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Feeding Biology of Danish Farmland Birds

Ministry of Environment and Energy, Denmark
Danish Environmental Protection Agency

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Feeding Biology of Danish Farmland Birds

A Literature Study

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Introduction

In this catalogue the feeding ecology of 25 bird species of Danish farmland is presented. For each species, energy demand, feeding habitat, and food during different parts of the year (including food of young, if relevant) are treated in major paragraphs. Besides, the occurrence of each species in Denmark (phenology, distribution, habitat, and population size) is described. A further 15 bird species are briefly dealt with in addition to the main species ('allied farmland species'). Besides the species accounts, short introductory chapters on energy requirements of birds and the ingestion of grit by birds have been included.

The species selected for this catalogue include most birds that occur in high numbers in Danish farmland, especially those that obtain a significant part of their food from the fields. A selection of species foraging in farmland at different times of the year and in different crops is represented. Some rare or threatened species that might be particularly vulnerable to incidental poisoning or inexpedient agricultural practices have also been included.

Whenever possible, data on food and feeding habitat refer to Danish conditions or studies from the UK, the Netherlands, northern Germany or southern Sweden, where roughly similar soil types and climatic conditions occur. In many cases it has been necessary to include studies from Central and East Europe, and sometimes from other areas as well. The major sources of information have been the comprehensive handbook series *The Birds of the Western Palearctic vol. I-IX* (1977-94, eds. S. Cramp & K.E.L. Simmons) and *Handbuch der Vögel Mitteleuropas vol. 1-13* (1966-93, eds. K.M. Bauer & U.N. Glutz von Blotzheim), the latter work not yet complete. Original literature on food and feeding habits has been extensively consulted, though, and a list of major references is provided for each species.

The official reference on phenology, distribution and abundance of birds in Denmark is *K.M. Olsen: Oversigt over Danmarks fugle* (Dansk Ornitologisk Forening 1992). For the present purpose, the information compiled by Olsen has been supplemented with data from the Danish Bird Census Group (*E.M. Jacobsen*), the Danish Breeding Birds Atlas programme (*M.B. Grell*) and the studies on distribution and densities of farmland birds by Ornis Consult.

Rare and threatened species deserve special attention. If a bird species dealt with in this catalogue is included in the Danish list of species in need of special protection, it is mentioned in the text. The conservation status of Danish birds is summarized in *S. Asbirk & S. Søgaard (eds.): Rødliste 90. Særligt beskyttelseskrævende planter og dyr i Danmark* (Miljøministeriet 1991). In this book, standard IUCN red list categories (endangered, vulnerable, rare) are used, supplemented with two new categories: 'decreasing' (more than 50 % population decline since 1960) and 'special responsibility species' (at least 20 % of the migrating or breeding population in NW Europe occurs in Denmark).

There is no conventional index to plants, insects and other food items in this catalogue. Instead, a table summarizing the diet of each of the 25 main bird species is included at the end of the species texts. In this table, it should be easy to look up a class of food items (e.g. rape seed, aphids) to see which bird species feed on the food item in question.

Energy requirements of birds

The daily energy requirement of a certain bird species is a subject which is usually ignored in even comprehensive handbooks and standard monographs. The reason, of course, is that data on energy metabolism of wild birds, living under normal unrestrained conditions, are extremely difficult to obtain. Data on basal metabolic rates have been obtained from captive birds of a number of species (see Pinowski & Kendeigh 1977 for a compilation); these values may be found in the species accounts following this introduction. Often, though, one is left with standard equations and rules of thumb whenever daily consumption and energy expenditures of a particular species are the issue.

If experimental data are not available for the species in question, the *Basal Metabolic Rate (BMR)* of a bird may be estimated from the following equation (modified from Bezzel & Prinzinger 1990):

$$BMR = a \cdot W^{0.723} \text{ kJ/day}$$

W = body mass in g
a = 2.22 - 3.72, depending on the species (and other factors?)

In general, large values of *a* are valid for passerines (order *Passeriformes*) while small values are valid for non-passerines, with the exception of *Apodiformes* (swifts and hummingbirds, the latter in particular having very high BMRs). Even with this exception, though, some overlap between passerines and non-passerines seems to exist, so the presentation of different equations for the two groups (as often seen in older texts) is probably not justified. [In the systematically ordered species accounts, the first nine species are non-passerines, while the others (from Skylark *Alauda arvensis* onwards) are passerines.]

From the BMR, the 'standard' or 'normal' *Daily Energy Expenditure (DEE)* of a free-living bird may be estimated. Two major tasks require additional energy: (1) The maintenance of body temperature when the ambient temperature is below the thermoneutral zone. (2) The daily activities of the bird.

Fortunately, a remarkably simple rule of thumb seems to be applicable under most conditions: *the average DEE is at a level of three to four times the BMR* (A. Turner in Brooke & Birkhead 1991). Values close to

four generally apply to small birds, while the multiplication factor approaches three in large birds. The extra energy demand is high during cold weather and when the bird is feeding nestlings (or engaged in other highly energy-demanding tasks as territory fights or egg production), whereas particularly low DEEs are found during incubation and moulting. The point, however, is that DEE in most species is fairly constant over year, due to the placing of breeding activities in the summer half, when maintenance of body temperature is less of a problem.

To convert from DEE (in kJ) to daily consumption (in g) one has to know (1) the energy content of the food and (2) the assimilation efficiency for the food in question.

A 'standard' assimilation efficiency of 75% is often assumed, but more accurate values have been determined for various types of food (Castro et al. 1989), e.g.:

Green plant parts	37%
Fruits	41%
Seeds	78%
Invertebrates	74%
Vertebrates	78%

The energy content of many food items varies, first of all due to (seasonal) variation in water content. This variation should be taken into account (if possible) when tables of energy content are consulted and a conversion from kJ (per g wet or dry weight) to g fresh weight is carried out. For a number of common food items of farmland birds, the values in Table 1 may be used.

When a bird's potential exposure to toxic chemicals used in agriculture is to be evaluated, data on daily food consumption by the species in question are urgently needed. Whenever possible, such data have been included in the species texts (e.g. Pink-footed Goose *Anser brachyrhynchus*, Grey Partridge *Perdix perdix*). In most species, though, information about daily food requirements in the wild does not seem to exist. In some of these species – supposed to be particularly important in pesticide risk assessments – daily intake has been estimated in the present context, based upon existing data on metabolic rate and composition of diet. These calculated values have been included in the species texts under the heading 'Estimations'.

It should be noticed that birds may also be exposed to agricultural chemicals through their ingestion of grit (see the following section).

Table 1. Energetic value (kJ/g) of some common food items of farmland birds. If available, both wet weight and dry weight values are presented, together with information on water content. Based on data from Wiegert 1964 and 1965, Kendeigh & West 1965, Helms 1980, Aeckerlein 1986, Potts 1986, Souci et al. 1986, Strudsholm et al. 1993 and P. Holter pers. comm.

	kJ/g wet	% water	kJ/g dry	% water
Barley, grain	11.2 - 12.0	12	15.7	15
Oats, grain	10.2 - 14.6	13	14.2	14
Wheat, grain	12.4 - 12.5	13	16.1	15
Rye, grain	10.7 - 11.4	14	15.9	16
Cereals, shoots & leaves			12.3 - 13.1	80 - 84
Rape, seed			19.3 - 21.9	8
Peas, seed (dry)	11.0 - 13.3	11	16.1	15
Peas, pod & seeds (green)	3.2	77		
Pulses *Fabaceae*, leaves & stem			9.5 - 14.9	80 - 87
Potatoes, tubers	2.9 - 3.3	78	14.2	76
Beets, leaves			10.3 - 12.5	87 - 88
Chicory, spinach etc., leaves	0.4 - 0.6	92 - 95		
Grasses, shoots & leaves			13.5	81 - 82
Poppy *(Papaveraceae)*, seed	17.8	6		
Black bindweed *(Polygonaceae)*, seed			19.0	12
Buckwheat *(Polygonaceae)*, seed	10.7 - 14.0	13		
Lupin *(Fabaceae)*, seed	8.6		16.7	11
Flox *(Linaceae)*, seed	17.8		20.8	9
Apples	2.2	85		
Cherries	2.1 - 2.4	83 - 85		
Black-currants	2.0	81		
Red-currants	1.6	85		
Strawberries	1.3	89		
Grasshopper *Melanoplus sp.*			21.0 - 22.6	
Spittlebug *Philaenus sp.*			22.3 - 24.6	
Beetle larvae *(Coleoptera)*			17.0 - 23.0 [1)]	

[1)] Values of 20-22 kJ/g dry weight probably apply to most insects (P. Holter pers. comm.)

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Pinowski, J. & S.C. Kendeigh (eds.) 1977: Granivorous birds in ecosystems. – Cambridge University Press, Cambridge, UK.

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Wiegert, R.G. 1965: Energy dynamics of the grasshopper populations in old field and alfalfa field ecosystems. – Oikos 16: 161-176.

Grit consumption of farmland birds

Many bird species ingest small stones (grit) in order to grind their food in the gizzard; grit may also be a source of minerals, especially calcium. The consumption of grit by farmland birds has been the subject of a recent Dutch study (de Leeuw et al. 1995), the findings of which are summarized in the following.

Gizzard contents of 198 birds of 27 species regularly foraging on arable fields were examined. The species were divided into five groups: small granivores (e.g. House Sparrow *Passer domesticus*, Greenfinch *Carduelis chloris*, Chaffinch *Fringilla coelebs*), large granivores (Grey Partridge *Perdix perdix*, Pheasant *Phasianus colchicus*, Woodpigeon *Columba palumbus*), ducks and geese (e.g. Greylag Goose *Anser anser*, Mallard *Anas platyrhynchos*), small non-granivores (e.g. Meadow Pipit *Anthus pratensis*, Blackbird *Turdus merula*, Starling *Sturnus vulgaris*), and large non-granivores (e.g. Black-headed Gull *Larus ridibundus*, Carrion Crow *Corvus corone*, Magpie *Pica pica*).

With the exception of some non-granivores, notably Meadow Pipits, White Wagtails *Motacilla alba* and Starlings, all individuals had grit (defined as inorganic particles > 0.5 mm) in their gizzard. The number of grit particles was positively correlated with the size of the bird, with ducks and geese containing particularly high numbers. There was no difference in the number of grit particles between granivores and non-granivores of similar size, but variation was higher in non-granivores than in granivores. Average number of grit particles found in the gizzards of some common species were: Greylag Goose 21,200, Grey Partridge 676, Pheasant 214, Black-headed Gull 128, Woodpigeon 208, Skylark *Alauda arvensis* 217, Blackbird 600, Carrion Crow 770, Greenfinch 95, Chaffinch 65.

As to the size of the grit particles ingested, though, significant differences between granivores and non-granivores were apparent. Although some non-granivores had large numbers of grit in their gizzard, the grit particles were invariably small (the majority belonging to size class 0.5 - 0.75 mm), and they were always accompanied by a huge number of still smaller soil particles. Grit particles in granivorous species were significantly larger, the average size being 1.2 and 2.4 mm in small and large granivores, respectively (median size class 1 - 1.25 mm in most small granivores, 1.75 - 2 mm in Grey Partridge, 2.75 - 3 mm in Pheasant, and 3.25 - 3.5 mm in Woodpigeon). Non-granivores apparently ingest grit indiscriminately together with soil particles whereas granivorous species pick up grit particles selectively. Average size of grit particles in ducks and geese was 1.0 mm; these species ingest grit by a 'sieving' action.

The shape of the grit in different species showed little variation. Most particles were about 1.4 times longer than wide, probably reflecting availability in the environment. With respect to grit colour, it could not be ruled out that preferences/avoidances did not exist: particles of different colours may well be ingested in accordance with their oc-

currence within the size classes preferred. Large granivores might prefer light-coloured particles, though. In other studies, clear preferences for light colours and avoidance of dark colours like black or green have been demonstrated (Pank 1976, Spittler 1978, Best & Gionfriddo 1993).

The Dutch study concludes that there is a significant overlap in size and shape between grit particles and granulate insecticides and molluscicides, and that this overlap may implicate a risk to farmland birds, especially small granivores. Pelleted seeds are normally too large to be taken as grit, although there is some overlap in size with the grit of large granivores.

References:

Best, L.B. & J.P. Gionfriddo 1993: House Sparrow preferential consumption of carriers used for pesticide granules. – Environmental Toxicolology and Chemistry 13: 919-925.

Leeuw, J. de, M. Gorree, G.R. de Snoo, W.L.M. Tamis, R.J. van der Poll & R. Luttik 1995: Risk of granules and treated seeds to birds on arable fields. – CML report 118, Centre of Environmental Science, Leiden University.

Pank, L.F. 1976: Effects of seed and background colours on seed acceptance by birds. – Journal of Wildlife Management 40: 769-774.

Spittler, H. 1978: Volierenversuche mit Fasanen zur frage der Aufnahmeminderung von insektiziden Granulaten durch schwarze Anfärbung. – Zeitschrift für Jagdwissenschaft 24: 89-96.

Whooper Swan *Cygnus cygnus*

DK: Sangsvane, D: Singschwan, F: Cygne sauvage

Distribution and phenology in Denmark:

Population. Common winter visitor from Fenno-Scandia and Russia. The swans arrive between late September and mid-October, and additional influx occurs during November-January; departure from late March to late April. Wintering population amounts to 5000 - 6000 birds in mild winters, and up to 11,000 in cold winters. Denmark holds the most important wintering grounds for the Whooper Swan; most of them winter in fjords in North and West Jutland (Limfjorden, Mariager Fjord), and along the coasts of southern Zealand and Lolland-Falster. In particularly severe winters, some birds leave DK and move to the Netherlands, Germany and UK.

The Whooper Swan is listed in the Danish Red Data Book as a 'special responsibility species' (more than 20% of the migrating or breeding population in NW Europe occurs in DK).

Habitat. Winters in shallow, sheltered coastal waters, or lakes and rivers, from where foraging excursions to nearby farmland habitats take place.

Breeding. No breeding population in Denmark (nearest sites in south Sweden); all visitors originate from Fenno-Scandia and Russia.

Food and feeding habitat:

Energy demand. Average body weight 8 - 11 kg. No measurements available on daily food consumption/metabolism, but data might be found in Krivtsov & Mineyev (1991).

Feeding habitat. Feeds in shallow fresh or salt water, wet or flooded meadows, and open fields. Particularly in early spring, or when ice inhibits foraging in wetlands, the Whooper Swans feed in cultivated areas.

Food. Mainly leaves and seeds of aquatic vegetation, leaves and roots of grasses and herbs, and grains and leaves of cereal and dicotyledonous crops.

Main studies of feeding ecology of staging Whooper Swans (and Bewick's Swans) from the Netherlands (Dirksen et al. 1991), several from Britain (e.g. Owen & Cadbury 1975, Black & Rees 1984, Rees 1990).

When foraging on meadows, Whooper Swans (as well as Bewick's Swans) take a wide variety of grasses and herbs, of which fresh leaves, stems and rhizomes of *Poaceae* (mainly *Lolium* and *Phleum*), and stolons of clover (*Trifolium*) most important, but sedges *Cyperaceae*

also occur. On farmland, spill grain on stubble fields may be used. Grain on spring-sown fields (mainly barley), shoots and leaves of autumn-sown cereals and rape commonly taken as are potatoes and left-overs of turnips and sugar beets [England, France].

It is unlikely that the adults and immature birds feeding together in DK should differ in diet.

Main literature:

Black, J.M. & Rees, E.C. 1984: The structure and behaviour of the whooper swan population wintering at Caerlaverock, Dumfries and Galloway, Scotland: an introductory study. – Wildfowl 35: 21-36.

Dirksen, S., Beekman, J.H. & Slagboom, T.H. 1991: Bewick's swans *Cygnus columbianus bewickii* in the Netherlands: numbers, distribution and food choice during the wintering season. – Wildfowl Supplement 1: 228-237 [not available in DK].

Krivtsov, S.K., Mineyev, Y.N. 1991: Daily time and energy budgets of whooper swans *Cygnus cygnus* and Bewick's swans *Cygnus bewickii* in the breeding season. – Wildfowl Supplement 1: 319-321 [not available in DK].

Owen, M. & Cadbury, C.J. 1975: The ecology and mortality of swans at the Ouse Washes, England. – Wildfowl 26: 31-42.

Rees, E.C. 1990: Bewick's swans: Their feeding ecology and coexistence with other grazing Anatidae. – Journal of Applied Ecology 27: 939-951.

Allied farmland species:

Bewick's Swan *Cygnus columbianus* (DK: Pibesvane). Common migratory visitor, passing DK from early October to early December, and late February to early May. Up to 3000 birds stage in DK in mid-October – most of them in North and West Jutland (Vejlerne, Ulvedybet, Harboøre Tange), but also on Langeland, and Zealand (Tissø, 500-600 birds). In mild winters, up to 2000 birds may winter in West and Southwest Jutland. Peak spring migration in March, when large groups may rest in northern Jutland.

Foraging behaviour similar to Whooper Swan, but when feeding on land, Bewick's Swans prefer soft grasses to coarse species when available. In England, birds feeding in wet meadows took 40% fine grasses, 20% coarse grasses, 26% roots and stolons, remainder similar parts of plants at river bank. Due to reduction in availability of aquatic plants, Bewick's Swans in The Netherlands have shifted to feeding mainly on farmland habitats. In Denmark, often occur on autumn-sown cereals, mainly winter wheat.

Bewick's Swans wintering in England spent most of their time (73%) at flooded fields, feeding almost exclusively on grasses, *Poaceae* (*Lolium perenne* 44%, *Alopecurus geniculatus* 32%, preferring the latter together with other soft grass species), but also a little clover, *Trifolium* (not preferred).

Probably incidentally, swans may take adult or larvae of larger insects (*Coleoptera*).

Pink-footed Goose *Anser brachyrhynchus*

DK: Kortnæbbet Gås, D: Kurtzschnabelganz, F: Oie à bec court

Distribution and phenology in Denmark:

Population. Locally abundant migrant and winter visitor from Svalbard (Norway). The entire population breeding in Svalbard passes along the west coast of Jutland, and up to 30,000 birds congregate at a few locations, first of all Nissum Fjord, and Vest Stadil Fjord, Filsø, Ballum Enge and Tipperne.

In autumn, the birds pass through DK from mid-September to late October on their way to the Netherlands. The birds return to DK by late December (mild winters) to early February (cold winters), and remain in DK till early May; around 15 May the last birds have left DK. In winter, the birds gather mainly at Ballum Enge (up to 15,000 birds) and Tipperne (5200).

The Pink-footed Goose is listed in the Danish Red Data Book as a 'special responsibility species'.

Habitat. In DK, the Pink-footed Geese forage on wide open farmland with permanent pastures and arable fields, and migrate to stay overnight in nearby lakes or fjords.

Breeding. No breeding population in Denmark; all visitors derive from Svalbard.

Food and feeding habitat:

Energy demand. Average body weight 2200 - 2500 g. Estimated daily energy intake for birds feeding on grassland was 1267 kJ/day, and on newly sown barley fields 2824 kJ/day, equivalent to a daily consumption of 793 g (fresh weight) of grass leaves, or 225 g dry barley grains.

Feeding habitat. Feeds mainly on permanent grassland, stubble fields and spring-sown cereal fields, but also on salt marsh and to a lesser extent autumn-sown cereal fields and grass in rotation. From late March, the entire population staging in DK shifts from feeding on

grassland (pastures as well as grass in rotation) to spring-sown cereal fields, especially barley. To prevent crop damage, alternative food (grain) is offered to the geese near Vest Stadil Fjord.

At Filsø, West Jutland, 36% of all 'goose-days' (92% Pink-footed Geese, 7% Greylag Geese *Anser anser* and 1% Bean Geese *Anser fabalis*) on the fields were spent on stubble fields (autumn), 38% on stubble fields with undersown seed grass (autumn-spring), and 21% on newly sown barley fields (spring).

Food. Herbivorous; diet composition on wintering grounds depends on local and seasonal variation in crop plant availability.

Ecology of staging Pink-footed Geese have been thoroughly studied in Denmark in recent years (Madsen 1985, 1990; Lorenzen & Madsen, 1986). Energetics of Bean Geese and others studied in Germany (Mooij 1992).

On pastures, the geese eat leaves of common agricultural grasses (*Poaceae*) and leaves and stolons of herbs (e.g. clover, *Trifolium*). Geese feeding on pastures tend to seek out patches with preferred grasses, especially patches with *Alopecurus geniculatus*. May also take roots and tubers (carrots, potatoes), as well as leaves of rape and other *Brassicaceae*.

In Netherlands, wintering geese (mixed species) feed on intensively fertilized grassland ('improved grassland'), with short vegetation of grasses (mainly of the genera *Lolium*, *Poa*, *Alopecurus*, *Holcus*, *Festuca*, *Elymus*, *Phleum*, *Agrostis*, and *Dactylis*) and dicotyledons (main genera *Bellis*, *Taraxacum*, *Stellaria*, *Ranunculus*, *Rumex*, *Trifolium*, *Achillea* and *Cardamine*).

When possible, the geese maximize energy intake by feeding on grain on stubble fields and newly sown cereal fields, mainly barley, but also oats and wheat. The geese take ungerminated grains at the surface or in the upper surface soil layers.

It is unlikely that the adults and immature birds feeding together in DK should differ in diet.

Main literature:

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Madsen, J. 1985: Relations between change in spring habitat selection and daily energetics of Pink-footed Geese *Anser brachyrhynchus*. – Ornis Scandinavica 16:222-228.

Madsen, J. 1990: Træk- og Overvintringsstrategier hos Gæs. – Dr. Scient. Thesis. Miljøministeriet, Danmarks Miljøundersøgelser. Report no. 10: 1-240.

Mooij, J. H. 1992: Behaviour and energy budget of wintering geese in the Lower Rhine area of North Rhine-Westphalia, Germany. – Wildfowl 43: 121-38.

Allied farmland species:

Greylag Goose *Anser anser* (DK: Grågås). Common migratory breeding species, and autumn and winter visitor. Breeding population in DK 3200 - 3500 pairs, most widespread in eastern part of the country (Zealand and Funen), but local concentration in Vejlerne (Northwest Jutland). Breeds at bogs and along shallow lakes near meadows, and on coastal islets.

Like the Pink-footed Goose, the Greylag Goose is listed in the Danish Red Data Book as a 'special responsibility species' (more than 20% of the migrating or breeding population in NW Europe occurs in DK).

Breeding population arrives from February, and depart in October-November; a few birds may winter in DK. From late July the Greylags, including visitors from Scandinavia, gradually gather in large flocks on a few locations. Numbers peak in late September when 30,000 - 47,000 (36,000 on average) geese visit Denmark; 60% of them are found in the southeastern part of the country, and the remainder in West and South Jutland.

During the breeding season, they feed on grassland, mainly on leaves of herbs and grasses. By late summer, most breeders join the staging migrants in farmland areas to eat grain at stubble fields, remains of beets, or grass.

Bean Goose *Anser fabalis* (DK: Sædgås). Common migrant and winter visitor from Fenno-Scandia and northern Russia. Up to 31,000 birds occur in East Denmark (mainly Lolland and Southwest Zealand) in cold winters (when they abandon wintering grounds in southern Sweden), while only up to 7500 birds arrive in mild winters. The geese in East Denmark usually arrive in late December, and leave DK during March. In Northwest Jutland, Bean Geese (less than 2000) occur between September and April; most birds are present in October and March.

Diet very similar to Pink-footed Geese. Wintering population in eastern Denmark mainly feeds on autumn-sown cereal fields, taking leaves or entire plants (sprouts). Also foraging on remains of beets and potatoes.

Barnacle Goose *Branta leucopsis* (DK: Bramgås). Common passage migrant from arctic Russia. Large numbers pass DK, and up to 7000 birds (numbers increasing during the last decade) regularly reside in Southwest Jutland, and a few hundreds in southeastern DK. Barnacle Geese visit DK from October to April, highest numbers occur in October-November.

Very rare breeding bird in DK; listed in Danish Red Data Book, category 'rare'.

Foraging behaviour similar to the *Anser* species summarized above.

Grey Partridge *Perdix perdix*

DK: Agerhøne, D: Rebhuhn, F: Perdrix grise

Distribution and phenology in Denmark:

Population. Common resident (sedentary) species closely affiliated with farmland. Limited dispersal from natal area; 97% of released birds recovered within 10 km from release site [Denmark]. Estimated breeding population 20,000 - 30,000 pairs. Marked population decrease since 1940s, although some stabilization has probably occurred since the end of the 1980s. Population decline ascribed to habitat loss (a reduction in grazed areas and hedges) and poor food access induced by herbicide and insecticide usage. No obvious regional differences, but possibly more common on poorer soils with less intensive farming practice.

The Partridge is listed in the Danish Red Data Book in the category 'decreasing'.

Habitat. Closely associated with 'old-fashioned' farmland with small fields surrounded by stripes of rough vegetation and hedges, but also in heathland and large clearings in forests. Occupies cereals and other crops as well as grassland, preferably near wild patches and fresh water. Nest placed on ground in thick vegetation in hedges or crops.

Breeding. Eggs laid mid-May to late June. Clutch size 10-20 eggs (mean 15.9 eggs). Incubates for 23-25 days. Young leave nest shortly after hatching, and both parents care for the chicks that are largely self-feeding. Chicks reach adult weight after c. 100 days. Family party stay together through first part of winter.

Food and feeding habitat:

Energy demand. Body weight 300-400 g. Estimates of daily energy intake (in winter) for wild birds range between 300 kJ/day at an ambient temperature of +15°C to 650 kJ/day at -15°C. This is equivalent to 22 - 49 g wheat grains (dry weight), or 116 - 246 g of wheat/rye leaves (wet weight). A study from Bohemia put the daily food consumption at 45-80 g (mean 65 g). Food consumption by captive birds (mean weight 354 g) fed a mixture of weed seeds and peas averaged 18.1 g in summer [Denmark].

Feeding habitat. Forages in open farmland, along hedges and roadsides. In arable land, feeds on areas with all types of cereal crops, vegetables and dicotyledonous crops (rape). Set-aside fields probably favoured.

Food. Chiefly plant materials, i.e. weeds and seeds in annual cycle associated with farmland practice. Green plant material stable food throughout the year. Insects important component in late spring and summer, particularly in chick diet.

Most comprehensive studies of adult diet from Denmark (Hammer et al. 1958, Steenfeldt et al. 1991), Britain (Potts 1986) and Poland (Oko 1963 reviewed by Dwenger 1991). Food preferences in captivity also studied in Denmark (Berthelsen et al. in prep.). Extensive studies of chick diet in Britain (Potts 1986), and Denmark (Rasmussen et al. 1992).

Adults. Generally, main types of food are green leaves of grasses, cereals and clovers, and cereal grain and weed seeds. In Danish farmland, birds ate a combination of seeds and leaves of cereals and weeds, and insects (larvae and adults). Previously, *Polygonaceae* (mainly seeds of *Polygonum convolvulus*) and *Convolvus arvensis* very significant, but a shift from weeds towards cereal crops has occurred in response to increased herbicide use [Britain].

Although green matter of plants constitute a large part of diet all year, there is a marked annual cycle in relative importance of food groups, associated with farmland practice [Denmark & Poland]. During winter and spring mainly leaves of cereal crops, graminoids and dicotyledonous weeds. In summer and autumn mainly seeds (*Poaceae*) and waste grain after cereal harvest. In August-November, seeds and grains make up 23-47% (by volume), and green matter 52-73%. In winter, birds feeding on ploughed fields rely heavily on grain and seeds (c. 80%), while birds on autumn-sown crops and pastures almost exclusively (96%) consume leaves.

Among green plant material identified in faecal samples, most important taxa were barley (max. 21% by volume), wheat (max. 21%), grasses *Poaceae* (max 58%), *Caryophyllaceae* (max. 27%), and *Boraginaceae* (max. 12%). Flowers and flowerbuds of *Caryophyllaceae* and rape formed up to 30% of diet in birds feeding in fields with undersown crops, winter cereals and dicotyledonous crops.

Energy-rich grain preferred to leaves when available. Captive birds in pens at harvested fields clearly favoured barley grains over weed seeds [Denmark]. Principal grain and seed taxa (max. % occurrence during year) are *Poaceae* (90%), barley (85%), wheat (55%), rape (10%), *Polygonaceae* (85%), *Caryophyllaceae* (55%), *Violaceae* (50%) [Denmark]. In food selection trials, preference order was wheat, rye, barley, oats. Preferred spherical, not elongated, seeds. When fed hemp (spherical seeds), favoured smallest size classes. In trials with local weed species [N France], captive birds preferred species of *Caryophyllaceae*, *Polygonaceae*, *Fabaceae*, *Taraxacum* spp. (*Asteraceae*), and *Brassicaceae*.

Insects only contribute significantly to food from May to July (up to 24%) [Denmark], or up to 17% in July [Poland], but insects may be a vital component for adults during feather moult, starting after the hatching of the chicks. Common insect taxa include *Coleoptera* (*Staphylinidae*, *Curculionidae*, *Carabidae*, *Chrysomelidae*, *Elateridae*) and *Diptera*. In Poland, *Hymenoptera* significant, especially adult and pupal ants *Formicidae* and sawflies *Tenthredinidae*. Other invertebrate food items include small proportions of earthworms *Lumbricidae* and snails *Gastropoda*.

Young. Invertebrates (almost exclusively insects) important component of chick diet, and may contribute more than 50% (by volume) of food consumed in the first weeks of life. Proportion of plant material in diet increases rapidly with chick age from about 20% (dry weight) at age 1-5 days to 80% at age 20-25 days in birds foraging in cereal fields [England]. Small chicks digest seeds poorly.

Major types of animal food items are ground-living, slow-moving insects (mainly *Coleoptera*), plant-dwelling larvae of sawflies and moths (*Tenthredinidae* and *Lepidoptera*), and cereal aphids (*Aphidoidea*).

The young feed opportunistically, and there is great variation in species composition and relative proportions of insect fauna in diet, depending on feeding habitat (crop type and farmland practice). Proportion (by volume) of insects in diet of small chicks varied from 3% in birds feeding in hedges, to 69% in beet fields. Seeds and cereal grain made up between 4% in spring-sown rape fields to 86% in field boundaries, while green matter ranged from 11% in field boundaries to 88% in rape fields [Denmark].

In the insect diet of Danish chicks feeding at rape and beet fields, dominant taxa were *Coleoptera* 80% (of which *Chrysomelidae* 29%, *Curculionidae* 16%, *Carabidae* 13%, *Nitidulidae* 12%), *Aphididae* 8% and *Diptera* 7% (*Tipulidae*). Among the *Chrysomelidae*, *Phyllotrea undulata* was most abundant.

Main literature:

Berthelsen, J.P., Rasmussen, K. & Kjellson, G. in prep. Fouragerende fugles udnyttelse af ukrudtsfrøpuljen: Metodeudvikling og vurdering af fødemuligheder i relation til pesticidpåvirkning. – Miljøprojekt nr. xx, Miljøministeriet, Miljøstyrelsen.

Dwenger, R. 1991: Das Rebhuhn. – Die Neue Brehm-Bücherei, 447. Ziemsen Verlag, Wittenberg Lutherstadt. 144 pp.

Hammer, M., Køie, M. & Spärck, R. 1958: Investigations on the food of partridges, pheasants and black grouse in Denmark. – Danish Review of Game Biology 3: 183-208.

Potts, G.R. 1986: The Partridge. – Collins, London. 274 pp.

Rasmussen, P.N., Steenfeldt, S. & Jensen, T.S. 1992: Insekter som føde for kyllinger af Agerhøns (*Perdix perdix*). – Flora og Fauna 98: 87-92.

Steenfeldt, S., Rasmussen, P.N. & Jensen, T.S. 1991: Food selection in a population of Partridge *Perdix perdix* in Danish arable farmland. – Dansk Ornitologisk Forening Tidsskrift 85: 67-76.

Quail *Coturnix coturnix*

DK: Vagtel, D: Wachtel, F: Caille des blés

Distribution and phenology in Denmark:

Population. Rare migrant and summer visitor from mid-May to early October. A few birds from Scandinavia may pass through DK, and in some years invasions (hundreds of birds) from southern Europe occur. Size of breeding population largely unknown, probably 0-10 pairs, almost certinly decreased during this century. Widespread decline in most of Europe, at least partly due to intensive hunting during migration through Mediterranean region.

The Quail is listed in the Danish Red Data Book in the category 'Rare'.

Habitat. Farmland areas with grassland, clover and cereal fields. Chooses moist, but not wet, herbage clear of forest edges and hedges, and has adapted to large cultivated fields, especially of winter wheat, clover, rye, oats, lucerne, rape and rotational grass.

Breeding. Eggs laid from late May to early July. Clutch size 8-15 eggs (mean 10.2 eggs) [Denmark]. Incubates for 17-20 days. Young leaves nest shortly after hatching, and are self-feeding. Fledging normally at 19 days, and family parties forage together for 50-70 days.

Food and feeding habitat:

Energy demand. Body weight 86-110 g. A Quail (97 g) in captivity had a BMR of 77 kJ/day. No information on daily food consumption.

Feeding habitat. Feeds concealed in vegetation in open grassland, fields, ditches, roadsides etc.

Food. Omnivorous, mainly seeds and insects found on ground. Leaves and other green matter less important than in other galliform birds.

Information mainly from old studies in Hungary and Russia. One small recent study from northern France (Combreau et al. 1990). No particular information on chick diet.

Adults. Chiefly fallen seeds, predominantly of weeds and cereals (wheat, oats, barley); other crop species include rape. Grain most

important after harvesting, while insects gain significance when seeds are scarce in spring and early summer [Hungary]. Among invertebrates, the Quail feeds on a wide variety of small ground-living species, adults as well as larvae. Green plant material is mainly tender tips of leaves of grasses and delicate herbs.

Important weed taxa in diet include (no quantitative information) *Carophyllaceae* (*Stellaria*, *Cerastium* and *Spergularia*), *Lamiaceae* (*Galeopsis*, *Stachys*, *Ballota*), *Scrophulariaceae* (*Euphrasia*, *Melampyrum*), *Polygonaceae* (*Polygonum*, *Rumex*), *Papaveraceae* (*Papaver*), *Plantaginaceae*, *Fabaceae* (*Vicia*), *Chenopodiaceae* (*Chenopodium*) as well as grasses *Poaceae* (*Lolium*, *Bromus*, *Setaria*).

Insect taxa important in Quail diet include adults and larvae of *Coleoptera* (*Carabidae*, *Staphylinidae*, *Curculionidae*, *Scarabaeidae*, *Elateridae*, *Tenebrionidae* and *Chrysomelidae*), bugs *Hemiptera*, ants *Formicidae*, earwigs *Dermaptera*, and grasshoppers (*Orthoptera*).

Young. No specific information on chick diet, but insects are likely to be significant during chick growth. Behavioural studies indicate that females leading young may dig out ants' nests and offer larvae to the young, and that chicks can handle medium-sized grasshoppers and beetle larvae (*Scarabaeidae*) when 4 days old.

Main literature:

Combreau, O., Fouillet, P. & Guyomarc'H, J.C. 1990: [Contribution to the study of the diet and food selection by young quail (Coturnix coturnix coturnix) in the Mont-Saint-Michel Bay (France)] (in french). – Gibier Faune Sauvage 7: 159-174.

Pheasant *Phasianus colchicus*

DK: Fasan, D: Fasan, F: Faisan de chasse

Distribution and phenology in Denmark:

Population. Very common resident, introduced breeding species. Population about 280,000 pairs in 1980s, but 500,000 birds released annually for hunting. Most abundant in eastern DK.

Habitat. Broadleaved woodland and scrub areas, and farmland with hedges, coverts and meadows. In winter, farmland birds may seek shelter in woodland. Nest placed on ground in thick vegetation in scrub, hedges or edge of woods.

Breeding. Eggs laid April to June. Clutch size 8-15 eggs (mean 11.9 eggs). Incubates for 23-28 days. Young leave nest shortly after hatching, and female cares for chicks that are largely self-feeding. Independent when 70-80 days old.

Food and feeding habitat:

Energy demand. Body weight 850-1150 g in the wild. Estimates of daily energy intake of wild birds not available, but captive breeding birds consumed about 80 g fodder, apparently equivalent to 837-970 kJ/day. Other studies in captivity indicated a consumption of 51 g food (maize and fodder pellets) per kg body weight per day. Two-week-old chicks consumed 1 - 2.7 g insects per day, depending on habitat.

Feeding habitat. Forages on open farmland, edge of woods, along hedges and roadsides. Radio-tracked broods preferred to forage in weedy areas, rough grass and winter barley, which all had a high arthropod biomass, and the broods avoided woodland [Britain].

Food. Generally omnivorous, eating cereal grain, seeds, berries and other fruits, green shoots, roots and tubers, small arthropods, molluscs and occasionally small vertebrates. Diet most diverse in autumn.

Quantitative studies of diet from Denmark (Hammer et al. 1958), England (Lackland & Bray 1973, Hill 1988), southern Finland (Pulliainen 1966, reviewed by Hill & Robertson 1988), and numerous studies from Romania and Bulgaria. Chick diet mainly studied in Britain (Hill 1985), but also older Danish data (Hammer et al. 1958). Food selection trials with Pheasants offered pesticide treated food reported by Bennet & Prince (1981).

Adults. Favours grain, in particular wheat, oats, barley, and maize, but also seeds of *Polygonaceae*, as well as nuts, acorns and fruits. Roots and tubers of potaoes also commonly taken. Animal food items include earthworms *Lumbricidae*, larval and adult *Coleoptera*, *Heteroptera*, and *Diptera*, grasshopper nymphs *Orthoptera*, along with snails *Gastropoda* and occasionally reptiles and amphibians. Larvae of *Tipulidae*, *Elateridae* (*Coleoptera*), *Bibionidae* (*Diptera*) and *Tenthredinidae* common items in some studies [Schleswig-Holstein].

Marked annual variation according to availability of food items. In Britain, grass, leaves and roots important all year, but mostly so from January to May (75-90% by volume), whereas only 35% in August-September. Grain important (45%) in July-August, and animal food items gain significance from spring through summer and form up to 5-15% of diet in August-October. Wild fruits and nuts make up about 40% in September-November. Grass and clover leaves often favoured items (50-90% occurrence) in November-February [Denmark].

In free-choice feeding trials, captive pheasants offered untreated maize (and pellets) and maize treated with pesticides (fungicide Captan, and insecticides Diazinon, Furadan and Lorsban) in various concentrations, the pheasants always preferred untreated food whenever available. Food consumption was reduced when only treated food was available, and the birds detected the presence of pesticides and avoided treated food if suitable alternatives existed.

Young. Invertebrates important in chick diet during first four weeks, green plants probably first taken from age 10 days, and seeds after 6 weeks. The importance of insects drops from 80% in first week, 60% in third week to 1% in ninth week [Czechoslovakia]. In Denmark, animal food items found in 100%, 71% and 68% of chick stomachs from June, July and August, respectively Denmark].

In british farmland, most important taxa in chick diet were: *Tenthredinidae* larvae (11.6% by dry weight), *Heteroptera* (17.5%), *Lepidoptera* larvae (11.6%), *Delphacidae* (*Auchenorrhyncha*, 10.4%), *Aphididae* (8.1%), and *Tipulidae* (5.7%). *Tenthredinidae* and *Lepidoptera* larvae, adult and larval *Carabidae*, larvae of *Staphylinidae* and adults of *Elateridae* are preferred (i.e. not taken according to availability) [Britain].

Captive chicks released into different habitats selected the largest insect species they could handle (mean 6.2 mm, but large range). They avoided very small insects (< 3mm) and very large ones (large beetles (*Coleoptera*), *Orthoptera* nymphs, and bees *Apidae*), even when food was in short supply. A conspicuous, slow-moving fly (*Lauxinidae*) was preferred to larger, dull-coloured and active *Muscidae*.

Main literature:

Bennett, R.S. & Prince, H.H. 1981: Influence of agricultural pesticides on food preference and consumption by Ring-necked Pheasants. – Journal of Wildlife Management 45: 74-82.

Hammer, M., Køie, M. & Spärck, R. 1958: Investigations on the food of partridges, pheasants and black grouse in Denmark. – Danish Review of Game Biology 3: 183-208.

Hill, D.A. 1985: The feeding ecology and survival of pheasant chicks on arable farmland. – Journal of Applied Ecology 22: 645-654

Hill, D. & Robertson, P. 1988: The Pheasant. Ecology, Management and Conservation. – Oxford. 281 pp.

Lachland, C. & Bray, R.P. 1973: A study of an unmanaged Pheasant population at Brownsea Island, Dorset. Pp. 609-617 in: Proceedings of the Xth Congress of the International Union of Game Biologists.

Pulliainen, E. 1966: Fasaanin ravinnosta suomessa. – Suomen Riista 19: 113-125.

Lapwing *Vanellus vanellus*

DK: Vibe, D: Kiebitz, F: Vanneau huppé

Distribution and phenology in Denmark:

Population. Common, mostly migratory breeding species. Arrives from February or March, and leaves gradually from September to November, depending on weather. Population estimate: 35,000 breeding pairs in late 1980s; since the mid 1970s the population has been reduced to about 1/3 of former size. Largest densities and numbers in West Jutland. Breeding densities in excess of 100 pairs/km^2 on meadows in Jutland, but only 0.2 - 5.8 pairs/km^2 in Swedish farmland. Population decrease mainly due to draining, land reclamation and intensified agricultural practice.

Passage migrants from Fenno-Scandia pass through DK. In late summer about 150,000 birds make a prolonged stopover, mainly in SW and NW Jutland, and up to 40,000 birds have been recorded in Tøndermarsken. A small part (up to 2000 birds) of the DK breeding population stay in mild winters, especially in western Jutland.

The Lapwing is listed in the 'Danish Red Data Book' in the category 'decreasing'.

Habitat. Breeds mainly on moist grassland, especially grazed salt marshes and meadows, but also on open farmland with low vegetation. On farmland, often select sites close to flooded areas or permanent grassland. Lapwings breeding in arable land strongly prefer spring-sown crops, and clearly avoid winter crops and rotational grassland [Scotland, Sweden]. A mosaic of spring crops and permanent, moist grassland probably optimal.

Breeding. Eggs laid from late March to late June. Clutch size 3-4 eggs. Incubates for 26-28 days. Nestling period 1-2 days; thereafter parents lead chicks to suitable foraging grounds where they feed on their own. Independent at fledging when 30-45 days old.

Food and feeding habitat:

Energy demand. Body weight 189-226 g. Birds fed beetle larvae (*Tenebrio molitor*) consumed 205 g/day (wet weight), or 16.2 g dry weight. Average growth rate of chicks (age 5 - 30 days) 4.9 g/day, lowest on arable land (3.0 g/day) and up to 5.2 g/day on salt marsh [Denmark]. Highest values of 5.06 - 6.21 g/day on grassland in England, but growth rate in the field much lower than in captivity [Netherlands].

Feeding habitat. Forages on moist ground with bare spots or low vegetation of grass and herbs, along edges of pools, or on fields with no or low vegetation. Feeds mainly during day, but also hunts night-active

prey on moonlit nights. Breeding Lapwings usually feed within 200-300 m of their nest [England].

Food. Mainly ground-living invertebrates, i.e. earthworms and surface-active invertebrates, particularly beetles, that are located by sight or sound. Young are not fed by parents, and apparently pick their food opportunistically rather than selectively.

Major studies of chick diet available from Netherlands (Beintema et al. 1991) and Scotland (Galbraith 1989a), and of adult feeding rates in spring and winter from England and Scotland (Gregory 1987, Galbraith 1989b). More extensive information mainly from older studies in NW France (Madon 1935 in Glutz von Blotzheim 1975), Britain (Collinge 1924-7 in Cramp 1983) and Ukraine (Kistjakiwskij 1957 in Glutz von Blotzheim 1975). One study of adult diet in pre-laying period in farmland and grazing areas of southern Sweden (Högstedt 1974).

Adults. Insects, mainly *Coleoptera*, and earthworms are principal food. Plant material, including grass leaves and seeds of *Ranunculus*, *Spergula* and *Polygonum*, only made up 11% by volume [Britain], and was present in 70% of stomachs [France].

A wide range of insects are eaten, probably in accordance to their availability. Adult *Coleoptera* make up 67% (by number) over the year in France, where *Curculionidae* (52%) and *Carabidae* (6%) predominate. Other numerous items were earwigs *Dermaptera* (9%), *Diptera* (10%, including *Tipulidae* and *Chironomidae*), and *Lepidoptera* (4%). A study from Ukraine showed similar distribution, although grasshoppers *Acrididae* formed 16% and *Formicidae* 14%.

In most studies earthworms are recorded, but their importance is probably underestimated in stomach analysis. In pre-laying period (early April) Lapwings in Swedish farmland and grazed areas were highly dependent on earthworms, and foraging adults caught one specimen in 23% of all pecks on ground. In spring, Scottish Lapwings feeding on grassland and spring cereal fields caught 0.2 - 0.5 large earthworms per minute spent actively foraging, and 1.5 - 2.1 'other' items (insects and small worms). On cereal fields, wintering birds caught up to 0.8 large worms per minute [England].

Apparently, there are seasonal changes in diet, with lumbricids most important in winter and early in spring when insect density is low. Before 1 May, whole *Lumbricidae* made up 9% (by number) of diet, *Coleoptera* adults 22% and larvae 17%, and *Diptera* larvae 50%. After 1 May, no earthworms were recorded, while adult *Coleoptera* comprised 80%, and *Diptera* 10% (latter sample included Lapwing chicks) [England].

Young. Diet in Scottish grassland areas differed somewhat between the habitats, according to availability. Dominant food was earthworms *Lumbricidae*, which made up 53% and 55% (of total dry weight) in the two habitats, respectively. On arable land, *Tipulidae* larvae comprised 22%, adult *Coleoptera* 13% (mainly *Scarabaeidae*, *Carabidae* and *Curculionidae*), while less important prey included *Aranea* (3%), beetle

larvae (2%), ants *Formicidae* and *Diptera*. On the rough grassland, adult *Coleoptera* (26%) (especially *Scarabaeidae*, 16%, and *Carabidae* 6%), were more important than the Tipulid larvae (9%). In the Netherlands, chicks selected ground-living prey, as opposed to vegetation-dwelling; *Lumbricidae* occurred in 81% of all samples (faeces), and adult *Coleoptera* in 92%. Larval *Stratiomyidae* were found in 49%, *Tipulidae* 37%, other *Diptera* 26%, and *Coleoptera* 24%.

Main literature:

Baines, D. 1990: The roles of predation, food and agricultural practice in determining the breeding success of the Lapwing (*Vanellus vanellus*) on upland grassland. – Journal of Animal Ecology 59: 915-929.

Beintema, A.J., Thissen, J.B., Tensen, D. & Visser, G.H. 1991: Feeding ecology of charadriiform chicks in agricultural grassland. – Ardea 79: 31-44.

Galbraith, H. 1989a: The diet of Lapwing *Vanellus vanellus* chicks on Scottish farmland. – Ibis 131: 80-84.

Galbraith, H. 1989b: Arrival and habitat use by Lapwings *Vanellus vanellus* in the early breeding season. – Ibis 131: 377-388.

Gregory, R.D. 1987: Comparative winter feeding ecology of Lapwings *Vanellus vanellus* and Golden Plovers *Pluvialis apricaria* on cereals and grasslands in the Lower Derwent Valley, North Yorkshire. – Bird Study 34: 244-250.

Högstedt, G. 1974: Length of the pre-laying period in the Lapwing *Vanellus vanellus* L. in relation to its food resources. – Ornis Scandinavica 5: 1-4.

Thompson, D.B.A. 1983: Prey assessment by plovers (*Charadriidae*): net rate of energy intake and vulnerability to kleptoparasites. – Animal Behaviour 31: 1226-1236.

Black-headed Gull *Larus ridibundus*

DK: Hættemåge, D: Lachmöve, F: Mouette rieuse

Distribution and phenology in Denmark:

Population. Very common resident or migratory breeding species. Over the last decades, an increasing proportion of the Danish birds have become residents, and they are joined by winter visitors from Fenno-Scandia and the Baltic Sea. Population estimate 180,000 breeding pairs. Some population decline 1950-1980, but now probably fairly stable. No obvious regional differences. Breeding population present from early March to early November; from July to October many (tens of

thousands) visitors join the local breeding population to moult in DK. Winter visitors depart between February and mid-May.

Habitat. Occupy shallow coasts, fjords and tidal flats as well as lakes, ponds or rivers. Breeds colonially on protected islets.

Breeding. Eggs laid early May to late June. Clutch size 2-3 eggs. Incubates for 23-26 days. Fledging period about 35 days, young independent shortly after.

Food and feeding habitat:

Energy demand. Body weight 250-350 g. In captivity, a Black-headed Gull (285 g) had a BMR of 173 kJ/day in summer, and a bird of 306 g had 161 kJ/day in winter. Estimated food consumption amounts to 535 kJ/d, equivalent to 165-220 g (wet weight) of earthworms (assumed to form 90% of diet). Nestlings 1-5 days old require about 180 kJ/day, or about 22 g (wet weight) of food/day during first week of life, increasing to 50 g when 7-17 days old, and 100-150 g when older.

Feeding habitat. Forages on ground, on water surface and mudflats as well as in the air (hunting swarming insects). In farmland feeds mainly on grassland and newly treated fields with exposed soil; often follows the plough. Seeks moist ground or flooded areas, where earthworms are most available. Kleptoparasitic on plovers *Pluvalis* spp. and Lapwings picking earthworms. Breeding birds usually feed within 5-12 km from the colony, although some may fly 30-40 km to particular favourable food sources.

Food. Omnivorous. Mainly takes animal matter, particularly insects and earthworms, but commonly supplemented with plant material and garbage. When feeding on coastal habitats, fish and polychaetes significant prey.

Main studies from farmland areas in Switzerland (Cuendet 1980), Britain (Vernon 1972), and older studies from Denmark (Spärck 1944). Nestling diet and growth studied in the Czech Republic (Honza & Modry 1994) and Bavaria (Brandl & Nelsen 1988).

Adults. Earthworms (*Lumbricidae*) and insects predominate in diet, with earthworms occupying as much as 50% of food mass and insects about 15%. Insect diet consists mainly of adults and larvae of ground-dwelling beetles, and *Tipulidae* larvae. Outside breeding season, fish, fruits, and refuse gain importance as does cereal grain. Most information comes from stomach analyses that may underestimate importance of earthworms.

Among the beetles, large adults of *Scarabaeidae*, *Carabidae*, *Chrysomelidae*, *Staphylinidae*, and *Curculionidae* important, while larvae of *Elateridae* (wireworms) taken in large numbers during ploughing. Among *Diptera*, larval and adult *Tipulidae* important. *Hymenoptera* larvae (*Tenthredinidae*) occasionally taken in great numbers [Germany].

Plant material includes fruits, e.g. cherries and acorn, grain taken from stubble fields in autumn and in spring from recently sown fields, weed seeds of *Polygonaceae*, *Caryophyllaceae*, and leaves of clover *Trifolium*.

The diet of birds feeding in Swiss farmland consisted of 92% (dry weight) earthworms, 2% insects, and 6% cereal grain (stubble fields) plus small amounts of weed seeds.

Young. Young fed mainly earthworms and insects, or fish and marine annelids, depending on location.

In a comprehensive Danish study (Spärck 1944), remnants of insects were found in 60% of all gull stomachs, *Lumbricidae* in 20%, crustaceans in 16%, fishes in 14%, plant material in 13%, and garbage in 25%.

In a cultivated region of the Czech Republic, nestling Black-headed Gulls were most frequently fed insects (58% by number found in stomach samples), plants (25%), and fruit (cherries, 13%), remainder being earthworms and other animal material. However, earthworms probably make up a larger proportion in terms of weight. The proportion of earthworms and fruit increased with chick age, while insects became less important: earthworms increased from 4% (by number) in 1-5 days old chicks, to 14 % in young 21-30 days of age; insects decreased from 91% to 58%.

Most important (by number of individuals) insect taxa in chick diet were adult (31%) and larval (9%) *Coleoptera* (mainly *Carabidae* and *Elateridae*), larvae (30%) and adults (10%) of *Diptera*, and larvae of *Hymenoptera* (6%) and *Lepidoptera* (5%).

Main literature:

Brandl, R. & Nelsen, I. 1988: Feeding frequency of Black-headed Gull chicks. – Bird Study 35: 137-141.

Cuendet, G. 1980: Untersuchungen zum Nahrungsverhalten der Lachmöwe Larus ridibundus und dessen Einfluss auf die Regenwurmpopulation. – Ornithologische Beobachter 77: 61-62.

Honza, M. & Modry, M. 1994: The flock-feeding system of the adult Black-headed Gull (*Larus ridibundus*) and the food of its nestlings. – Folia Zoologica 43: 237-244.

Vernon, J.D.R. 1972: Feeding habitats and food of the Black-headed and Common Gulls; part 2 - food. – Bird Study 19: 173-186.

Allied farmland species:

Common Gull *Larus canus* (DK: Stormmåge). Common resident or migratory breeding species and winter visitor. Breeders arrive in March

and leave DK in September. Migration through Denmark late March-early April, and July-November, when winter visitors from Fenno-Scandia also arrive. Large numbers (tens of thousands) gather in West and South Jutland in September-October. Breeding population about 29,000 pairs; marked decline since 1940. Breeds mainly along the coasts of central and southeastern DK, in Limfjorden and Southwest Jutland. Especially during migration, Common Gulls occur in inland agricultural areas.

The Common Gull is listed in the Danish Red Data Book in the category 'decreasing'.

Diet and foraging habitats very similar to Black-headed Gull, with earthworms and insects being important components in diet for birds feeding in farmland habitats (comparisons given by Vernon 1972, and Glutz von Blotzheim 1982). Common Gulls may prefer more dry areas for feeding than Black-headed Gull.

Woodpigeon *Columba palumbus*

DK: Ringdue, D: Ringeltaube, F: Pigeon ramier

Distribution and phenology in Denmark:

Population. Very common resident or migratory breeding species and winter visitor. Population estimate 290,000 breeding pairs in 1994, widely distributed all over DK. Some population decline from 1970 to early 1980s, but since then marked increase. About half the breeding population is migratory, arriving between February and early April, and leaving DK late August to November. Large numbers of migrants from Scandinavia pass through DK, mainly in early April and mid-October (more than 200,000 noted in one day), and some of them winter.

Habitat. Breeds in trees in woods, parks and gardens anywhere in the country.

Breeding. Large variation in breeding season, with laying from February to October, but most lay between May and July. Clutch size 1-2 eggs (mean 1.8 eggs). Incubates for 17 days. Fledging period about 30-34 days, young independent one week later.

Food and feeding habitat:

Energy demand. Body weight 470-526 g. Average BMR in 3 domesticated Rock Doves (*C. livia*) with mean weight 327 g was 152 kJ/day. Daily food consumption in captive adult Woodpigeons 43 g wheat. Other estimates are: 84 g on mixed diet, or 88 g on pure grain. In winter (presumably wild birds), daily intake averages 60 g (dry weight) in clover field, 47 g in pasture (main food clover).

Estimations. A reasonable estimate of DEE is 670 kJ/day. If a suitable field is available, this energy demand may probably be covered entirely on leaves and shoots of rape in January-March and beets later in spring. This requires the ingestion of 58 g of leaves (dry weight), or c. 450 g fresh weight, per day. During sowing time, rape seeds may probably constitute (at least) 50% of diet for a short period, equivalent to 18 g seed/day.

Feeding habitat. Food taken principally on ground, but also in trees. In farmland feeds in open fields, mainly in dicotyledonous crops, and in meadows.

Pigeons foraging in British farmland showed preference for certain crops, depending on season: cereal stubble fields in November-January, rape fields in January-February, newly sown cereals March-May and October-November; also pea fields in March and pasture in February-May.

Urban Woodpigeons also flies to surrounding farmland to feed, mainly in summer [Germany].

Food. Feeds on a wide range of plant material: green leaves, seeds and grain, berries, buds, flowers and root crops. Invertebrates occasionally taken. Changes in pigeon diet induced by shifts in agricultural practice in recent decades.

Although no major studies of diet from DK, several studies from northern Europe summarized by Cramp (1985) and Glutz von Blotzheim & Bauer (1980). Recent studies on interaction with farming practice and crop damage in Britain (Ingles et al. 1989, 1990).

Adults. When available, feeds extensively on all types of grain from stubble fields and newly sown cereal fields, and on peas and rape seeds. In winter, green leaves of dicotyledonous crops (rape) and weeds important, the latter especially where winter fallow fields are available. Tree fruits (beech nuts, acorn etc.) also significant in autumn and winter. In summer diet highly variable, and includes small proportions (up to 5% in August) of invertebrates, mainly earthworms, snails, beetles *Coleoptera*, and larvae of *Lepidoptera*.

Particularly in southern Britain, pigeons feeding on leaves of (autumn-sown) rape cause serious crop damage from January to March, when alternative food sources are at the lowest (Inglis et al. 1989). The pigeons eat the leaves of small plants and occasionally the complete top and growth point. Among the varieties of rape, the 'double-low' types with low glucosinolate contents may be preferred.

Quantitative data on annual changes in diet mainly from 1960s and 1970s, prior to main shifts in farming practice towards autumn-sown crops. In Belgium, pigeons utilized cereals or legumes heavily from April to mid-May (91% fresh weight of crop contents), and mid-July to mid-October (97%, including 53% wheat, 29% peas, 11% barley). In winter half (mid October-April), cereals and legumes made up 36%, while other significant food included 19% green leaves and 45% fruits

and seeds, especially acorns and beech nuts. Diverse summer diet (mid-May to mid-July) contained mainly (33%) leaves of clover and lucerne, and 55% fruits, seeds and sub-soil parts of *Ranunculaceae*.

Tests in captivity ranked food in order of preference: barley grains, rape seeds, acorns, peas.

Young. Pigeons feed their nestling on crop milk (a secretion from the adult birds' crop), making up 92% (dry weight) of provisions to newly hatched chicks, and gradually decreasing to 21% in chicks 15 days or older. The balance is made up by same food as that of adults, except that invertebrate food (especially snails) and weed seeds are more frequent. In Britain, chick crops contained 43-77% (by number) of cereal grains, depending on season, 5-38% seeds of *Brassicaceae*, 6-11% weed seeds, 3% weed leaves, 3-5% beans, 1-9% peas, and 3% snails.

Main literature:

Cramp, S. (ed.) 1985: The Birds of the Western Palearctic, vol. IV. – Oxford University Press, Oxford.

Glutz von Blotzheim, U.N. & Bauer, K.M. (ed.) 1980: Handbuch der Vögel Mitteleuropas, band 9. – Akademische Verlagsgesellschaft, Wiesbaden.

Ljunggren, L. 1968: Seasonal studies of Wood Pigeon populations. I. Body weight, feeding habits, liver and thyroid activity. – Viltrevy 5: 435-504.

Inglis, I.R., Isaacson, A.J., Thearle, R.J.P. & Westwood, N. J. 1990: The effects of changing agricultural practice upon Woodpigeon *Columba palumbus* numbers. – Ibis 132: 262-272.

Inglis, I.R., Thearle, R.J.P. & Isaacson, A.J. 1989: Woodpigeon (*Columba palumbus*) damage to oilseed rape. – Crop Protection 8: 299-309.

Allied farmland species:

Stock Dove *Columba oenas* (DK: Huldue). Scarce migratory breeding species, common migrant, and rare winter visitor. Population estimate 400 breeding pairs. Population decline during this century, but since 1980 some recovery. Migrants from Fenno-Scandia pass DK (mostly eastern part) from early March to mid-April, and late September to early October (max. 1500-2000 birds per day recorded). Often migrate and feeds with flocks of Woodpigeon.

The diet is similar to that of Woodpigeon, but even more varied, with weed seeds being more important. In an all-year study from Britain, crops contained 37% (by number) of cereal grains, 23% seeds of *Brassicaceae*, 28% weed seeds (mainly *Caryophyllaceae* and

Polygonaceae). Cereal grain most important in November-December (69%).

Besides crop milk, nestlings mainly fed seeds of weeds (especially *Brassicaceae*, *Fabaceae*, and *Ranunculaceae*) and cereals.

Little Owl *Athene noctua*

DK: Kirkeugle, D: Steinkauz, F: Chouette chevêche

Distribution and phenology in Denmark:

Population. Rare, resident breeding species. Population estimate c. 150 pairs, decreasing. The population decline is ascribed to habitat changes, loss of nest sites.

The Little Owl is listed in the Danish Red Data Book in the category 'vulnerable'.

Cconfined to western parts of Denmark – west of the Great Belt – but very rare in South Jutland and Funen.

Habitat. Breeds in the countryside, often in farm-buildings and detached houses in villages. Also breeds in hedgerows, especially of pollard willows and poplars, and in churches; the latter was more common in former times. Avoids dense vegetation and tall, dense stands of trees.

Breeding. Eggs laid from mid-April to late May. Clutch size 2-5 eggs. Incubates for 27-28 days. Nestling period 30-35 days. Young provided for up to 1 month after fledging.

Food and feeding habitat:

Energy demand. Body weight 160-206 g. Average daily food requirements for adults (presumably free-living) is 50-80 g. A captive adult male fed 1 day old chickens consumed 15.1 kg/year corresponding to 88,300 kJ/year. In December-January food intake averaged 36 g/day, in April-August 44 g/day, and in October-November 46 g/day. No further information on daily consumption.

Feeding habitat. Forages in the open country in areas with short vegetation, especially pastures or meadows. Also on dunghills and lawns.

Food. Small mammals, birds and invertebrates. Earthworms and other soft-bodied invertebrates may be underestimated or excluded in diet analyses. Nestling diet apparently contains more invertebrates than that of adult.

Main studies of adult diet all year from Denmark, eastern Germany and Belgium (Haensel & Walther 1966 in Glutz von Blotzheim & Bauer 1980, Libois 1977, Laursen 1981). Main studies of nestling diet from Switzerland (Glutz von Blotzheim & Bauer 1980).

Adults. In most studies small *Rodentia* are the most important prey in terms of biomass, but invertebrates, in particular earthworms *Lumbricidae* and beetles *Coleoptera*, are the most numerous. Birds also significant in some studies. In three studies from Denmark, eastern Germany and Belgium, small voles *Microtinae* were the most important food items and constituted by number (proportion of biomass in brackets) 5%, 21% (73%) and 9% (78%), respectively, of diet. Mice *Murinae* also important, comprising 1%, 5% (15%) and 1% (4%), respectively. Birds made up 9% of prey biomass in one study [Belgium]. The most frequent food items in an all-year Danish study were earwigs *Dermaptera* (76%) and beetles *Coleoptera* (17%), while beetles dominated in similar studies from East Germany (59%) and Belgium (67%); soft-bodied invertebrates were excluded in these comparisons.

In Denmark, invertebrates were important from May to November, and rodents between November and May. Birds and shrews *Soricidae* were not represented in diet between May and August, but important from December to February.

Young. Mainly fed invertebrates; small mammals also significant. Earthworms *Lumbricidae* are predominant (55% by number, 34% by weight). *Lepidoptera* contributed 18% by number, *Orthoptera* 11%, *Coleoptera* 6%, small mammals 2% (33% by weight) and birds 9% (by weight).

Main literature:

Glutz von Blotzheim, U.N. & Bauer, K.M. (ed.) 1980: Handbuch der Vögel Mitteleuropas, band 9. – Akademische Verlagsgesellschaft, Wiesbaden.

Laursen, J.T. 1981: Kirkeuglens *Athene noctua* fødevalg i Østjylland. – Dansk Ornitologisk Forenings Tidsskrift 75: 105-110.

Libois, R. 1977: Contribution a l'etude du regime alimentaire de la choette cheveche an Belgique. – Aves 14: 165-177.

Skylark *Alauda arvensis*

DK: Sanglærke, D: Feldlerche, F: Alouette des champs

Distribution and phenology in Denmark:

Population. Very common migratory breeding species. A minor part of the population are residents. Population estimate 1.35 mill. pairs in 1993-94; decreasing, mainly due to changes in agricultural practice. No regional differences.

The Skylark is listed in the Danish Red Data Book in the category 'decreasing'.

The migratory movements of the Danish breeding population, and the passage of migrants from Fenno-Scandia, are highly variable. In mild winters birds will not leave until November/December and return in January/February. Normally, spring migration peaks in March with daily totals up to 10,000 individuals, but daily totals in excess of a few thousands are rare. In autumn, migration is much less concentrated.

Habitat. Breeds in the open country in areas covered with grass or low green herbage. Common in cultivated fields with cereals and other low crops; set-aside seems suitable as well. Avoids areas close to trees, hedges and buildings.

Breeding. Eggs laid from mid-April to late June. Clutch size 3-5 eggs. Incubates for 11 days. Nestling period 18-20 days but young usually leave nest at 8-10 days, and become independent at c. 25 days.

Food and feeding habitat:

Energy demand. Body weight 35-44 g. Daily food intake by adult birds in April in Caspian region 424 *Lepidoptera* larvae, corresponding to 8.5 g dry weight. Energy consumption of free-living birds 243 kJ/day.

Estimations. In February-March, 90% of diet may be leaves of cereals and/or grasses (remainder mainly weed seeds). Assuming a DEE of 240 kJ/day, this demands a daily consumption of 16.1 g cereal leaves (dry weight) or about 90 g fresh weight. During sowing in spring and autumn, diet may consist entirely of cereal grains: c. 20 g/day (fresh weight). In beet fields in spring, up to 63% of diet may be seedlings and leaves of sugar beets (cf. below), equivalent to a daily consumption of 10.6 g (dry weight) or c. 82 g fresh weight.

Feeding habitat. Feeds mainly on the ground, taking seeds or insects from soil surface, leaves or flowers. Forages in meadows, cereal fields and other crops and set-aside-areas where vegetation is no too high or dense. When crops grow higher, the larks will forage along edges and tramlines of fields. Also feeds on ploughed and stubble fields.

Food. Cereals and larger seeds of weeds very important in adult diet. Cereals especially important in spring and autumn, green parts are important in winter, and insects in summer. Nestlings mainly fed invertebrates.

Adult diet from arable land thoroughly studied in Denmark (Elmegaard et al. 1994), England (Green 1978, 1980) and Kazakhstan (Rjabow 1968). Main study of nestling diet in farmland in Switzerland (Jenny 1990).

Adults. In England, cereal grains very important in spring, summer and autumn except in breeding period when insects gain importance. Grass *Poaceae* seeds and flowers important in a short period in summer. Leaves, especially of cereals, predominant in mid-winter and early spring in some areas, and seeds of weeds in others (especially *Chenopodiaceae*, *Polygonaceae* and *Lamiaceae*). In the absence of grains and seeds in late winter and early spring, small leaves of wheat and rye notable components in lark diet. Sometimes digs with bill to expose partly exposed grains; uproots cereal seedlings (< 4 cm) to peck off attached grain. When seeds and insects become available in late spring, these are preferred over green plant material, and crop damage in sugar beets is reduced.

Most important invertebrates include beetles *Coleoptera* (*Elateridae*, *Curculionidae*, *Carabidae* and *Chrysomelidae*). In Danish farmland, 48-94% (by number) of arthropod specimens in faecal samples were *Coleoptera* (*Curculionidae*, *Chrysomelidae*, *Carabidae* and *Staphylinidae* prevailing). *Hymenoptera* (chiefly sawflies *Tenthredinidae*) formed 0-14%, *Diptera* 2-14% (mainly *Tipulidae*), while larval *Hemiptera* and *Lepidoptera* made up 0-6% and 0-5%, respectively; *Araneae* formed 0-14%. In rape fields, small *Chrysomelidae* (*Meligethes* spp. and *Ceuthorrhynchus* spp.) very commonly taken. Apparently, Skylarks prefer *Chrysomelidae*.

In British sugar beet fields, *Coleoptera* constituted 16% of diet (by dry weight) in April and May, weed seeds 21%, whereas seedlings and leaves made up 63% (mainly *Polygonaceae*, *Chenopodiaceae* (*Chenopodium album* and *Beta vulgaris*), and *Caryophyllaceae*).

In Kazakhstan from May to September, plant material constituted 54% (by number) of diet, mainly cereals and weed seeds and to a lesser extent vegetative parts. Among the invertebrates, *Coleoptera* predominated (24% by number), mainly *Carabidae*, *Tenebrionidae* (adults and larvae), *Chrysomelidae* and *Curculionidae*; *Orthoptera* and *Hymenoptera* (mainly *Formicidae*) also important, each comprising 11% of diet.

Young. The major food items (56% by number) in farmland are larval and adult *Diptera* (mainly *Tipulidae* and *Stratiomyidae*), *Orthoptera* (12%) and *Lepidoptera* (larvae and adult, 11%). *Hymenoptera*, *Coleoptera* and *Araneae* made up 3%, 6% and 7%, respectively. Other items include earthworms *Lumbricidae* and small snails *Gastropoda*.

Main literature:

Elmegaard, N., Rasmussen, P.N. & Poulsen, J.G. 1994: Arthropod food items in the Skylark (*Alauda arvensis*) in Danish fields. – Arbejdsrapport fra Miljøstyrelsen, Nr. 46. Miljøministeriet, Miljøstyrelsen

Green, R.E. 1978: Factors affecting the diet of farmland skylarks. – Journal of Animal Ecology, 47: 913-928.

Green, R.E. 1980: Food selection by Skylarks and grazing damage to sugar beet seedlings. – Journal of Applied Ecology, 17: 613-630.

Jenny, M. 1990: Nahrungsökologie der Feldlerche *Alauda arvensis* in einer intensiv genutzen Agrarlandschaft des schweizerischen Mittellandes. – Der Ornithologische Beobachter, 87: 31-53.

Rjabow, W.F. 1968: Die Nahrung der Feldlerche in der Kustanai-steppe. – Der Falke 15: 112-118.

Swallow *Hirundo rustica*

DK: Landsvale, D: Rauchswalbe, F: Hirondelle rustique

Distribution and phenology in Denmark:

Population. Very common migratory breeding species. The Danish breeding population arrives in April to mid-May and leaves from late August to mid-October. Breeding population estimated to 2-300,000 pairs towards the end of the 1980s. Probably some population decline since the 1970s, but numbers vary, presumably due to changing environmental conditions in African winter quarters. No regional differences in population density.

Common migrant from mid-April to mid-June and from late July to mid-November. In autumn tens of thousands may roost together in reed-beds.

Habitat. Totally dependent on buildings for placement of nest – but not necessarily connected to human activities. Breeds mainly in the countryside in connection with farms but also in towns and on abandoned buildings. Nest usually placed indoors in stables, barns, garages, sheds etc., but may also be placed outdoors under roofs, bridges etc.

Breeding. Eggs laid from mid-May to mid-July. Clutch size 4-5. Incubates for 11-19 days. Nestling period 18-23 days. Young become independent some weeks later.

Food and feeding habitat:

Energy demand. Body weight 19-20 g. A captive Swallow (18.0 g) had a BMR of 27.2 kJ/day. No information on daily consumption, but probably very similar to House Martin (see below for consumption of nestlings).

Feeding habitat. Dependent on small insects taken in flight in lower airspace – over surface of swallow water or areas with low vegetation cover like pastures, meadows, agricultural crops etc.

Food. Almost entirely dependent on flying insects – in breeding season especially *Diptera* and *Hymenoptera*. Little data on adult diet, e.g. from Poland (Glowacki 1977 in Cramp 1988). Major studies on nestling diet from a German agricultural area (Loske 1992) and Czechoslovakia (Kozena 1979).

Adults. In Poland *Hymenoptera* comprised 78% of 355 food items from adult diet (by number), *Coleoptera* 14%, *Heteroptera* 6% and *Diptera* 2%.

Young. In German farmland *Diptera* was the major food item – 66% by number during whole breeding season (mainly *Bibionidae*, *Syrphidae*, *Muscidae* and *Rhagionidae*), also *Ephemeroptera* 9%, *Homoptera* 9% (mainly *Aphidoidea*), *Heteroptera* 7%, *Coleoptera* 5%, *Hymenoptera* 2% and *Arachnida* 1% .

In farmland in Czechoslovakia (by number) mainly *Diptera* 62% (chiefly *Syrphidae* and *Muscidae*), *Hemiptera* 28% (largely *Aphidoidea*) and *Hymenoptera* and *Coleoptera* 4% each.

Main literature:

Cramp, S. (ed.) 1988: The Birds of the Western Palearctic, vol. V. – Oxford University Press, Oxford.

Kozena, I 1979: A study of the qualitative composition of the diet of young swallows in an agricultural farm. – Folia Zoologica 28: 337-346.

Loske, K-H. 1992: Nestlingsnahrung der Rauchschwalbe (*Hirundo rustica*) in Mittelwestfalen. – Vogelwarte 36: 173-187.

Allied farmland species:

House Martin *Delichon urbica* (DK: Bysvale). Very common migratory breeding species. Breeding population estimated to 100-170,000 pairs in the late 1980s, decreasing. Lower population densities in Western and Northern Jutland. Very common migrant from Scandinavia in April-June and July-October. Listed in Danish Red Data Book, category 'decreasing'.

Diet very similar to that of Swallow – mainly *Diptera* (c. 50%) and *Aphidoidea*, other *Hemiptera* and *Coleoptera*. Broods of 4 nestlings

received on average 226 kJ/day of which 158 kJ was utilized [central Scotland].

Sand Martin *Riparia riparia* (DK: Digesvale). Common migratory breeding species. Breeding population estimated to 20-40,000 pairs in the late 1980s, decreasing. Distribution seems patchy, probably due to lack of suitable breeding sites (natural cliffs or gravel pits). Common on migration to/from Scandinavia in spring and autumn. Like the House Martin, Sand Martin is listed in Danish Red Data Book, category 'decreasing'.

Usually forages in low airspace. Main food items *Diptera*, *Aphidoidea* and *Coleoptera*.

Meadow Pipit *Anthus pratensis*

DK: Engpiber, D: Wiesenpieper, F: Pipit de pres

Distribution and phenology in Denmark:

Population. Common migratory breeding species. Arrives in March-April and leaves September-November. Breeding population estimated to 40,000 pairs in 1993-94, decreasing. Highest densities occur in grazed meadows, especially in the marshland of southern Jutland and along rivers in western Jutland. Lower densities in intensively cultivated areas on Funen and Zealand.

Very common migrant from Fenno-Scandia from early March to mid-May and from early September to early December. During spring migration, 22,000 individuals have been recorded on a single day and daily totals of 2-10,000 individuals are frequent. In autumn, more than 100,000 birds on a single day have been recorded in western Jutland and daily totals of 5-10,000 regularly occur. In mild winters some remain in DK.

Habitat. Open areas with rather low vegetation cover. In DK prefers salt-marshes, meadows and watersides of streams and lakes, also occur in heathland. In farmland almost exclusively on permanent grass fields.

Breeding. Eggs laid from mid-April to early August. Clutch size 3-5. Incubates for 11-15 days. Nestling period 10-14 days. Young fed by parents in c. 13 days after fledging.

Food and feeding habitat:

Energy demand. Body weight 17-20 g. A Meadow Pipit (18.9 g) in captivity had a BMR of 26.0 kJ/day. Captive birds consumed on average 14.2 g of meal worms/day, but more food is probably needed under natural conditions.

Feeding habitat. Feeds almost exclusively on the ground. Forages in moist areas with low vegetation cover, along ditches etc. In agricultural areas mainly on grassland (if kept low), especially permanent grassland, occasionally in root crops and cereal fields. Avoids areas close to hedges and dense vegetation > 20 cm high.

Food. Mainly insects less than 5 mm but also seeds during autumn and winter. In adult diet, *Diptera*, *Coleoptera* and *Hymenoptera* very important all year and *Gastropoda* and seeds in winter. *Diptera* – especially *Tipulidae* – very important in nestling diet where *Trichoptera* and *Lepidoptera* also occur frequently.

Major studies on adult diet in Wales (Walton 1979), southern Norway 1200 m above sea-level (Hågvar & Østbye 1976) and in Germany (Henle 1983). Major studies on nestling diet in England (Coulson 1956 in Cramp 1988) and Wales (Walton 1979).

Adults. In Welsh grassland areas, adult diet consisted solely of invertebrates. *Diptera* (mostly *Bibionidae*) was the major food item and constituted 49% of diet by number, but monthly variation very large for all invertebrate groups – e.g. *Diptera* 3% in March but 74% in May and *Lepidoptera* 53% in March but 0 in July. *Coleoptera* second most important (14%) followed by *Araneae* 10%, *Lepidoptera* 8% (*Coleophora alticolella* larvae) and *Hymenoptera* 7%.

In the Norwegian study *Coleoptera* dominated (22% by number), *Hymenoptera* 15%, *Diptera* 14%, *Opiliones* 8%, *Araneae* 7%, *Heteroptera* 5%. Seeds were also found: *Scrophulariaceae* (*Euphrasia*) 14%, other seeds 2%. In Germany (August), *Coleoptera* consisted 31%, *Hymenoptera* 20%, *Hemiptera* 11% and seeds 10%. In France in winter seeds of grasses (*Poa annua*) were important together with snails (found in 53% and 42% of stomachs, respectively).

Young. Diet much the same as that of adults. First brood in England fed almost entirely *Diptera* – 88% by number (*Tipulidae* 85%) – and *Trichoptera* (11%). *Tipulidae* dominated food of second brood, too (41%), *Trichoptera* 30%, other *Diptera* (mainly adults) 16% and *Lepidoptera* 9%. In Wales, *Diptera* also major nestling food item – 66% by number, *Lepidoptera* 17%, *Hymenoptera* 11% and *Coleoptera*, *Opiliones* and *Collembola* 2% each.

Main literature:

Cramp, S. (ed.) 1988: The Birds of the Western Palearctic, vol. V. – Oxford University Press, Oxford.

Henle, K. 1983: Populationsbiologische und -dynamische Untersuchungen am Wiesenpieper (*Anthus pratensis*) auf der insel Mellum. – Vogelwarte 32: 57-76.

Hågvar, S. & Østbye, E. 1976: Food habits of the Meadow Pipit, *Anthus pratensis*, in alpine habitats at Hardangervidda, south Norway. – Norwegian Journal of Zoology 24: 53-64.

Walton, K.C. 1979: Diet of Meadow Pipits *Anthus pratensis* on mountain grassland in Snowdonia. – Ibis 121: 325-329.

White Wagtail *Motacilla alba*

DK: Hvid Vipstjert, D: Bachstelze, F: Bergeronnette grise

Distribution and phenology in Denmark:

Population. Very common migratory breeding species (*M. a. alba*). Arrives in Denmark from late February to early May – leaves in September-October. Danish breeding population estimated to 110.000 pairs in 1993-94, increasing. Apparently no regional differences.

Common migrant in April-May and August-September, very rare in winter when British race *M. a. yarrellii* ("Pied Wagtail") may also occur.

Habitat. Breeds in a wide range of open habitats, often near water. Very common in the cultivated landscape, often in association with human settlements and along roads and tracks. Avoids tall and dense vegetation.

Breeding. Eggs laid from early April to early August – main period late April to mid-May. Clutch size 5-6. Incubates for 11-16 days. Nestling period 11-16 days – young fed by parents for 4-7 days after fledging.

Food and feeding habitat:

Energy demand. Body weight 20-24 g. BMR of captive birds (mean weight 18.1 g) averaged 25.1 kJ/day. Energy demand in midwinter c. 91 kJ/day [England]. No information on daily consumption.

Feeding habitat. Feeds mainly on the ground or at the edge of water, often catches flies by jumping into the air. Prefers low vegetation or bare spaces. In farmland feeds in pastures, newly sown fields, ploughed fields, along ditches and other waterside habitats, in farmyards and along roads.

Food. Feeds almost exclusively on invertebrates, mainly *Diptera* but also *Coleoptera* and other insects. Prefers small food items (2-7 mm).

Major studies of adult diet in winter in England (*M. a. yarrellii*) (Davies 1976 & 1977) and from Austria all year (*M. a. alba)* (Glutz von Blotzheim & Bauer 1985); also some studies from former Soviet republics (in Cramp 1988).

Adults. In the two studies from western Europe, *Diptera* (*Tipulidae*, *Chironomidae*, *Sphaeroceridae* and *Scatophagidae*) were the most important food items. In England in March, birds feeding in flocks at

pools took mainly *Diptera* (97% by volume), while diet of single birds feeding at dung pads comprised more than 75% *Diptera* (by number) and 13% *Coleoptera*. In Austria, all year diet consisted mainly of *Diptera* (37% by number), *Trichoptera* (27%), *Coleoptera* (16%), *Lepidoptera* 11% and *Orthoptera* 5%. Also, a few seeds were found.

In other studies the most frequent found insect orders were *Odonata* and *Coleoptera* (30% each by number) [Russia]; *Coleoptera* [Moldavia]; *Coleoptera* (*Curculionidae*, *Carabidae*, *Elateridae* and *Chrysomelidae*), *Hemiptera* and *Hymenoptera* [eastern Russia].

Young. No information on nestling diet from Western Palearctic. Studies from Kirgizia indicate same diet as adults: *Diptera* 45% (mainly *Tipulidae*), *Lepidoptera* 11% and *Orthoptera* 5%.

Main literature:

Cramp, S. (ed.) 1988: The Birds of the Western Palearctic, vol. V. – Oxford University Press, Oxford.

Davies, N.B. 1976: Food, flocking and territorial behavior of the Pied Wagtail in winter. – Journal of Animal Ecology 45: 235-253.

Davies, N.B. 1977: Prey selection and social behavior in Wagtails. – Journal of Animal Ecology 46: 37-57.

Glutz von Blotzheim, U.N. & Bauer, K.M. (1985): Handbuch der Vögel Mitteleuropas, band 10/II. – Akademische Verlagsgesellschaft, Wiesbaden.

Dunnock *Prunella modularis*

DK: Jernspurv, D: Heckenbraunelle, F: Accenteur mouchet

Distribution and phenology in Denmark:

Population. Common breeding species. The major part of the population leaves DK in winter, but wintering individuals are not rare. Danish breeding population has been reduced by 60-70% since 1976; latest estimate c. 100,000 breeding pairs (1993-94). No obvious regional differences except lower densities on Bornholm and probably in West Jutland. Common migrant August-November and March-May.

Listed in Danish Red Data Book, category 'decreasing'.

Habitat. Occurs in almost all kinds of woodland, scrub, hedges, parks and gardens, especially in habitats with dense ground vegetation. Common in farmland where it breeds in hedgerows, coverts etc.

Breeding. Eggs laid from early April to late June. Clutch size 4-6. Incubates for 12-13 days. Nestling period 11-12 days; young become independent 14-17 days later.

Food and feeding habitat:

Energy demand. Body weight 18-21 g (15-25 g). A captive Dunnock (16.8 g) had a BMR of 28.0 kJ/day. No information on daily consumption.

Feeding habitat. Feeds primarily on ground, mainly under bushes, hedges, young conifers etc. – also in herbs up to 1 m above ground and occasionally in higher vegetation, especially in summer. In farmland may preferentially feed in winter rape fields in spring and early summer, later in year also in other crops, e.g. beet fields. Wintering birds often forage near human dwellings.

Food. Adult food mainly arthropods in spring and summer, especially *Coleoptera* and *Araneae*. Seeds important in autumn and winter, notably *Urticaceae* and *Poaceae*. Nestlings mainly fed insects – *Homoptera*, *Coleoptera*, *Collembola* and *Diptera*; also *Opiliones*.

Major studies in England of adult diet (Cramp 1988) as well as nestling diet (Bishton 1985). Also major studies of nestling diet in different forests in Czechoslovakia (Kristin 1989, 1993).

Adults. Over year, seeds and animal food of approximately equal importance estimated by volume in faeces. In an English study, seeds constituted 90% of diet in February declining to 0% in April-July; average over year 52%. Among invertebrates, *Coleoptera* (mainly *Curculionidae* and *Staphylinidae*) most important year round: 62% (by number in faeces) of animal diet in summer (May-October) and 73% in winter (November-April); *Araneae* 29% and 12% respectively, *Oligochaeta* 4%/4% and *Gastropoda* 2%/7%. Among seeds, *Urticaceae* most important; in August-October *Urtica* made up 46% of total faecal volume and *Holcus lanatus* (*Poaceae*) 34%. From November to April, seeds of *Urtica* (35%), elder *Sambucus nigra* (18%) and *Rumex* (*Polygonaceae*) (7%) common.

In other, less intensive studies seeds of *Polygonaceae* (winter) and *Amaranthaceae* (winter and early spring) were important.

Young. Mainly invertebrates like in adult summer diet. In general *Homoptera*, *Coleoptera*, *Collembola*, *Diptera* and *Opiliones* preferred, but variation is large.

In hedgerows surrounded by a mixture of woodland, farmland and grassland in England, *Coleoptera* (mainly *Curculionidae*, *Staphylinidae*, *Carabidae* and *Chrysomelidae*) occurred in 44-100% of nestling faeces (lowest values from beginning of breeding season); *Diptera* (*Muscidae*) in 83-91% – except in the end of breeding season when only 25% – *Araneae* and *Opiliones* in 28-69% and *Lepidoptera* larvae in 83% during first half of June but only in 3-33% during remainder of breeding

season. Besides, *Hemiptera* (*Aphidoidea* and *Miridae*), *Gastropoda* and *Oligochaetae* were present during first half of July (in 19%, 31% and 17% of faeces, respectively), and seeds of rape *Brassica napus* were found in July (in 9%).

In Czechoslovakia, *Homoptera* were common (22% by number but only 9% by weight), together with *Collembola* (by number/weight) 21%/5%, *Opiliones* 14%/23%, *Lepidoptera* 12%/30%, *Diptera* 10%/11%, *Araneae* 10%/2%, *Gastropoda* 3%/3% and *Hymenoptera* 2%/9%. In two other Czech studies *Heteroptera* dominated (60% and 54% of items, respectively) with *Opiliones*, *Coleoptera*, *Diptera* and *Collembola* making up between 1% and 13% of nestling diet.

Main literature:

Bishton, G. 1985: The diet of nestling Dunnocks *Prunella modularis*. – Bird Study 32: 113-115.

Cramp, S. (ed.) 1988: The Birds of the Western Palearctic, vol. V. – Oxford University Press, Oxford.

Kristin, A. 1989: Ernährung der Nestlinge der syntopischen Arten Zilpzalp (Phylloscopus cyllobita) und Heckenbraunelle (Prunella modularis). – Folia Zoologica 38: 349-362.

Kristin, A. 1993: Präferenzen in der Nestlingsnahrung der Heckenbraunelle *Prunella modularis* in verschiedenen Waldvegetationsstufen. – Vogelwelt 114: 72-82.

Fieldfare *Turdus pilaris*

DK: Sjagger, D: Wacholderdrossel, F: Grive litorne

Distribution and phenology in Denmark:

Population. Very common migrant and winter visitor from Fenno-Scandia and Russia; numbers and phenology vary greatly between years, due to irruptions. No accurate estimate of total wintering population ('tens of thousands'); numbers fluctuate, and migratory movements may occur during most of winter. During spring migration, 10-100,000 individuals have been recorded on a single day, but daily totals in excess of a few thousands are rare. Flocks of more than 1000 resting and foraging birds are not uncommon.

Autumn migration from September onwards, numbers normally peaking from mid-October until November, but in some years not until January. Spring migration culminates in second half of April and may continue until late May. Occurs most numerously in northern and western Jutland but also in high numbers on Zealand. Phenology and

years of peak numbers often vary between eastern and western DK, reflecting different origins of the birds.

Fairly common, resident or dispersive breeding species. Breeds in most parts of DK, most commonly in NW-Jutland, N-Zealand and Bornholm. Population estimate 2-4000 pairs (1994). Swift colonization following first breeding 1960; numbers still increasing and breeding range expanding.

Habitat. Outside breeding season in open country (fields, grassland), especially where interspersed with lines of trees, and in fringes between open and wooded areas. Also in parks, orchards, and other sites where berry-bearing trees and shrubs occur (autumn and winter). Often in large flocks.

In DK breeds in edges of woods (deciduous or coniferous), islands of trees in open country, avenues, parks etc.; mixture of trees and open areas probably essential. Often in colonies.

Food and feeding habitat:

Energy demand. Average body weight c. 105 g (90-115 g, depending on season). No available measurements of metabolic rate, but captive Blackbirds *T. merula* (mean weight 82.8 g) had an average BMR of 85 kJ/day while the BMR of a Mistle Thrush *T. viscivorus* (108.2 g) was 95.4 kJ/day.

No information about daily consumption of adults. Fledging weight c. 60 g, mean growth rate of nestlings 4.5 g/day, average total consumption 775 g/nestling from hatching to fledging (13 days, data from a clutch of 5).

Feeding habitat. Feeds mostly on ground, but also in vegetation when taking fruits and berries. In farmland mainly in meadows and other areas with low-grown grasses, permanent or perennial within rotation. Set-aside may be suitable, as demonstrated for Blackbird *T. merula*.

Food. Earthworms and other invertebrates most important food items over year, but fruits and berries important from late summer until onset of spring and may be essential during winter. Young fed on invertebrates, primarily earthworms.

Data from winter quarters in Central Europe (Germany, Switzerland) compiled by Lübcke & Furrer (1985). From summer half, major studies in Norway (Meidell 1937, Otto 1979). Nestling food also studied in Germany (Lübcke 1975).

Adults. From early July fruits and berries enter the diet, their importance increasing during autumn as availability of invertebrates (see below) declines. Sufficient supplies of fruits probably essential during winter months, especially when frosty weather prevails; migratory and dispersive movements often follow depletion of fruit resource in an area. Almost all kinds of fruits are eaten (incl. commercially impor-

tant), but *Sorbus*, *Crataegus* and *Rosa* seemingly preferred [Central Europe]. No data from DK, but *Prunus* and *Hippophaë* (latter in N and West Jutland) certainly important in addition to above-mentioned. Also apples *Malus*, but fruits of high energy content preferred and probably crucial for survival during cold periods.

When available, invertebrates also taken during autumn and winter; relative importance of animal and vegetable food (fruits) difficult to judge from analyses of stomach content due to differences in digestibility. Autumn data only from Norway (subalpine birch region): of animal food, c. 30% adult and 25% larval *Coleoptera*, 20% *Opiliones*, 12% adult *Formicidae*. In UK (September-May), 36% fruits and seeds, 5% other plant material, 37% insects, 15% earthworms *Lumbricidae*, 7% other invertebrates. In Hungary, one study (December-March) only found fruits and seeds, but an older study (November-April) also invertebrates (notably 77% *Coleoptera*, 7% *Lepidoptera*, 6% *Helix*), although fruits still dominating.

In spring, earthworms become dominant (60% of animal food by number, even more by weight), together with adult *Formicidae* and *Coleoptera* [S Norway, birch region]. Alongside old berries, vegetable food reported to include leaves of *Poaceae*, *Cyperaceae* and *Juncaceae*.

During breeding time, earthworms also dominate (57% of dry weight), 9% *Coleoptera*, 4% *Gastropoda*, 26% vegetable matter (most of which from alimentary canal of earthworms) [West Norway, Bergen region]. In Russia (Moscow region), June-July: 36% *Coleoptera* (largely *Curculionidae*), 15% *Hymenoptera*, 14% *Lepidoptera* larvae, 6% *Diptera* (mainly larvae), 6% earthworms, 4% *Chilopoda*, 14% plant material.

Young. Quantitative data from West Norway and Germany (Nordhessen). In Norway, earthworms completely dominate: 64% of dry weight (also, 27% brown vegetable matter from earthworm guts), 7% *Diptera* (adults and larvae). In Germany, 53% earthworms, 23% *Coleoptera* (mainly *Elateridae* larvae, *Carabidae* and *Cantharidae*), 8% *Diptera*, 6% *Hymenoptera* (mainly *Tenthredinidae*), 4% snails.

Main literature:

Lübcke, W. 1975: Nahrungsuntersuchungen an der Wacholderdrossel *(Turdus pilaris)*. – Vogelkdl. Hefte Edertal 1: 82-87.

Lübcke, W. & R. Furrer 1985: Die Wacholderdrossel. – Neue Brehm-Bücherei 569, A. Ziemsen Verlag, Wittenberg Lutherstadt.

Meidell, O. 1937: Undersøkelse av Mageinnhold hos Gråtrost (*Turdus pilaris* L.). – Nyt Mag. Naturv. 76: 59-132.

Otto, C. 1979: Environmental factors affecting egg weight within and between colonies of Fieldfare *Turdus pilaris*. – Ornis Scandinavica 10: 111-116.

Allied farmland species:

Redwing *Turdus iliacus* (DK: Vindrossel). Very common migrant, less common winter visitor. Peak numbers in autumn (mid-late October), occurring most abundantly in N and W Jutland; often less numerous in spring (mid-March - early May). Habitat choice outside breeding season as *T. pilaris*.

Blackbird *Turdus merula* (DK: Solsort). Very common throughout year (most numerous Danish breeding bird: c. 2.4 mill. pairs), but with primary breeding populations in woodland and gardens and secondary populations occurring in farmland; farmland pop. estimated at 400,000 pairs. In farmland prefers sites adjacent to species' primary habitats and areas with hedgerows, coverts etc.; less dependent on grassland for feeding than *T. pilaris* and *T. iliacus*.

Whitethroat *Sylvia communis*

DK: Tornsanger, D: Dorngrasmücke, F: Fauvette grisette

Distribution and phenology in Denmark:

Population. Very common migratory breeding species. Arrives from late April to mid-May and leaves the country in August-September. Population decline until 1985, probably due to severe drought in Sahelian winter quarters, but some recovery has occurred since then; latest estimate c. 400,000 breeding pairs (1993-94). Also, common migrant to/from Fenno-Scandia from late April to June and from late July to mid-October.

Habitat. Breeds in open country in hedges and shrubs, preferentially where surrounded by areas with high weeds and grasses. Also in forest edges and clearings. In farmland often attempts breeding in winter oil-seed rape.

Breeding. Eggs laid from second half of May to late July. Clutch size 4-5. Incubates for 9-14 days. Nestling period 10-12 days. Young independent 15-20 days after fledging.

Food and feeding habitat:

Energy demand. Body weight 14-16 g. No information on metabolic rate or daily consumption.

Feeding habitat. Feeds mainly on insects in bushes and in herb layer by searching foliage and small branches. Also takes insects in flight and from ground. In farmland mainly forages in hedges, shrubs, bushes and rape fields, less often in winter cereals and other crops.

Food. During spring and breeding season mainly insects, especially *Heteroptera, Coleoptera, Hymenoptera* and *Lepidoptera*. In late summer fruits and berries enter diet, becoming important food source on autumn migration. Nestling diet mainly *Lepidoptera, Araneae, Heteroptera* and *Hymenoptera*.

Major studies on adult diet from Denmark during spring migration (Laursen 1978), eastern Germany in May-September (Emmrich 1974 cit. Cramp 1992), and Switzerland in autumn (Turrian & Jenni 1991). Major studies on nestling diet from Germany (Siefke 1962; Emmrich 1973 cit. Cramp 1992) and Sweden (Cavallin 1988).

Adults. During spring migration [Denmark, staging birds] insects dominate: *Lepidoptera* c. 50% (by dry weight) and *Coleoptera* (mainly *Curculionidae*) c. 25%; *Heteroptera* (mainly *Psyllidae*) also common in diet (c. 20% by number). Stamens and bracts from hawthorn *Crataegus* and other bushes and trees occur but are of minor importance (c. 2% and 5% by number, respectively).

In eastern Germany (May-September), *Heteroptera* most important food item: 35% of animal food (by number), *Hymenoptera* (especially *Formicidae*) 25%, *Coleoptera* 13%, *Araneae* 9% and *Lepidoptera* (mainly larvae) 7%. Some variation during season: in May, *Coleoptera* dominate followed by *Lepidoptera* larvae; berries (*Ribes*) only found in 18% of stomachs. July to mid-August occurrence of fruit increases: *Rubus* in 52%, *Ribes* in 28% and *Hippophaë* in 6% of stomachs. Late August to mid-September, *Hymenoptera* (adults) make up 45% of diet, *Heteroptera* 7%, *Coleoptera* 4% and fruits found in more than 50% of stomachs.

During autumn migration (August-September), *Hymenoptera* also dominate (64% by number), *Heteroptera* 14% and *Coleoptera* 9%. Remains of *Rubus* occurred in 42% of stomachs and *Cornaceae* in 18% [Switzerland].

Young. In eastern Germany (by number) *Lepidoptera* 28%, *Araneae* 22%, *Heteroptera* 13%, *Hymenoptera* 9%, *Orthoptera* 8% and *Diptera* 7% of nestling food. In another German study *Lepidoptera* (especially larval *Geometridae* and *Noctuidae*) made up 43%, *Araneae* 20%, *Diptera* (mainly adults) 19% and *Gastropoda* 6%. In Sweden (by number) 60% of diet were larval *Lepidoptera, Hymenoptera* and *Coleoptera, Araneae* 14% and *Diptera* 6%.

Main literature:

Cavallin, B. 1988: Törnsångere *Sylvia c. communis*. Pp. 307-314 *in*: Andersson, S. (ed.) Fåglar i jordbrukslandskapet. – Vår Fågelvärld, Suppl. No. 12.

Cramp, S. (ed.) 1992: The Birds of the Western Palearctic, vol. VI. – Oxford University Press, Oxford.

Laursen, K. 1978: Interspecific relationships between some insectivorous passerine species, illustrated by their diet during spring migration. – Ornis Scandinavica, 9: 178-192.

Siefke, A. 1962: Dorn- und Zaungrasmücke *Sylvia communis, S. curruca*. – A. Ziemsen Verlag, Wittenberg Lutherstadt.

Turrian, F. & Jenni, L. 1991: Etude de trois especes de fauvettes en periode de migration postnuptiale a Verbois, Geneve. – Alauda, 59: 73-88.

Allied farmland species:

Lesser Whitethroat *Sylvia curruca* (DK: Gærdesanger). Very common migratory species; breeding population estimated to 160,000 pairs in 1993-94, decreasing. Also common migrant from Scandinavia. Occurs mainly in hedgerows, forest edges and gardens. Like Whitethroat, feeds mainly on invertebrates, but also berries in late summer and autumn.

Willow Warbler *Phylloscopus trochilus* (DK: Løvsanger). Very common migratory species. Population estimate 600,000 breeding pairs (1993-94); fairly stable although some decline may have occurred since the 1980s. Very common on migration from Scandinavia. Occurs in forests (especially in early successional stages), overgrown fens with birch and willow, gardens etc; also in farmland where interspersed with hedgerows and coverts. Feeds mainly on insects and spiders; in autumn also berries.

Starling *Sturnus vulgaris*

DK: Stær, D: Star, F: Etourneau sansonnet

Distribution and phenology in Denmark:

Population. Very common breeding species. Mainly migratory, but a minor part of the population is resident, depending on weather conditions in winter. No reliable estimate of breeding population, but certainly several hundred thousand breeding pairs. Population size almost halved since the middle of the 1970s. No obvious regional differences in breeding densities. The Danish population is joined by a large number of migrants from Scandinavia in autumn when flocks of 100,000 individuals forage in the marshlands of SW Jutland.

Habitat. Associated with open country. Breeds in open forests or near woodland edges, in towns and villages, always near grassland (grazed meadows, grass fields, lawns etc.). Breeds naturally in hollow trees and woodpeckers' nest-holes or artificially in building apertures, nest-boxes etc.

Breeding. Eggs laid from mid-April to late May. Clutch size 4-7. Incubates for 11-15 days. Nestling period 21 days; young may leave nest after 17 days if disturbed. Young still fed by parents for a few days after fledging.

Food and feeding habitat:

Energy demand. Body weight 77-83 g, somewhat variable (52-108 g). Daily energy requirement highest in spring (c. 290 kJ/day) and lowest in summer (c. 200 kJ/day) [England]. Intake of captive adult birds 210-265 kJ/day if kept on animal food, 382 kJ on poultry pellets. In another study consumed 6.6 g (dry weight) per day (153 kJ/day) if kept on animal diet (crickets) or 5.2 g/day if kept on fruit (pulp and skin only). Daily intake by nestling at 5 days of age c. 450 kJ; daily intake by nestling at 15 days c. 840 kJ. Total intake over 19-day nestling period 12,350 kJ/nestling [Netherlands].

Feeding habitat. Feeds mainly on ground in open areas of short grass or (less often) in other kinds of short or sparse vegetation like cereal stubble. Also forages in heaths, intertidal zones, salt marshes, feeding areas for domestic stock and seasonally in orchards and thickets bearing soft fruits or berries. In farmland in southern England, 50-90% of feeding birds were recorded in grassland all year, but in late summer up to 40% in stubble fields and up to 10% in trees. In autumn, stubble and ploughed fields also important, and in winter and spring areas with spilled grain in farmyards are frequented.

Food. Animal as well as vegetable matter throughout year. Insects dominate in spring and summer while plant material comprises a high proportion of diet during autumn and winter. Invertebrate food taken on soil surface or just below soil surface by bill-probing. Vegetable food mainly seeds (including cereals) but also fruits during summer and autumn. Nestlings are fed almost entirely on insects.

Major studies of adult and nestling diet in Czechoslovakia and Poland (Havlin & Folk 1964; Gromadzki 1969).

Adults. Feeds on a wide range of plant and animal material, relative proportions vary with season. The proportion of plant material in diet is less than 50% from April to June, but between 50% and 95% during remainder of year. In Poland (February-September) and Czechoslovakia (March-November), 85% and 69% of food items were animal with almost no vegetable food items taken from March to June.

In Poland, *Coleoptera* (*Carabidae* and *Scarabaeidae* among others) dominated animal fraction of diet (c. 40%), with *Diptera* and *Hymenoptera* making up c. 20% each; *Lepidoptera* were also found in reasonable numbers. Cultivated fruits were found in up to 70% of stomachs (varying proportion in different months), cereals in up to 60%, wild seeds in up to 40% and wild fruits in up to 30%.

In Czechoslovakia, *Hymenoptera* (mainly *Formicidae*) dominated animal part of diet, followed by *Coleoptera*, *Diptera*, *Lepidoptera* and

Araneae. Wild fruits were more important than cultivated fruits and cereals were more important than wild seeds.

Young. Nestling food almost entirely of animal origin, mainly insects. A few species usually predominate, often *Diptera* (notably larval *Tipulidae* and adult *Bibionidae*), *Lepidoptera* (especially *Noctuidae* larvae), *Coleoptera* (adults and larvae) and earthworms *Lumbricidae*. In Poland, *Diptera* comprised 44% of food items, *Coleoptera* 27%, *Lepidoptera* 13%, *Hemiptera* 8% with *Hymenoptera*, *Araneae* and *Oligochaeta* being less important. In Czechoslovakia, *Coleoptera* 52%, *Lepidoptera* 25%, *Diptera* 8%, *Hymenoptera* 7% and *Oligochaeta* 5%; fruits constituted 2% of nestling diet.

Main literature:

Gromadzki, M. 1969: Composition of food of the Starling *Sturnus vulgaris* in agrocenoses. – Ekologia Polska 17: 287-311.

Havlin, J. & Folk, C. 1965: Potrava a vyznam spacka obecneho, *Sturnus vulgaris*. – Zoologicke Listy 14: 193-208.

Hooded Crow / Carrion Crow *Corvus corone*

DK: Krage (Gråkrage/Sortkrage), D: Aaskrähe (Nebelkrähe/ Rabenkrähe), F: Corneille mentelee / Corneille noire

Distribution and phenology in Denmark:

Two distinct races occur in Denmark – Hooded Crow *Corvus corone cornix* and Carrion Crow *Corvus corone corone*. The two races occur in different parts of DK, but no differences in habitat and food choice seem to exist.

Population. Hooded Crow is a very common, mostly resident breeding bird. Population estimate 100-200,000 breeding pairs – steadily, albeit slightly, increasing. Common migrant and winter visitor, wintering population probably larger than breeding population. No regional differences in density of breeding population, but gives way to Carrion Crow in southernmost parts of Jutland.

Breeding range of Carrion Crow in DK limited to southern and western Jutland, the isles south of Funen and Lolland-Falster. Mainly resident. Breeding population probably a few thousand (max. 10,000) individuals, many of which in mixed pairs with Hooded Crow.

Habitat. Prefers open cultivated land with copses, groves, hedgerows or scattered trees. Also, but less often, at forest edges, in city parks and other urban areas with tall trees. Flocks in winter on open fields and along coasts.

Breeding. Eggs laid from late March to mid-May. Clutch size 3-6. Incubates for 18-19 days. Nestling period 28-38 days. Young can probably feed themselves when leaving nest, but normally stick to the parents for 3-5 weeks after fledging.

Food and feeding habitat:

Energy demand. Body weight 490-590 g. BMR of captive birds (mean weight 529 g) averaged 309 kJ/day. Daily consumption in captivity c. 130 g plant and 25 g animal material. For birds in central France, estimates of daily energy demand over year varied between 517 kJ/day in August and 645 kJ/day in February (calculated for a body weight of 519 g). Daily intake (fresh weight) varied from 61 g in June to 83 g in February.

Average daily intake of nestlings c. 65 g/day at a nestling weight of 100 g, increasing to c. 140 g/day at fledging.

Feeding habitat. Feeds almost exclusively on ground. Mainly in farmland where it prefers grassland, stubble, potatoes and other dicotyledonous spring crops; also frequents periodically mown or harrowed fields, ploughed fields, roadsides and fences.

Food. Generally invertebrates and cereal grain, also small vertebrates, eggs, carrion and scraps. Great variation in diet with seasonal changes depending on habitat and type of agriculture.

Major studies on adult diet from central France, all year (Jollet 1984) and southern Spain, autumn and winter (Soler & Soler 1991). Major studies on nestling diet from Norway (Meidell 1943) and Scotland (Houston 1977).

Adults. Plant material constitutes 50-80% of diet over year; generally, the proportion of plant material (especially cereals and root crops) eaten is highest in autumn and winter. In France, plant material constituted 31-47% (by number) in March-May, 6% in June (fruits of *Prunus*), 86-94% in July-October and 64-83% in November-February. Cereal grain most important, but in late autumn and winter green parts of autumn-sown cereals also frequent. Invertebrates important during breeding season (c. 30-85% of diet), less common outside breeding season (5-30%). Earthworms *Lumbricidae* most important group over year, constituting up to 47% of diet. Among the insects, *Coleoptera* (mainly *Scarabaeidae*) most frequent.

In autumn and winter in Spain, plant material (mainly cereals) constituted c. 50% of diet. Among the invertebrates, *Orthoptera* was important (8-24% of animal diet by dry weight) while *Hymenoptera* and *Coleoptera* (adults and larvae) were very common but constituted only 1% and 2-5% of animal diet (by dry weight), respectively.

Young. Diet much like adult diet in spring, reflecting local availability. Beetles *Coleoptera* (mainly *Scarabaeidae*, *Carabidae*, *Curculionidae* and *Elateridae*) very important – comprised 39% and

64% of diet (by number) in Norway and Scotland, respectively. *Diptera* and *Opiliones* also important – c. 15% and 8% (by volume) in both studies. In an English study, *Lepidoptera* larvae were common. Plant material less important: cereal grain 7% and other plants 11%.

Main literature:

Houston, D.C. 1977: The effect of Hooded Crows on hill sheep farming in Argyll, Scotland: The food supply of Hooded Crows. – Journal of Applied Ecology 14: 1-15.

Jollet, A. 1984: Variation saisonnieres du regime alimentaire de la Corneille noire *Corvus corone* dans le bocage limousin. – L'Oiseau et R.F.O. 54: 109-130.

Meidell, O. 1943: Undersøkelser over kråkas næring. – Nytt Mag. Naturvid. 84: 1-91.

Soler, J.J. & M. Soler 1991: Analisis comparado del regimen alimenticio durante el periodo ontono-invierno de tres especies de corvidos en un area de simpatria. – Ardeola 38: 69-89.

Rook *Corvus frugilegus*

DK: Råge, D: Saatkrähe, F: Corbeau freux

Distribution and phenology in Denmark:

Population. Common resident and migrating breeding bird. Population estimate 45,000 pairs in mid-1980s; breeding population declining until the mid-70s but has been stable since then. Highest population densities in the eastern part of Denmark. Very few colonies in the western and northern parts of Jutland, probably due to poorer soils in these areas.

Common, but not very numerous, migrant from Fenno-Scandia and Balticum in autumn (September-November) and spring (February-May). Congregate in winter with Hooded Crow and Jackdaw in large flocks in farmland.

Habitat. Breeds in colonies, in fairly tall trees (deciduous trees preferred in DK), in groves or forest edges fronting open grass- or farmland. Avoids dense forests, wetlands and gardens. Dependent on farmland habitats; breeds only in towns and villages where adjacent countryside is readily accessible.

Breeding. Eggs laid from early March to late April. Clutch size 2-6 eggs. Incubates for 16-18 days. Fledging period 30-36 days. Fed by parents for c. 6 weeks after fledging.

Food and feeding habitat:

Energy demand. Body weight 340-600 g. BMR of a 390 g Rook was 226 kJ/day. Average food requirements of adults c. 750 kJ/day; over the year, daily consumption averages 10-70 g (wet weight) of grains and 15-70 g of animal material. In northern Scotland, daily energy intake ranges from c. 450 to 2450 kJ through the year.

Daily energy requirements for a nestling aged 1-5 days c. 230 kJ, at 6-10 days 380 kJ, at 11-20 days c. 460 kJ, and at 21-30 days c. 500 kJ. Total demand over nestling period c. 12,500 kJ per nestling; each young receives c. 35 g of cereals and 1750 g of invertebrates during that time.

Feeding habitat. Feeds almost exclusively on the ground on meadows and arable land. Feeds on fields with newly sown cereal crops in spring, and often follows the plough taking invertebrates. In late summer and autumn favours newly harvested cereal fields (especially maize), stubble, ploughed or dung-fertilized fields, and areas with freshly sown winter cereals. In winter, mainly on grassland or harvested root-crop fields.

Food. Omnivorous; animal food chiefly insects, earthworms, small vertebrates, carrion, while main plant material is cereal grain. Animal and plant material taken throughout the year, but relative proportions change considerably. On average, each group forms c. 45% of diet, and scraps and vertebrates make up c. 5% each. Among the invertebrates, *Lumbricidae*, *Coleoptera*, *Diptera* and *Lepidoptera* seem to be most important, and cereal grains and potatoes are most important plant material. Food items such as worms and *Tipulidae* larvae as well as sprouting crops, ungerminated grains, roots and tubers often digged out from below soil surface.

Major all-year-studies on adult diet in farmland areas from Denmark (Fog 1963) and Poland (Gromadzka 1980); winter diet studied in an urban area in Czechoslovakia (Folk and Beklova 1971). Principal studies of nestling diet from Denmark (Fog 1963), southwestern Germany (Ganzhorn 1986) and southeastern England (Lockie 1955).

Adults. In Denmark, 347 adult birds were collected in 1942-1960; 3/4 of the birds had 50% (by volume) or more vegetable matter in their gizzards. All other data from this study expressed as frequency of occurrence in gizzards: cereal grains occurred in 94% of 273 adult birds (79-95%, depending on season), potatoes in 7-10%, and weed seeds in 1-7%. Among the invertebrates, most important taxa included *Coleoptera* (34-57%), *Diptera* (22-33%), and *Lepidoptera* (7-14%). Earthworms were taken all-year, but were most important (21%) from January to March. Vertebrates constituted only a minor part of the diet all year round. Other quantitative studies support these findings: invertebrates comprise more than 50% of diet in spring and c. 50% in summer, while vegetable matter dominant the rest of the year [Poland]; in European USSR, *Coleoptera* made up 53% (by volume), *Lepidoptera* 18%, cereal grains 14%, and other crops 11%. In a study from Czechoslovakia (February-July), cereal grains comprised (by

volume/number) 55%/62% of diet, whereas *Coleoptera* formed 13%/16%. In winter, grains were still most important food (70%/47%), while other plants made up 6%/19%, carrion and scrap 16%/13%, and *Coleoptera* 0.1/7%.

Apparently, animal food items preferred to plant material when available. Invertebrates probably taken according to accessibility and seasonal abundance; availability of earthworms, *Tipulidae* and *Elateridae* larvae, dependent on soil condition.

Young. In Denmark, cereal grains as well as *Coleoptera* and *Diptera* were primary food items for nestlings. Potatoes were also important.

In Germany, invertebrates formed 72% (dry weight, mainly *Lumbricidae* 48%, and *Diptera* 13% (chiefly pupae)). Cereals (mainly maize and oats) contributed 24%, and mice (12%).

In southeastern England, invertebrates main food items: *Lumbricidae* comprised (by volume/number) 61%/33%, *Diptera* 6%/13%, *Coleoptera* 2%/6%, *Opiliones* 1%/13%; cereals only formed 13% by volume.

Main literature:

Fog, M. 1963: Distribution and food of the Danish rooks. – Danish Review of Game Biology, 4: 61-109.

Folk, C. & Beklova, M. 1971: Die Winternährung der Saatkrähe – *Corvus frugilegus* – im städtiscen Milieu. – Zoologicke Listy 20: 357-363.

Ganzhorn, J.U. 1986: Quantitative Aspekte der Nahrungsbiologie nestjunger Saatkrähen. – Ökologie der Vögel 8: 49-56.

Gromadzka, G.H.J. 1980: Food composition and food consumption of the Rook *Corvus frugilegus* in agrocoenoses in Poland. – Acta Ornitologica 17: 227-256.

Lockie, J.D. 1955: The breeding and feeding of Jackdaws and Rooks with notes on Carrion Crows and other Corvidae. – Ibis 97: 341-369.

Tree Sparrow *Passer montanus*

DK: Skovspurv, D: Feldsperling, F: Moineau friquet

Distribution and phenology in Denmark:

Population. Very common resident and dispersive breeding species. A minor part of the population migrates. In winter the Danish population is joined by a small number of migrants from southern Scandinavia. Population is estimated to 480,000 pairs in 1993-94, increasing. No obvious regional differences.

Habitat. Breeds mainly in the cultivated areas surrounding inhabited regions, in open suburbs and villages. Also in hedgerows and forest edges if suitable nest sites available. Flocks in winter up to 1000 individuals. In periods of snow-cover particularly near human settlements.

Breeding. Eggs laid from mid April to July. Clutch size: 2-7 (normally 5). Incubates for 11-14 days. Fledging period 15-20 days. Young continue to be fed by parents for 10-14 days after fledging.

Food and feeding habitat:

Energy demand. Body weight: 18-29 g. BMR of a captive Tree Sparrow (22.3 g) measured at 35.2 kJ/day. Estimates of average food consumption in Germany and Netherlands 2.73 and 3.18 kg/year (dry weight) respectively. Estimates of annual energy demand for individuals in 17 different populations ranged from 57,000 to 87,000 kJ/bird. Daily energy intake of adults in captivity 96 kJ/day (body weight 23 g). Energy intake from hatching to fledging for one nestling c. 1100 kJ.

Estimations. An average DEE of c. 150 kJ/day is probably realistic in the wild. Around sowing and harvest, Tree Sparrows may cover this demand entirely on cereal grains, equivalent to a daily intake of 12-13 g (fresh weight).

Feeding habitat. Feeds mainly on the ground in fields, gardens or parks, along roadsides, on farmyards etc. Large flocks often gather on stubble fields.

Food. Cereal grains and seeds of weeds dominate adult diet most of the year, but invertebrates very important during breeding season, mainly *Coleoptera*, *Diptera* and *Hymenoptera*. Other plant material like buds and berries comprise only a minor part of diet. Nestling diet mainly invertebrates – *Lepidoptera* (larvae), *Coleoptera*, *Diptera*, *Hemiptera* and *Orthoptera* important.

Major studies on adult diet in Poland, Germany and Netherlands (Weins & Dyer 1977), Germany (winter, Keil 1970), and Yugoslavia

(Szlivka 1984). Nestling food studies from eastern Germany and Czechoslovakia (Dornbusch 1973, Kristin 1988).

Adults. In farmland areas, cereal grains and weed seeds important all year. Cereal grains formed 54% and 58% (by dry weight) in Germany and Netherlands, respectively, and 4-37% in three Polish studies, while weed seeds made up 28% [Germany & Netherlands], and 29-94% [Poland]. Corresponding figures for invertebrates were 18%, 15%, and 1-34%, respectively. In agricultural area in Germany, winter, cereal grains formed 10% and weed seeds 79%; no invertebrates was found.

In Yugoslavia invertebrates only significant from April to June, comprising 44% (by number), of which *Coleoptera* 73%, *Diptera* 20% and *Hymenoptera* 8%. In the rest of the year invertebrates comprised 0-5.5% of diet. Cultivated seeds comprised 36%-50% in July-December and 21-26% in January-June.

Seeds of *Poaceae* (excluding cereals) normally dominate among the weeds, forming 24-32% (by number) of winter and spring diet in Spain, and 8-45% in Yugoslavia all year. Seeds of *Chenopodiaceae* important in Spain (24-33%) but were not found in Yugoslavia. *Amaranthaceae* important in both Spain and Yugoslavia in winter and *Brassicaceae* also significant in Yugoslavia in spring and autumn. *Polygonaceae* and *Asteraceae* common in some periods.

Prefers small to medium sized seeds: seeds of 5 mg preferred to seeds of 1 mg, 2 mg and 37 mg.

Young. Mainly invertebrates, while weed seeds of minor importance. In farmland in Czechoslovakia, *Lepidoptera* made up 36% (mainly larvae), *Coleoptera* 30%, *Hemiptera* 12%, *Diptera* 12% and *Arachnida* 10%. In farmland in Yugoslavia, *Coleoptera* formed 55%, *Orthoptera* 33% – the large number of *Orthoptera* (*Tridactylus variegatus*) might have been due to insecticide spraying. In pine woods in eastern Germany, *Lepidoptera* (mainly larvae) made up 53% of diet, *Coleoptera* 21%, *Diptera* 12% and *Hemiptera* 8%.

Main literature:

Dornbusch, M. 1981: Die Ernährung einiger Kleinvogelarten in Kiefernjungbestockungen. – Beiträge zur Vogelkunde 27: 73-99.

Keil, W. 1973: Investigations on food of House- and Tree Sparrows in a cereal-growing area during winter. *In* Kendeigh, S.C. & Pinowsky, J. (eds): Productivity, population dynamics and systematics of granivorous birds. – Polish Scientific Publishers, Warszawa.

Kristin, A. 1988: Nahrungsansprüche der Nestlinge *Pica pica* und *Passer montanus* in den Windbrechern der Schüttinsel. – Folia Zoologica 37 (4): 343-356.

Szlivka, L. 1983: Data on the biology of the Tree Sparrow (*Passer montanus montanus*). – Larus 33-35: 141-159.

Weins, J.A. & Dyer, M.I. 1977: Assessing the potential impact of granivorous birds in ecosystems. *In* Pinowski, J. & Kendeigh, S.C. (eds): Granivorous birds in ecosystems. – Cambridge University Press, London.

Allied farmland species:

House Sparrow *Passer domesticus* (DK: Gråspurv). Very common resident or dispersive breeding bird. Significant population decline until 1980, stable since then; population estimated to c. 940,000 pairs in 1994. Listed in Danish Red Data Book, category 'decreasing'. No regional differences. Close and flexible association with man, usually occurs close to buildings. Avoids close or dense vegetation like forests, shrub and reedbeds. Except for seasonal foraging in cereal fields or other crops, avoids open terrain.

Adult diet mainly seeds from crops or weeds. Food of nestlings mainly invertebrates.

Greenfinch *Carduelis chloris*

DK: Grønirisk, D: Grünling, F: Verdier d'Europe

Distribution and phenology in Denmark:

Population. Very common breeding species. The majority of the breeding population is resident or dispersive, but some birds leave Denmark in the winter. Population estimate c. 500,000 pairs in 1993-94, increasing. Lower population densities in mid- and southern Jutland, probably as a result of fewer suitable habitats.

The Greenfinch is a common migrant and winter visitor from Fenno-Scandia and possibly from Russia. No estimate of winter population, but very common and maybe even more numerous than during breeding season. Irruption-like appearance in some years. Autumn migration peaks in late October to late November, but migratory movements may continue most of the winter. Spring migration mainly in March and April.

Habitat. Breeds mainly in cultivated land and open urban areas; gardens, parks, churchyards, hedges, also in woodland edges, mixed forest and groups of trees in farmland. Outside the breeding season may use areas away from trees, like fields, salt marshes and other open areas. Avoids dense coniferous forests.

Breeding. Eggs laid from early April to mid-July. Clutch size: 4-6. Incubation: 11-15 days. Fledging period: 14-18 days. Young of first brood fed for less than 14 days after fledging, those of second clutch probably for a longer period.

Food and feeding habitat:

Energy demand. Body weight 26-30 g. A Greenfinch in captivity had BMR ranging from 41 kJ/day in summer (weight 28.2 g) to 48.1 kJ/day in winter (weight 29.0 g). Daily consumption in captivity 5.9 g dehusked seed kernels. No information on energy requirements of young.

Estimations. An average DEE of 175 kJ/day may be assumed. When suitable, newly sown fields are available, this energy demand may probably be covered entirely on cereal grains (14-15 g fresh weight/day) or rape seeds (c. 9 g fresh weight/day).

Feeding habitat. Feeds mainly on the ground or in herbs or bushes less than 2 m above the ground. Forages in open country, fields, uncultivated areas, hedges, parks and gardens.

Food. Adults almost exclusively vegetarian. Eats a wider range of seeds than other typical finches (*Carduelinae*), but mainly *Asteraceae*, *Brassicaceae*, *Chenopodiaceae* as well as cereals. Eats seeds of fruits but generally not the flesh. Nestling diet same as adult, but invertebrates probably more important in nestling diet.

Major studies of adult food from Schleswig-Holstein (Eber 1956) and of adult and nestling diet from southern England (Newton 1967).

Adults. Feeds on fairly large seeds (main size-range 10-100 mg; range 0.1-230 mg) and a few insects. In agricultural areas mainly seeds of *Asteraceae*, *Brassicaceae*, *Chenopodiaceae*, *Rosaceae* and cereals. In southern England *Asteraceae* (mainly *Arctium*) made up 34% of diet, *Brassicaceae* 17% (*Sinapis* and *Brassica*), cereals 11%, and *Polygonaceae* 5%. In Germany, *Chenopodiaceae* (*Beta* spp.) 24%, *Asteraceae* 16% (mainly *Artemisia* spp.), *Brassicaceae* 11% (*Brassica, Sinapis, Capsella*), cereals 10%, *Rosaceae* 10% (rose hips) and *Caprifoliaceae* 5%. In garden areas in southern England, *Taxaceae* 55%, *Rosaceae* 23% (hips) and *Sorbus* 14%.

In spring, fresh sown cereals and beets and a number of weeds were important. In southern England, various *Brassicaceae* and cereals formed 80% of diet in summer, but cereals otherwise especially important in autumn. *Arctium* main food in winter, while in Schleswig-Holstein, *Symphoricarpos* is favoured where available, though main item is seeds of beet.

Over whole year invertebrates (chiefly *Lepidoptera* larvae, and a few *Aphidoidea*) contributed on average 1% to Greenfinch diet, with peak occurrence (6%) in May, although this may include food carried to nestlings.

Young. Diet of nestlings similar to that of adults in breeding season, although it probably contains more invertebrates. Nestling diet consists of *Brassicaceae* 24 %, cereals 21%, *Asteraceae* 22%, *Alnus* 11%, *Euphorbiaceae* 11% and invertebrates 6% (almost entirely *Aphidoidea* and *Lepidoptera* larvae). Invertebrates form the highest proportion of nestling diet in May-June (11%), decreasing to 3% in July-August.

Invertebrates disappear from nestling diet around day 7-11. Other less extensive studies mention adult *Diptera* and *Araneae* in nestling diet.

Main literature:

Eber, G. 1956: Vergleichende Untersuchungen über die Ernährung einiger Finkenvögel. – Biol. Abh. 13/14: 1-60.

Newton, I. 1967: The adaptive radiation and feeding ecology of some British Finches. – Ibis 109: 49-53.

Linnet *Carduelis cannabina*

DK: Tornirisk, D: Bluthänfling, F: Linotte mélodieuse

Distribution and phenology in Denmark:

Population. Very common, mostly migratory, breeding bird. A minor part of the population stays in Denmark in winter. Breeding population estimated to 280,000 pairs. Population reduced by almost two thirds from mid-1970s to 1982, but has been steadily recovering since then. No regional differences in population density.

Common migrant from Scandinavia in autumn and spring (mid-August to mid-November and mid-March to May). Autumn migration culminates in the beginning of October and spring migration peaks in early April. Largest numbers of migrants in the eastern part of DK; a small proportion of the migrants winter in Denmark.

The Linnet is listed in the Danish Red Data Book in the category 'decreasing'.

Habitat. Breeds mainly in open farmland with hedges and low trees, uncultivated areas and young plantations. Also common in parks and gardens but avoids dense forests. Certainly favoured by set-aside regulations. In winter, switches to more open habitats in farmland and coastal areas such as salt marshes.

Breeding. Eggs laid from late April to end of July; the latest young leave nest in mid-August. Clutch size: 4-6. Incubation 11-13 days, fledging period 10-17 days; young are independent c. 14 days later. Normally 2 broods, but 3 frequently occur.

Food and feeding habitat:

Energy demand. Average body weight 17-21 g. A captive Linnet (16.9 g) had a BMR of 29.3 kJ/day. Captive birds on average eat 2.6-5.2 g (fresh weight) of seed kernels per day. Growth rate of nestlings c. 1.3 g/day (fledging period 15 days).

Estimations. Prefers small seeds, e.g. rape, to cereal grains (cf. below). A DEE of 115-120 kJ/day may be covered by a consumption of 6-7 g rape seed (fresh weight) per day.

Feeding habitat. Feeds on or close to the ground, in bushes and suitable herbs less than 1 m above ground, chiefly in farmland (especially uncultivated parts) and gardens. Gregarious outside breeding season.

Food. Feeds almost exclusively on small to medium sized seeds and a few invertebrates. Importance of invertebrates in nestling diet is unclear.

Major studies of adult diet from Schleswig-Holstein (Eber 1956) and southern England (Newton 1967). Main nestling food studies from England (Newton 1967), and from Germany (Hachfeld 1979, Dornbusch 1981).

Adults. Feeds almost exclusively on seeds (main size-range 1-10 mg; range 0.05-50 mg) throughout year; mainly *Caryophyllaceae*, *Polygonaceae*, *Brassicaceae*, and *Asteraceae*. Milky seeds preferred. Invertebrates (*Lepidoptera*) appears incidentally in adult diet according to some older studies. Only rarely eats buds or seeds of fleshy fruits. Rather unselective; in England took seeds of 25 of the 30 most common weeds in agricultural area, but no cereal grains though common in study area: seeds of *Brassicaceae* (*Sinapis*) made up 33%, *Polygonum* 14%, *Asteraceae* 13% (thistles, *Taraxacum*), *Chenopodium* 11%, and *Caryophyllaceae* 9% (*Cerastium, Stellaria*). In Germany *Brassicaceae* also predominant food (28%, mainly *Brassica*), and – in general – the studies confirm the findings from England. However, cereal grain is the most frequent food item in April and in autumn in a German study.

Over the full annual cycle, seeds from available *Brassicaceae* seem to be predominant food.

Young. In central Germany, nestling food contained mainly seeds of *Taraxacum*, *Capsella* and other *Brassicaceae*, as well as *Spergula* and *Rumex*; principal invertebrates were *Aphidoidea* and *Lepidoptera* (larvae). In another German study, no invertebrates were found; nestlings were fed almost exclusively *Tussilago*, *Brassica* and grass seeds. In the Swiss Alps no insects were found in nestling diet. In England, seeds of *Asteraceae* (chiefly *Taraxacum, Cynareae, Hypochoeris*) made up 34% (by volume), *Brassicaceae* 17% (mainly *Sinapis*), *Caryophyllaceae* 11% (thistles, *Stellaria*), and *Ulmus* 8%.

Insects occurred only in 2 of 62 broods: *Aphidoidea* formed 15% of diet in first 9 days in one brood. In earlier studies in England and western Russia, insects predominant food, forming 100% and 86% respectively – mainly *Coleoptera*, *Diptera* (adults and larvae), *Lepidoptera*, and *Ephemeroptera* (larvae). Modern studies conclude that invertebrate proportion is much overestimated in earlier studies.

Main literature:

Dornbusch; M. 1981: Die Ernährung einiger Kleinvogelarten in Kiefernjungbestockungen. – Beitr. Vogelkd. 27: 73-99.

Eber, G. 1956: Vergleichende Untersuchungen über die Ernährung einiger Finkenvögel. – Biol. Abh. 13/14: 1-60.

Handtke, K & Witsack, W. 1972: Beobachtungen an einer Brutkolonie des Bluthänflings bei Halberstadt 1959-1962. – Naturkdl. Mus. Heineanum 7: 21-41.

Newton, I. 1967: The adaptive radiation and feeding ecology of some British Finches. – Ibis 109: 49-53.

Allied farmland species:

Goldfinch *Carduelis carduelis* (DK: Stillits). Common, mostly resident, breeding species. Danish breeding population: c. 30,000 pairs in 1993-94, increasing during recent years (since 1990), but probably after having suffered long-term decline. Occurs most frequently in the eastern and southern parts of Denmark. Common migrant and winter visitor. Habitat is open country close to woods, parks or old gardens; also in uncultivated industrial areas and certainly favours set-aside. Food is small seeds of same size-range as for the Linnet; mainly *Asteraceae*. Usually only few invertebrates, but *Aphidoidea* up to 25% of diet in some weeks during April-July.

Chaffinch *Fringilla coelebs*

DK: Bogfinke, D: Buchfink, F: Pinson des arbres

Distribution and phenology in Denmark:

Population. Very common breeding bird. Major part of the population is migratory, but residents are joined by winter visitors from Fenno-Scandia and Balticum. Population estimate 1.7 mill. breeding pairs, increasing. No regional differences in breeding densities. No estimate of wintering population – probably variable, reflecting food abundance. Very common on migration in spring and autumn. Spring migration culminates late March when up to 200,000 individuals have been recorded on a single day. Autumn migration peaks between late September and mid-October with daily maxima up to 300,000 individuals.

Habitat. All types of woods, parks, large gardens, hedgerows or any other place with trees. Outside breeding season, mainly woodland (often near edges) and open farmland.

Breeding. Eggs laid from mid-April to early July. Clutch size: 4-5. Incubates for c. 13 days. Average fledging period c. 14 days; fed by parents for 3 weeks after fledging.

Food and feeding habitat:

Energy demand. Body weight: 19-25 g. Daily consumption in captivity: 3.9 g of de-husked kernels/day. Maximum daily intake in wild (one study) 7 g fresh weight, 138 kJ. Over the year, BMR range 32.2-41.6 kJ/day. A nestling in the wild received 4.2 g (81.9 kJ) at 9 days of age and 3.7 g on day 12.

Feeding habitat. Feeds mainly on the ground outside breeding season, but feeds in trees in spring and summer when taking invertebrates. Forages in a wide range of habitats – cultivated land, woods, parks and gardens; occurs in farmland all year round. Gardens and farmyards are particularly important in winter, and woods only favoured in years when suitable seeds (beech mast) are plentiful.

Food. Has a wide-ranging and very varied diet consisting mainly of seeds and other plant material; in breeding season mainly invertebrates. Young fed entirely on invertebrates.

Major studies of adult diet from Britain (Newton 1967 & 1972) and Schleswig-Holstein (Eber 1956); nestling diet also extensively studied in Russia (St Petersburg area, Prokofieva 1963 cited by Cramp 1994).

Adults. Except for breeding season, almost exclusively plant material, especially seeds from a wide range of weeds and cereals – often collected from beneath standing crop. Seeds taken range in weight from 0.1 to 230 mg. In southern England seeds formed 85% of diet and invertebrates 15% from mid-July to September. From October to mid-April, invertebrates only made up 3-6%. Outside the breeding season (i.e. mid-July to mid-April), cereal grains predominant (46% by number), followed by weed seeds (*Chenopodiaceae* 10%, *Caryophyllaceae* 7%, *Brassicaceae* 6%) and – less frequent – grasses, beech and others. Invertebrates mainly *Coleoptera* (5%), *Lepidoptera*, *Aphidoidea* and *Diptera* (2% each). The Chaffinch is very fond of grains picked from stubble fields, and cereals ar most important component from July to September. *Brassicaceae* more frequent from October to mid-April than remainder of the year.

In all-year-studies from Schleswig-Holstein (based on feeding observations which include food that might be fed to nestlings), cereal grains formed 49% of diet, beech mast 28%, seeds of *Asteraceae* 5%, *Brassicaceae* 4%, *Polygonaceae* 4%; invertebrates formed 9%.

Invertebrate proportion (by number) of diet varied from 0.5-2% (October-February) to 10-11% (March and April) and 32-76% (May-September). Invertebrates found included *Collembola*, *Coccoidea*, *Aphidoidea*, *Coleoptera*, *Hymenoptera*, *Diptera* (larvae and adults), and *Lepidoptera*.

In southern England, marked differences were found between single, roosting 'resident' birds and communally roosting 'immigrants'. The latter only took seeds from cereals, *Polygonum* spp., *Brassicaceae* and *Chenopodium* whereas 'residents' ate seeds from 16 plant species and more invertebrates as well.

Young. In St Petersburg area 90.5% invertebrates and 9.5% plant material. Invertebrates were *Coleoptera* 21%, *Diptera* 14% (adults and larvae), *Lepidoptera* 12% (virtually all larvae), *Hymenoptera* 9% (mostly larvae), *Tricoptera* 7% (adults and larvae), *Araneae* 7%, *Ephemeroptera* 6%. In a less extensive study in England *Aphidoidea, Lepidoptera* and *Coleoptera* accounted for 98% of diet.

Main literature:

Cramp, S. (ed.) 1994: The Birds of the Western Palearctic, vol. VIII. – Oxford University Press, Oxford.

Eber, G. 1956: Vergleichende Untersuchungen über die Ernährung einiger Finkenvögel. – Biol. Abh. 13/14: 1-60.

Newton, I. 1967: The adaptive radiation and feeding ecology of some British Finches. – Ibis 109: 49-53.

Allied farmland species:

Brambling *Fringilla montifringilla* (DK: Kvækerfinke). Very common migrant and winter visitor. Very rare, irregular breeder. No estimates on winter population in normal winters, but common; several million individuals in winters when beech nuts are plentiful. Very common on migration with daily maxima up to 200,000 individuals. In winter and on migration forages on agricultural land and in beech woods, feeding mainly on cereal grains and beech nuts.

Corn Bunting *Miliaria calandra*

DK: Bomlærke (Kornværling), D: Grauammer, F: Bruant proyer

Distribution and phenology in Denmark:

Population. Locally common, resident or dispersive breeding species. Fairly high population densities in West Jutland, patchily distributed elsewhere. Population estimate c. 30,000 breeding pairs in 1993-94, decreasing. About 30% reduction in breeding range from 1971-74 to 1995; size of Danish population more than halved since 1980.

Flocks outside breeding season, especially in periods of snow-cover. Winter flocks may reach 1000 individuals in W and N Jutland and a few hundreds in the rest of the country.

Corn Bunting is listed in Danish Red Data Book in the category 'decreasing'.

Habitat. Breeds almost exclusively in farmland – avoids forests and wetlands. Apart from a need for perches to overlook territory and to serve as song-post (low trees, bushes, wires, fences), is at home in fully open country and has minimal demands for cover. Seems to prefer areas with high diversity of crops; in UK a strong association with barley fields is often claimed. Occupy specific areas with high density, while other seemingly suitable sites nearby are left vacant or may be abandoned after years of successful breeding. This tendency is still unexplained. In winter prefers stubble – mainly weedy stubble. Also in grassland and winter cereals.

Breeding. Eggs laid from early May to end of July. Clutch size: 4-6. Incubation: 11-14 days. Fledging period: 9-13 days, often leave nest before fully fledged. Young fed by parents for c. 2 weeks after leaving nest.

Food and feeding habitat:

Energy demand. Body weight: 41-56 g. No information on daily consumption of adults or nestlings.

Feeding habitat. Feeds almost entirely on ground in arable fields and short rough grass – sometimes in damp meadows. Occasionally in bushes and trees when searching for invertebrates. In autumn often in stubble fields and where root crops have been harvested. In harsh winters also at farmyards and grain deposits.

Food. Mainly seeds of *Poaceae* (often cereals), *Polygonaceae* and *Brassicaceae*. Also other kinds of plant material and invertebrates (latter especially during breeding season). Nestling diet mainly invertebrates, but also seeds.

Main studies of adult diet from Scotland (Goodbody 1955). Major studies on nestling diet in Germany, Switzerland and Scotland (Gliemann 1973, Hegelbach 1980, Hartley & Quicke 1994).

Adults. In NE Scotland, March-June, took mainly seeds (61% cereals) but also invertebrates (small *Coleoptera* 32%). No beetles were taken in March but comprised 79% of diet in June. In Schleswig-Holstein wheat grains important when available but later in autumn birds preferred seeds of weeds and root crops. Takes much grain during sowing and may uproot cereal seedlings.

An older study from England mention seeds of herbs as most important food item followed by insects and cereals.

Young. In Germany, *Lepidoptera* 42% (mainly larvae), *Orthoptera* 14% (mainly *Tettigoniidae* and *Acrididae*), *Coleoptera* 10%, *Dermaptera* 9%; cereal grains comprised 16% of diet (by number). In Scotland, *Opiliones* main food item followed by *Diptera* (*Tipulidae*, *Syrphidae*),

Coleoptera (adults), *Lepidoptera* (larvae) and *Orthoptera* (*Acrididae*); seeds of any kind were rare. Another study from Scotland mention pulp of unripe grains as major food item, but probably suboptimal compared with a diet based on insects. Nestling diet in Switzerland mainly *Diptera* and *Orthoptera* – few other invertebrates and cereal grains.

Main literature:

Gliemann, L. 1973: Die Grauammer. – Neue Brehm-Bücherei, Wittenberg Lutherstadt.

Goodbody, I.M. 1955: Field notes on the Corn Bunting: habitat and distribution in Aberdeenshire. – Scottish Nature 67: 90-97

Hartley, I.R. & Quicke, D.L.J. 1994: The diet of nestling Corn Buntings on North Uist – insects not grain. – Scottish Birds 17: 169-170.

Hegelbach, J. 1980: Die Nahrung von Grauammer-Nestlingen und deren Abhängigkeiten. – Ornitologische Beobachter 77: 60.

Yellowhammer *Emberiza citrinella*

DK: Gulspurv, D: Goldammer, F: Bruant jaune

Distribution and phenology in Denmark:

Population. Very common, mostly resident, breeding species. A minor part of the population leaves DK in winter, but the residents are joined by winter visitors from Fenno-Scandia. Population estimate 570,000 breeding pairs. Population size fairly stable, although a small decline may have occurred since the late 1980s. No obvious regional differences, but population densities may well be somewhat lower on the poorer soils in the western parts of DK.

Habitat. Breeds mainly in farmland, especially where interspersed with hedgerows, coverts etc. Also occurs in woodland, in clearings and younger (mainly coniferous) stands. Flocks in winter, when it will also make for human settlements in farmland and woods.

Breeding. Eggs laid from end of April to late July. Clutch size: 3-5. Incubates for 12-14 days. Nestling period 10-13 days; young may leave nest before fully fledged. Young still fed for 8-14 days after fledging.

Food and feeding habitat:

Energy demand. Body weight normally 27-30 g. BMR of captive birds (mean weight 26.9 g) averaged 39.6 kJ/day. No information about daily consumption. Growth rate of nestlings 2.1 - 2.4 g/day.

Estimations. Assuming a DEE of 160 kJ/day, Yellowhammers may consume 13-14 g (fresh weight) of cereal grain per day. Diet may consist entirely of grains when suitable fields (with seed or spillage) are available for feeding (cf. below).

Feeding habitat. Feeds almost exclusively on ground, avoids areas with dense vegetation. In farmland feeds in fields, along roads, farm buildings etc.; easy access to open ground or short vegetation probably essential. No obvious crop preferences during the breeding season, but seeks out newly harvested fields in autumn and stubble fields in winter, together with artificial food sources (dungheaps, stored grain, wildlife feeding sites).

Food. Seeds of cereals and grasses most important food items, especially outside the breeding season. Invertebrates form an important part of the diet from April onwards, and young fed almost exclusively on animal food items.

Major studies of adult food from Schleswig-Holstein (Eber 1956) and England (Prys-Jones 1977 cited in Cramp 1994). Nestling food thoroughly studied in Mecklenburg (Bösenberg 1958).

Adults. Outside the breeding season predominantly herbivorous (seeds), animal food items only taken in sizeable amounts April-September (October). In Schleswig-Holstein, 11% of all feeding observations over year concerned invertebrates, ranging from 1% in February to 53% in June-August.

Seeds of *Poaceae* (grasses and cereals) dominate throughout year (84-100% of all seeds taken [England]). All cereals are eaten, probably in approximate accordance with their availability, together with seeds of *Lolium, Festuca* and *Poa*. Cereals make up 73% of the vegetable food over year in Schleswig-Holstein, 51-99% in England (the proportion being lowest in January-February). In an older English study, however, cereal grains made up just 14% of vegetable food over year. In tests, captive Yellowhammers show a strong preference for *Poaceae* seeds, only accepting seeds of dicotyledonous herbs if very hungry.

Herb seeds eaten are mainly *Urticaceae (Urtica), Chenopodiaceae (Chenopodium), Polygonaceae (Rumex, Polygonum)* and *Fabaceae (Vicia, Trifolium)* [England], but also *Cerastium* and *Taraxacum* [Schleswig-Holstein]. Generally seems to prefer seeds rich in starch and avoid oily seeds; seeds of *Brassicaceae* – although often very common in Yellowhammer habitats – seem to be completely ignored.

Detailed quantitative information about animal food items only available from Russia (Moscow region) and Ukraine (3 studies). In Moscow region, invertebrates only taken in any numbers from April to August, making up a maximum of 70% of the food items in June. Adult beetles (*Coleoptera*, 84% of which *Curculionidae*) completely dominating, supplemented with a few *Lepidoptera* larvae and *Tipulidae*. In Ukraine, *Coleoptera* (*Curculionidae, Staphylinidae*) also most common prey (except in autumn), followed by *Lepidoptera* (mostly

larvae), *Orthoptera* (*Acrididae*, notably in autumn), *Hymenoptera* and *Hemiptera*.

Young. In Mecklenburg, 29% of food items *Lepidoptera* (*Noctuidae*, *Nymphalidae* and *Geometridae*, mostly larvae but one-third adults), *Coleoptera* 22% (*Chrysomelidae*, *Curculionidae*, *Elateridae*, about 70% adults), *Diptera* 11% (*Asilidae* most common, 72% adults), *Dermaptera* 6% (*Forficula auricularia*), *Hymenoptera* 5% (mainly *Tenthredinidae* larvae), *Araneidae* 5%, *Orthoptera* 4% (mainly *Acrididae*). Remainder included woodlice *Armadillidium* and small snails, together with some seeds (almost 14%, mainly cereal grains, but also sunflower *Helianthus*); the proportion of vegetable food varied between nests.

Other, less extensive studies do not mention seeds as part of nestling diet. In Schleswig-Holstein, young fed *Orthoptera*, adult and larval *Lepidoptera*, *Diptera*, and snails.

Main literature:

Bösenberg, K. 1958: Zur Nestlingsnahrung der Goldammer. – Falke 5: 58-61.

Cramp, S. (ed.) 1994: The Birds of the Western Palearctic, vol. VIII. – Oxford University Press, Oxford.

Eber, G. 1956: Vergleichende Untersuchungen über die Ernährung einiger Finkenvögel. – Biologische Abhandlungen 13-14: 1-60.

XX: Very important at one or more life stages X: Regularly makes up at least 5-10% of diet o: Occurs, but less frequently	Whooper Swan	Pink-footed Goose	Grey Partridge	Quail	Pheasant	Lapwing	Black-headed Gull	Woodpigeon	Little Owl	Skylark
Cereals, grain	X	XX	XX	X	XX		X	XX		XX
Cereals, leaves	X	X	XX		X			o		XX
Clover a.o. pulses *Fabaceae*, leaves	o	o	X		X		o	X		
Rape, seed				X				X		
Rape, leaves		o	o					XX		
Other dicotyledonous crops, leaves		o	o					X		X
Beets, seed										
Peas, seed								X		
Potatoes, tubers	X	o			XX			o		
Apples					o					
Cherries					o		X	o		
Black & Red currant *Ribes*					o					
Strawberries										
Grasses, seed	X	o	XX	XX	X	o		o		X
Grasses, leaves	XX	XX	XX	o	X	o				o
Dicotyledonous weeds, seed		o	XX	XX	X	o	o	o		XX
Dicotyledonous weeds, leaves	X	o		o	X		o	XX		X
Springtails *Collembola*										o
Grasshoppers *Acrididae & Tettigoniidae*			o	o	o	X	o		X	XX
Earwigs *Dermaptera*			o	o	o	X	o		X	o
Bugs *Heteroptera & Auchenorrhyncha*			o	X	X					o
Aphids *Aphidoidea*			X		X					o
Butterflies & moths *Lepidoptera*, adults						o	o		o	X
Butterflies & moths *Lepidoptera*, larvae			X		X	X	o	o	o	X
Diptera, adults			o		o	o	o		o	XX
Diptera, larvae			X		X	XX	X		o	XX
Hymenoptera, adults			X	o			o		o	XX
Hymenoptera, larvae			X	o	XX		o			o
Beetles *Coleoptera*, adults			X	X	o	XX	X	o	XX	XX
Beetles *Coleoptera*, larvae			XX	X	o	o	X			o
Snails & slugs *Gastropoda*			o	o	o	X	o	o	o	o
Earthworms *Oligochaeta*			o		X	XX	XX	o	XX	o
Woodlice *Isopoda*						o				o
Millipedes *Diplopoda*					o		o		o	o
Centipedes *Chilopoda*							o		o	o
Spiders *Araneae*			o	o	o	o	o	o	o	X
Harvestmen *Opiliones*						o				o

XX: Very important at one or more life stages X: Regularly makes up at least 5-10% of diet o: Occurs, but less frequently	Swallow	Meadow Pipit	White Wagtail	Dunnock	Fieldfare	Whitethroat	Starling	Hooded and Carrion Crow	Rook	Tree Sparrow
Cereals, grain				o			XX	XX	XX	XX
Cereals, leaves										
Clover a.o. pulses *Fabaceae*, leaves									o	
Rape, seed				o						
Rape, leaves										
Other dicotyledonous crops, leaves		o		o						
Beets, seed										
Peas, seed						o	o		o	
Potatoes, tubers								X	X	
Apples					X		X	o	o	
Cherries					o	X	X	o	o	o
Black & Red currant *Ribes*					o	X				o
Strawberries					o			o	o	
Grasses, seed		XX		XX					o	XX
Grasses, leaves					o					o
Dicotyledonous weeds, seed		X		XX		o		o	o	XX
Dicotyledonous weeds, leaves								o		
Springtails *Collembola*		o		o					o	
Grasshoppers *Acrididae & Tettigoniidae*	o	o	o	o	o	X	o	X	X	o
Earwigs *Dermaptera*	o	o	o	o		o	o	o	o	
Bugs *Heteroptera*	X	X	o	o	o	XX	o	o	o	X
Aphids *Aphidoidea*	X	o	o			o	o			
Butterflies & moths *Lepidoptera*, adults	o	XX	X	o		XX	o	o	X	X
Butterflies & moths *Lepidoptera*, larvae	o	X	o	X	o	XX	XX	o	o	XX
Diptera, adults	XX	XX	XX	XX	o	X	XX	X	X	X
Diptera, larvae		X	o		o	o	XX	o	o	
Hymenoptera, adults	XX	XX	X	X	X	XX	X	o	o	X
Hymenoptera, larvae	o		o	o	o	o	o	o	o	
Beetles *Coleoptera*, adults	XX	XX	X	XX	X	XX	XX	XX	XX	XX
Beetles *Coleoptera*, larvae			o		X	o	XX	o	X	o
Snails & slugs *Gastropoda*		XX	o	X	o	X	o	o	o	o
Earthworms *Oligochaeta*		o	o	X	XX		X	XX	XX	o
Woodlice *Isopoda*		o					o	o	o	
Millipedes *Diplopoda*					o	o	o	o	o	
Centipedes *Chilopoda*		o					o	o	o	
Spiders *Araneae*	o	X	o	XX	o	X	o	o	o	o
Harvestmen *Opilionès*		X		XX	o	o	o	X	o	

XX: Very important at one or more life stages X: Regularly makes up at least 5-10% of diet o: Occurs, but less frequently	Greenfinch	Linnet	Chaffinch	Corn Bunting	Yellowhammer					
Cereals, grain	XX	X	XX	XX	XX					
Cereals, leaves										
Clover a.o. pulses *Fabaceae*, leaves			o							
Rape, seed	X	XX	o	o						
Rape, leaves										
Other dicotyledonous crops, leaves			o							
Beets, seed	XX		o							
Peas, seed										
Potatoes, tubers										
Apples	o		o							
Cherries	o		o							
Black & Red currant *Ribes*			o							
Strawberries	o		o							
Grasses, seed	o	X	XX	X	XX					
Grasses, leaves										
Dicotyledonous weeds, seed	XX	XX	XX		o					
Dicotyledonous weeds, leaves										
Springtails *Collembola*			o		o					
Grasshoppers *Acrididae & Tettigoniidae*		o	o	XX	X					
Earwigs *Dermaptera*			o	X	o					
Bugs *Heteroptera*	o	o	o	o	o					
Aphids *Aphidoidea*	o	o	o		o					
Butterflies & moths *Lepidoptera*, adults	o	o	o	o	X					
Butterflies & moths *Lepidoptera*, larvae	o	o	X	XX	XX					
Diptera, adults	o	o	XX	XX	X					
Diptera, larvae		o			o					
Hymenoptera, adults	o	o	X		o					
Hymenoptera, larvae					o					
Beetles *Coleoptera*, adults	o	o	XX	X	XX					
Beetles *Coleoptera*, larvae	o			o	o					
Snails & slugs *Gastropoda*		o	o	o	o					
Earthworms *Oligochaeta*		o	o	o	o					
Woodlice *Isopoda*					o					
Millipedes *Diplopoda*			o	o	o					
Centipedes *Chilopoda*			o							
Spiders *Araneae*	o	o	X	o	o					
Harvestmen *Opiliones*				XX						

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