the number of pairs decreased between 1970 and 1982 from 1 000 to 30, and from 3 000 to 500, respectively (P. Saurola, pers. comm.). The total decline of the species in an area of 2 000 km^2 in Häme was from c. 6 000 to c. 2 500 pairs (Saurola 1983). In many species, however, real trends may readily be masked by considerable annual fluctuations.

Effects of agricultural practices on birds

Various closely linked factors, including man's agricultural practices, evidently affect the densities of bird populations. On the whole, however, the complex causal relationships are far from clear, and it is difficult to identify specific relationships between single activities and their impact (e.g. de Molenaar 1983). Bird densities depend on the area of fields, probably due to the edge effect, and on the characteristics of the fields (see also Bezzel 1982). Many species of agricultural habitats seem to prefer abandoned and open-ditched fields, and only two species, the Skylark and the Lapwing *Vanellus vanellus*, breed abundantly on uniform fields with subsurface drainage (Table 3) (see also v. Haartman et al. 1963–72, Törmälä 1980, Tiainen & Ylimaunu 1984). Accordingly, many species seem to be harmed by drainage, and to benefit from abandoned fields. The recent abandonment of fields seems to have benefitted various species preferring scrubby open habitats. Because of ecological succession, however, the benefit to the species of open habitats is short-lasting (see e.g. Törmälä 1984). Many other changes in agricultural practice seem to have adverse and/or beneficial effects on birdlife as well.

The transition to subsurface drainage affects the resources available to birds by making habitats more uniform. The disappearance of open ditches, verges, scrub, fences, etc. also means the disappearance of sheltered nesting places, singing posts, and various food plants and animals (invertebrates, reptiles, small rodents) (e.g. Halenius 1980, Laursen 1981, Bezzel 1982, de Molenaar 1983, Steen 1983, O'Connor 1985). Drainage also makes the main food of various species, earthworms (Lumbricidae), stay out of reach deeper in the soil. Only a few bird species, the

Table 3. Densities (pairs/km²) of the most numerous breeding bird species in different agricultural habitats in Vantaa, S Finland (Halenius 1980).

Species	Cereal fields				Abandoned fields		N
	Drained		Ditched				
	1973	1974	1973	1974	1973	1974	
Alauda arvensis	100.6	91.3	104.0	83.6	103.6	100.0	324
Saxicola rubetra	2.1	7.6	13.4	9.1	76.4	94.5	113
Sylvia communis	4.3	1.9	6.7	4.6	38.2	25.5	45
Emberiza hortulana	8.6	11.4	6.7	6.1	18.2	10.9	34
Anthus pratensis	–	3.8	6.7	3.0	18.2	25.5	32
Vanellus vanellus	21.4	17.7	6.7	1.5	–	–	23
Motacilla flava	–	–	1.7	1.5	16.4	12.7	18
Perdix perdix	4.3	1.9	1.7	1.5	7.3	9.1	14
Numenius arquata	2.1	–	3.4	1.5	10.3	5.5	13
Phasianus colchicus	–	–	1.7	3.0	10.9	5.5	12

Lapwing, Skylark and Ortolan Bunting, seem to have benefitted from the habitat change due to covered drainage, and the removal of scrub and trees from drained fields has been detrimental to buntings (e.g. de Molenaar 1983, Robertson & Skoglund 1985).

Not only has there been a decrease in the area of sown grasslands — an important habitat for many birds of farmland, another fatal development for birds is that drainage and fertilization allow the grass to be cut more frequently and earlier in the season (see de Molenaar 1983). The date of the first cut is even earlier — in the beginning of June — when, as is now usual, the grass is mown for silage instead of for hay. Besides slaughtering both young and adult birds, mechanization and early harvesting also greatly diminish the mass of invertebrate food (see de Molenaar 1983, Steen 1983). The abundance and number of insect species in a certain type of vegetation depend on the number of plant species and the structure of the plant cover, the complexity of the plants and the microclimate. Intensive management reduces vegetation types, and thus considerably impoverishes insect life, both qualitatively and quantitatively. This loss is aggravated by the consequences of the uniform structure and species composition of modern cultivated areas and the use of artificial fertilizers.

Fertilizing of grasslands results in a dense, heavy mat of grass, with a cooler microclimate, less favoured by insects (de Molenaar 1983). This not only affects the breeding conditions of specialized grassland birds, but in particular the main food source for their offspring and the young of birds breeding in adjacent forest edges and scrub. This phenomenon presents a serious threat, especially in combination with periods of bad weather, when the feeding time is limited.

Fertilizers and specialization reduce the supply of various seeds and invertebrates in favour of cereal production (e.g. de Molenaar 1983). An increase in soil fertility increases the production of plant and animal biomass, and this may have a positive effect on the avifauna. However, the resulting decrease in diversity of the plant cover and in the associated invertebrate life (see Steen 1983), and also the fact that increased fertilizing is accompanied by a variety of measures for the improvement and intensification of agriculture will more often than not cancel out the original beneficial effect.

An instructive example of the complex causal nexus between nature and human activity is offered by the decrease of the Corncrake (v. Haartman 1958, 1973). The Corncrake was probably not a member of the Finnish avifauna before the agricultural period. It was highly favoured by the development of agriculture, but has been disappearing over large areas of Europe since mowing-machines came into use, and because the hay harvest comes earlier in the modern farming schedule (see however Mäki & Rinne 1985). Its decline occurred earliest in the areas with the most efficient agriculture, and latest in the most old-fashioned ones.

The Partridge has shown great annual fluctuations and has declined steeply in recent decades, probably due to increased use of pesticides and other changes in agricultural practices (v. Haartman et al. 1963–72). In Britain, the chief causes of the Partridge's decline have been the loss of chick food consequent on the disappearance of leys and forage, and an increased dependence on cereal insects, themselves subjected to chemical treatment (see Murton & Westwood 1974, Green 1984, O'Connor 1985). The decline of the Quail *Coturnix coturnix* is probably also largely due to modern agricultural practices, especially pesticides and mechanical mowing (v. Haartman et al. 1963–72).

The decline of the Curlew in Finland may be related to new agricultural methods, especially earlier harvesting and subsurface drainage (v. Haartman 1975). Production of young in the species seems to be low even in the preferred habitats (Ylimaunu & Ylimaunu 1984). In Germany, Curlews have only recently colonized fields, largely because their original habitats have been cleared for agriculture (see Bezzel 1982, 1985), but their reproductive success in agricultural habitats is nearly nonexistent, because the few chickens that are hatched die of starvation. As a result of high site fidelity and low adult mortality, however, populations with no offspring can persist for several years (Kooiker 1977, Kipp 1977, 1982).

The Lapwing has expanded northwards and increased in numbers in Finland during this century (v. Haartman et al. 1963–72). At the same time it has expanded its habitat range from the preferred large fields to smaller ones (e.g. Tiainen et al. 1985). Towards the end of the 1970s decreases in the southern parts of the country were reported (Hildén & Hyytiä 1981). The growth of vegetation after abandonment of shore grazing has caused marked local declines (Soikkeli & Salo 1979). Declines of the species in some other countries have been attributed to changes in agricultural practices. The reproduction rate on intensively used meadows and fields is far too low to maintain a stable population (see Bezzel 1985). In Britain, Lapwing densities have fallen in areas of intensive cereal production, due to reduced breeding success, whilst the numbers in areas of pastoral farming have increased (O'Connor & Shrubb 1985; see O'Connor 1985).

The Black-headed Gull has benefitted from the new breeding habitats provided by the eutrophication of waters due to fertilizers washed off the land, and also from the abundant food source provided by newly sown fields, especially in spring (see e.g. v. Haartman 1973). The Common Gull *Larus canus* has followed the example of its relative (Bergman 1960).

The Wood Pigeon *Columba palumbus* has expanded its range northwards and increased in Finland in the present century (v. Haartman et al. 1963–72, Saari 1984). This can most probably be ascribed to improved availability of food caused by the intensification of farming, particularly in the growing of cereal crops (Saari 1984). The Stock Dove *C. oenas* has decreased, but the populations seem to be recovering in southwestern Finland. The causal factors suggested for the decline in the Stock Dove population include the use of chemicals in agriculture (e.g. v. Haartman et al. 1963–72, see also Saari 1984). The population decline in the 1950s and 1960s may have been due, at least partly, to the effects of pesticides, especially the reduced availability of weed seeds caused by herbicides, but can also be ascribed to the reduced area of verges resulting from intensification of land use, e.g. subsurface drainage. The recent increases may be attributed to the withdrawal of certain harmful pesticides from the market, and the species has probably also started to exploit the availability of various seeds on bare soil in intensive arable farming (see Murton & Westwood 1974). There may be local differences, but just as the decline was widespread, occurring simultaneously over large geographical areas, so the increase may be a widespread result of large-scale trends in agriculture (Saari 1984, see also O'Connor 1985).

About two-thirds of the Finnish Kestrels breed in agricultural habitats (Kuusela 1983), and it is generally assumed that the reduced habitat heterogeneity on agricultural land is the main factor affecting the breeding densities of Kestrels (Brown 1976, Kuusela 1979b, Nilsson 1981). A population decrease observed in southern Finland (Linkola & Myllymäki 1969) has been explained by the coincidence of pesticide contamination and hard wintering conditions in Central Europe during the early 1960s (v. Haartman et al. 1963–72).

Effects of pesticides

Changes in Finnish raptor populations have often been attributed to pesticides accumulating in food webs, for example, concentrating in the Peregrine *Falco peregrinus* via Wood Pigeons (v. Haartman et al. 1963–72) and in the Sparrowhawk *Accipiter nisus* via granivorous and soil invertebrate-feeding passerines of agricultural habitats (Solonen & Lodenius 1984). British Peregrines have recovered after the withdrawal of organochlorine pesticides from routine use in agriculture (see Newton 1979, O'Connor 1985), but the Finnish population is still low, although slowly increasing (see e.g. Wikman 1983). The breeding success and the population level of Finnish Sparrowhawks have recently shown some indications of improving (Solonen 1984), concurrently with general declining trends in the use of organochlorine pesticides, and in the mercury content of birds (Solonen & Lodenius 1984). It has been suggested that high levels of mercury in the eggs of some accipiters have contributed to documented organochlorine-related declines in the populations (Fimreite et al. 1970), and that these contaminants accumulate almost in parallel in the food chains (Holt et al. 1979). In Central Europe, DDE seems to be the main factor responsible for impaired breeding success of birds of prey, whereas cyclodienes seem to have had the most pronounced effect on the condition of the population (see e.g. Newton 1979, Cooke et al. 1982, Newton & Haas 1984).

The detection of mass mortalities of farmland birds due to poisoning by their eating seeds dressed with organochlorines and methylmercury in England and Sweden in the 1960s were the first indications of environmental pollution by agricultural pesticides (see e.g. Borg et al. 1969, Jensen et al. 1972, Cooke et al. 1982, O'Connor 1985). As regards direct toxicity, extensive tests have confirmed that the organochlorine, organophosphorus and organometallic compounds are the most toxic pesticides (see Newton 1979). Some organophosphates may have delayed neurotoxicity in birds (Francis et al. 1980, Ohkawa et al. 1980), but the sensitivity to organophosphates varies between species (Bursian et al. 1983, Niethammer & Baskett 1983). Organophosphate pesticides also readily penetrate the skin, and birds can absorb lethal or toxic doses through their feet from sprayed vegetation (Fowle 1972, Hudson et al. 1979).

A mass death of Starlings in Sweden ultimately caused by pesticide poisoning was triggered and synchronized by bad weather (Enemar 1958). Had not the death of the poisoned birds been synchronized by the weather conditions, it might have taken place slowly, without being concentrated in a small area, and thus escaped observation (see v. Haartman 1984). Seed dressings (see e.g. Tejning 1967, Johnels et al. 1979) and pesticides accumulating in invertebrates (e.g. Edwards 1976, Thomé 1983) may be harmful to granivorous and soil invertebrate-feeding birds and their predators not only due to direct toxicity and sublethal effects but also through destruction of their prey species and reduced availability of both seed and animal food (e.g. Murton & Westwood 1974, Newton 1979, Steen 1983, O'Connor & Shrubb 1985).

Concluding remarks

More bird species have increased than decreased in agricultural habitats in Finland in recent decades, but many species have recently shown local decreasing trends, and these may be reflections of larger-scale phenomena. In addition, many earlier increasing trends seem to be levelling off or turning into declines. Some of the species still common in agricultural habitats in Finland have decreased or even become endangered elsewhere (see e.g. Anon. 1982, Bezzel 1982, 1985). In the FRG, where the agricultural development is similar to that in Finland but still more advanced, at least 57 of the 78 endangered breeding bird species are endangered by modern agricultural methods, including consolidation of farmland and abandonment of extensive utilization (Bauer & Thielcke 1982). The causes of the recent population declines in Finland are, however, largely obscure, though in various cases the only common denominator of the declining species seems to be their foraging in arable land. Thus, the causes may lie in the breeding areas, but other explanations are, of course, also possible. In addition, it is probably often difficult to separate agricultural and other factors affecting birds.

The nowadays diminishing clearance of new fields provides nesting and foraging habitats for birds, but farmland is usually considered inferior to the original habitats of species of open land (e.g. Murton & Westwood 1974, Bezzel 1982). However, fields are important and often essential to birds, because their original habitats have been largely destroyed by man, and consequently a considerable proportion of many bird populations of open environments at present inhabits agricultural habitats. The data presented suggest that the modernization of agriculture has evidently caused some changes in the birdlife in Finland, but the exact causal relationships between the agriculture and birds are still largely unknown. Thus, detailed studies on the topic are badly needed.

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Selostus: **Suomen maatalous ja peltojen linnusto**

Suomen noin 2.5 miljoonalla viljelyskelpoisella hehtaarilla viljellään viljaa (47 %), heinää (37 %) ja muita viljelyskasveja. Viime vuosikymmeninä viljan viljelyala on tasaisesti kasvanut heinänviljelyn, luonnonniittyjen ja laidunten vähetessä (kuva 1). Peltoympäristöt ovat tulleet entistä yksitoikkoisemmiksi salaojituksen ja viljelyn erikoistumisen johdosta. Maankäyttö on tehostunut rajusti koneistumisen sekä väkilannoitteiden ja torjunta-aineiden käytön myötä. Esimerkiksi vuoden 1960 jälkeen traktorien määrä on noin kolminkertaistunut, leikkuupuimurien määrä kymmenkertaistunut, väkilannoitteiden käyttö kaksinkertaistunut ja torjunta-aineiden käyttö nelinkertaistunut.

Maamme linnustossa on viitisenkymmentä lajia, jotka yleisesti tavalla tai toisella hyödyntävät peltoja, mutta useimmat niistä käyttävät enemmän tai vähemmän myös muita ympäristöjä. Noin 15 lajia sekä pesii että ruokailee viljelysmailla muiden lajien käyttäessä peltoja vain ravinnon hankintaan (taulukko 1). Useimmat peltolintulajimme käyttävät ravinnokseen maaperän selkärangattomia eläimiä (matoja, hyönteistoukkia yms.) tai kenttäkerroksen hyönteisiä, mutta joukossa on myös muutamia pääasiassa peltojen kasviravintoa käyttäviä lajeja sekä lintuja ja nisäkkäitä syöviä petolintuja. Muuttokäyttäytymisen mukaan lyhyt- ja pitkämatkaiset muuttolinnut muodostavat suurimmat lajiryhmät (lähes 40 % kumpikin) loppujen ollessa suureksi osaksi paikkalintuja.

Käytettävissä olevan aineiston mukaan 14 peltolintulajimme kanta on viime vuosikymmeninä runsastunut ja 8 lajin kanta on taantunut (+/– taulukko 1). Paikallisesti runsastuneita tai taantuneita lajeja on ainakin 24 (+/– sulkeissa). Eräs 1970-luvulla selvimmin taantuneista lajeista on kottarainen (kuva 2). Moni muukin meillä tällä vuosisadalla runsastunut laji näyttää viime aikoina taantuneen ainakin paikallisesti (taulukko 2). Monet lajit ovat ilmeisesti kärsineet salaojituksesta (esim. taulukko 3), heinänviljelyn vähenemisestä, entistä aikaisemmasta sadonkorjuusta, koneellistumisesta ja lannoitteiden ja torjunta-aineiden käytöstä pesäpaikkojen, suojan ja ravinnon vähetessä. Torjunta-aineilla voi olla myös erilaisia suoria haittavaikutuksia lintuihin. Jotkut lajit taas ovat luultavasti hyötyneet esimerkiksi sopivien elinympäristöjen määrän lisääntyessä ja tiettyjen ravintokohteiden saatavuuden parantuessa. Vaikka eräät muutokset linnustossamme ovatkin ilmeisesti maanviljelyskäytännön uudenaikaistumisen seurausta, maatalouden ja peltojen linnuston väliset vuorovaikutussuhteet ovat suurelta osin selvittämättä.

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