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Food resources and foraging success of Curlews *Numenius arquata* in different farmland habitats

Åke Berg

Berg, Å., Department of Wildlife Ecology, The Swedish University of Agricultural Sciences, Box 7002 S-750 07 Uppsala

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The availability of food for breeding Curlews *Numenius arquata* and their foraging success were studied in different farmland habitats at a study site in central Sweden in the years 1987–1991. Earthworms were found to be the most important food organisms during the pre-breeding period, when a significantly higher number of earthworms were caught per minute in sown grassland than in tillage. The biomass of earthworms did not differ between these habitats, so the greater availability of earthworms in sown grass was probably due to their intact burrow systems, which made them easier to catch than in tillage, where their burrow systems were destroyed each year during cultivation. Surface-living invertebrates played a minor role as food items during the pre-breeding period, especially in terms of biomass. Significantly fewer earthworms were caught in the breeding period than in the pre-breeding period. In the breeding period the shorter-billed males caught significantly more surface-living invertebrates than the longer-billed females in tillage and meadow, whereas the longer-billed females were able to catch more earthworms than the males. The availability of surface-living invertebrates to Curlews was probably affected by both invertebrate density and vegetation structure. A large number of surface-living invertebrates were caught per minute in tillage, where their biomass was relatively low and the vegetation sparse. In sown grass (with relatively high and dense vegetation), the biomass of invertebrates was high, but the number caught by Curlews per minute low, despite many foraging pecks and probes. The greater availability (not larger biomass) of food items in grasslands and flooded tillage than in dry tillage early in the season is probably a factor responsible for the higher densities of Curlews in these habitats than in modern farmland, where dry tillage predominates.

1. Introduction

Swedish farmland is a mosaic of different habitats, but intensively managed tillage is by far the dominant habitat in large parts of Sweden (Statistiska Centralbyrån 1990). Less intensively managed sown grasslands (leys and sown pasture) are relatively common in some areas, but have decreased markedly during recent decades when farms have specialized in cereal crops (Gerell 1988). Meadows are uncommon in farmland today and have decreased in area since the 19th century. Meadows that are not reclaimed are usually abandoned, which leads to a high and dense vegetation unsuitable for many meadow-living birds (Alexandersson and Eriksson 1988).

Many farmland birds in Sweden are found only in grazed or cut meadows, or occur in higher densities in meadows than in other habitats (Alexandersson & Eriksson 1988). Curlews *Numenius arquata* have their highest densities on meadows (Pettersson 1988), but they also inhabit farmland with sown grass, especially along rivers and lakes, while they are uncommon in areas of dry tillage (Berg & Sjöberg in press, Pettersson 1988). A possible explanation of this variation in Curlew density is differences between habitats in the availability of food for adults, but food resources for chicks and potential nest sites might also be limiting factors. Curlews are known to be omnivorous, mainly feeding on different kinds of invertebrates (Cramp and Simmons 1983). Stomach analyses have shown that earthworms and a variety of insects are important food items in non-coastal areas (Burton 1974, Ryabow & Mosalowa 1967, Kistyakivski 1957).

Curlews on Swedish farmland have been shown to select territories with a high proportion of grassland close to water (Berg in press). These grasslands have been shown to be preferred nest sites with a higher hatching success than tillage (Berg 1992). Curlews breeding in farmland spent a disproportionate amount of their foraging time in grassland during the pre-breeding period. These preferences were not, however, found during the incubation period, when all habitats were used about as much as expected (Berg in press). The aim of this study was to evaluate whether food is an important determinant of habitat exploitation in Curlews by investigating the foraging success of adult Curlews in different farmland habitats. The biomass of earthworms and surface-living invertebrates in these habitats was quantified. Differences in food availability and foraging success between pre-breeding and breeding periods, habitats and sexes are discussed.

2. Study sites and methods

2.1. Study sites

Most (86%) of the 169 observations of foraging Curlews, and all the invertebrate and earthworm samplings were done at a mixed farmland site (approximately 59°57′N, 16°17′E), consisting of 55.5 km² farmland around the village of Västerfärnebo in the province of Västmanland. Dry tillage was dominant (62.6%), but there were large areas of seasonally flooded tilled fields (9.1% of the total farmland area in years with maximum flooding), remnants of old seasonally flooded meadows (12.9%) and relatively large areas of sown pasture and ley (12.5%). The remaining 2.9% consisted of scrub. The study site was a mosaic of these habitats and most Curlew territories (mean size 45.2 ha) included several relatively small patches of grassland surrounded by tilled fields (Berg in press). Some complementary foraging studies (14%) were done at a study site (approximately 59°56′N, 17°45′E) close to Uppsala in the province of Uppland.

2.2. Sampling periods and habitat changes

Studies of foraging Curlews and sampling of surface-living invertebrates were made both during the pre-breeding period (9 April – 5 May) and during the breeding period (6 May – 9 June). Earthworms were sampled only during the breeding period. The tillage was mainly ploughed in autumn and sown in spring, when the Curlews incubated, and spring farming was mostly finished by 20 May. The sown pastures were grazed from the beginning of May (incubation phase) and some leys from early June (during chick rearing). Meadows and some tilled fields were flooded during the end of April and the first week of May, but the time and amount of flooding varied between years. These fields then started to dry up, first the tilled fields and then the meadows which were situated closest to the river.

2.3. Invertebrate sampling

Surface-living invertebrates were sampled with pitfall traps from 28 April to 5 May and from 25 May to 1 June in 1988. Traps were put out in tillage and sown grass during both periods, in meadows during the breeding period (flooded in pre-breeding period) and in flooded tillage during the pre-breeding period (dry during breeding period). The traps were filled with water plus some detergent and removed after 7 days. Invertebrates longer than 3 mm (considered to be profitable prey for Curlews) were put in alcohol (smaller items discarded) and later dried for about 15 hours at 60°C to constant weight to obtain an estimate of the biomass of invertebrates in different habitats. Three ordinary pitfall traps, consisting of two 850 ml plastic containers buried flush with the soil surface 20 cm apart, were set out at random in a field in each habitat in eight Curlew territories. A piece of wood 20 cm long and 4.5 cm high was placed along the ground between the two containers, forming a barrier that deflected the invertebrates into either container (similar method to that of Wallin 1985). In addition, three pitfall traps of the same model were set inside a metal barrier (circle 60 cm in diameter and 30 cm high) in the same fields. The barriers were covered with mosquito nets and forced about 10 cm into the ground, to prevent invertebrate ingress and egress from the enclosed area. These traps caught invertebrates from an area of 0.28 m^2, which made it possible to obtain density estimates of invertebrates in the different habitats. The ordinary pitfall traps caught invertebrates from an area of unknown size, and the number of invertebrates caught depended on invertebrate density, but was probably also influenced by differences in mobility between invertebrate groups and differences in invertebrate mobility between habitats (Westerberg 1977).

Earthworms were sorted by hand from soil samples (25 × 25 × 25 cm) taken in three habitats; dry tillage, flooded tillage and sown grass between 8 May and 15 May in 1988. Samples were not taken in meadows because these were still flooded at that time. Five soil samples were taken in each habitat in each of the eight territories, giving a total of 120 soil samples. The earthworms were put in alcohol and later dried for about 15 hours at 60°C to constant weight.

2.4. Studies of foraging Curlews

Foraging Curlews were studied from a relatively short distance (25–100 m) with telescopes in different habitats: tillage, flooded tillage, fallow fields, sown grass and meadows. Observations were made on 9 April – 5 May in all habitats (during the pre-breeding period and before the start of spring farming operations), and in tillage, sown grass and meadows on 6 May – 10 June (during the breeding period and when spring farming operations were in progress). Observations of foraging birds were made within territories when Curlews could be readily watched during the breeding seasons in 1987–1991. The birds (separate data for males and females) were followed for a minimum of three minutes of foraging (mean observation time = 5 min and 9 s). Periods of activities other than foraging were excluded from the data analyses. Every step, peck and probe with the bill was noted. Successful pecks and probes were noted (swallowing action seen) and the prey was categorized as earthworms or others (probably including small earthworms).

Foraging success was defined as the number of prey caught per minute, which seemed appropriate since foraging techniques varied between habitats. In arable fields Curlews seemed to locate their prey (mainly surface-living invertebrates) by sight while walking rapidly around and often caught a prey item when they tried. In grassland Curlews walked slowly and were usually probing or pecking when looking for prey. Therefore foraging success was not defined as the number of captures per attempt, since this would reflect differences in foraging techniques and not differences in food availability and foraging success between habitats.

Differences in foraging success between sexes were related to differences in morphology. The 76 Curlews whose measurements were used in the test for morphological differences between sexes (weight at end of incubation period and bill length) were marked with colour rings on the legs and could be sexed after observations of their behaviour. These Curlews were caught on the nest during the second half of incubation. Bill length was measured in a straight line from the base of the culmen to the tip. Of the studied birds 49% were colour marked; unmarked birds were sexed by bill length.

2.5. Statistics

Several multisample comparisons were made in this study and the Kruskal and Wallis test was used, since the data were not normally distributed. When significant differences were found, a Tukey-type multiple comparison test (Zar 1984) was used to determine between which of the samples significant differences occurred.

3. Results

3.1. Morphological differences between sexes

Bill length and weight were measured in order to relate morphological differences between the sexes to differences in foraging success. Females were significantly heavier than males (Table 1) and their bill lengths significantly longer (Table 1). There was, however, overlapping both in bill length (males 99–129 mm, females 121–157 mm) and in weight at end of the incubation period (males 609–780 g and females 710–955 g). Discriminant analyses showed that bill length was the best predictor of sex (96.0% of all Curlews correctly classified), but weight was also a good predictor of sex (90.5% correctly classified). When both variables were included there was also a significant difference between sexes (discriminant analysis, $F = 135.7$, $P < 0.001$), but bill length and weight together (95.9% correctly classified) did not predict sex better than bill length alone.

3.2. Foraging success and food availability in the pre-breeding period

Foraging success (number of earthworms or other prey caught per minute) did not differ significantly between sexes in the pre-breeding period, when compared within the five studied habitats (Mann-Whitney U-tests, P-values > 0.1, except for sown grass). There was a tendency for males to catch more other prey per minute than females in sown grass, but this difference was not statistically significant (Mann-Whitney U-test, $U = 108.5$, $P = 0.068$). Males and females were therefore pooled in analysing foraging success in different habitats (Fig. 1). These analyses showed that the number of earthworms caught per minute differed significantly between habitats (Kruskal Wallis test, $H = 12.8$, $P < 0.05$), and this was due to significantly higher foraging success in sown grass than tillage (Tukey-type test, $Q = 3.1$, $P < 0.05$). The number of other prey items caught per minute did not differ between habitats ($H = 4.3$, $P > 0.3$).

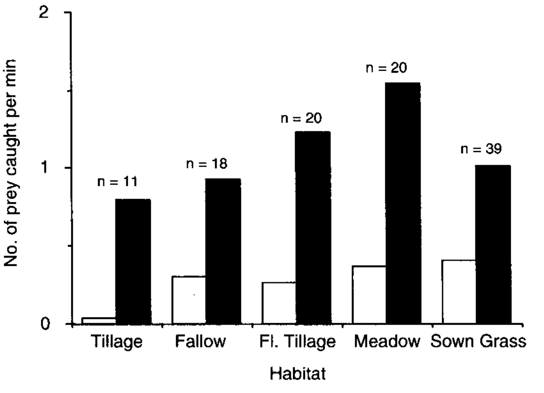

Fig. 1. Mean number of earthworms (light bars) and other prey (dark bars) caught per minute by female and male Curlews during foraging studies in the pre-breeding period (9 April – 5 May). The foraging studies were made in tillage, fallow fields, flooded tillage, meadows and sown grass. The sexes were pooled in this period, since there were no significant differences in foraging success. The number of foraging studies in each category is given above each bar.

Table 1. Comparison of mean bill length (mm) and weight (g) ± SD of 39 male and 37 female Curlews caught on the nest during the second half of incubation.

	Males		Females			
	Mean	SD	Mean	SD	F	P
Bill length (mm)	114.3	6.7	140.2	9.4	197.9	<0.001
Weight (g)	666.3	32.9	799.4	61.1	135.9	<0.001

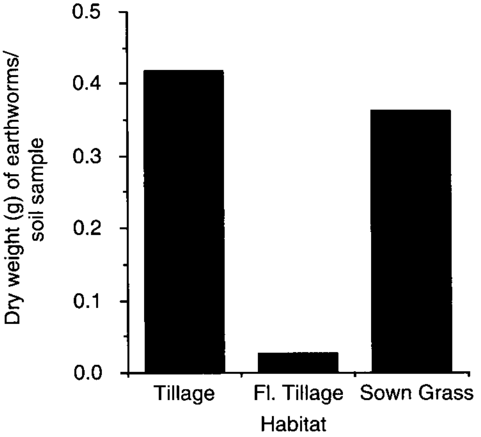

Fig. 2. Mean dry weight (g) of earthworms per soil sample (25 × 25 × 25 cm) in tillage, flooded tillage and sown grass (n = 40 in each habitat). The difference between habitats was significant (Kruskal and Wallis test, $H = 47.7$, $P < 0.001$) and due to significantly fewer earthworms in flooded tillage than in sown grass (Tukey-type test, $q = 7.2$, $P < 0.05$) and tillage ($q = 9.1$, $P < 0.05$).

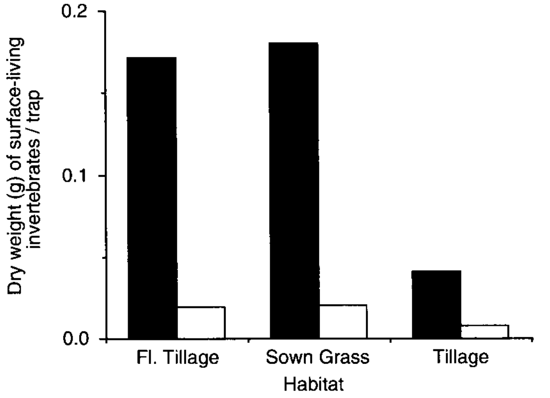

Fig. 3. Biomass (mean dry weight in g per trap) of surface-living invertebrates in ordinary pitfall traps (dark bars) and enclosed pitfall traps (light bars) in flooded tillage (n = 24 and 24, respectively), sown grass (n = 24 and 24, respectively) and tillage (n = 17 and 15, respectively) during the pre-breeding period. The difference between habitats was significant for ordinary pitfall traps (Kruskal and Wallis test, $H = 20.6$, $P < 0.001$) and was due to significantly fewer invertebrates in tillage than in sown grass (Tukey-type test, $Q = 4.4$, $P < 0.05$) and flooded tillage ($Q = 3.6$, $P < 0.05$). The difference between habitats was also significant for enclosed pitfall traps ($H = 11.4$, $P < 0.01$) and also due to fewer invertebrates in tillage than in sown grass (Tukey-type test, $Q = 3.2$, $P < 0.05$) and flooded tillage ($Q = 2.4$, $P < 0.05$).

The total biomass of earthworms differed significantly between habitats (Fig. 2). This was due to fewer earthworms in flooded tillage than in dry tillage and sown grass, since the biomass of individual earthworms did not differ between habitats (ANOVA, $F = 2.2$, $df = 2$, $P > 0.10$). The total biomass of earthworms in dry tillage was not significantly lower than in sown grass, as might be expected from the difference in foraging success between the two habitats.

The biomass of surface-living invertebrates differed significantly between habitats during the pre-breeding period in enclosed and ordinary pitfall traps (Fig. 3). The biomass in ordinary pitfall traps was significantly lower in dry tillage than in flooded tillage and sown grass (Fig. 3). The biomass in enclosed pitfall traps was also significantly lower in dry tillage than in sown grass and flooded tillage (Fig. 3).

3.3. Foraging success and food availability in the breeding period

During the breeding period (6 May – 10 June) there were some differences in the foraging success of males and females. Males caught significantly more surface-living invertebrates per minute than females in both tillage and meadows (Table 2) and females caught significantly more earthworms per minute than males in dry tillage (Table 2). Thus the sexes were not pooled when comparisons of foraging success in different habitats were made. These differences were not the result of differences in the time of day between foraging studies of males and females, since the number of observations of males and females during the morning (< 10.00 hours), day (10.00–18.00 hours) and evening (> 18.00 hours) did not differ significantly ($\chi^2 = 3.1$, $df = 2$, $P > 0.2$).

The foraging success of males differed between habitats (Fig. 4a). The number of earthworms caught per minute differed significantly between habitats (Kruskal and Wallis test, $H = 10.0$, $P < 0.01$), due to greater success in sown

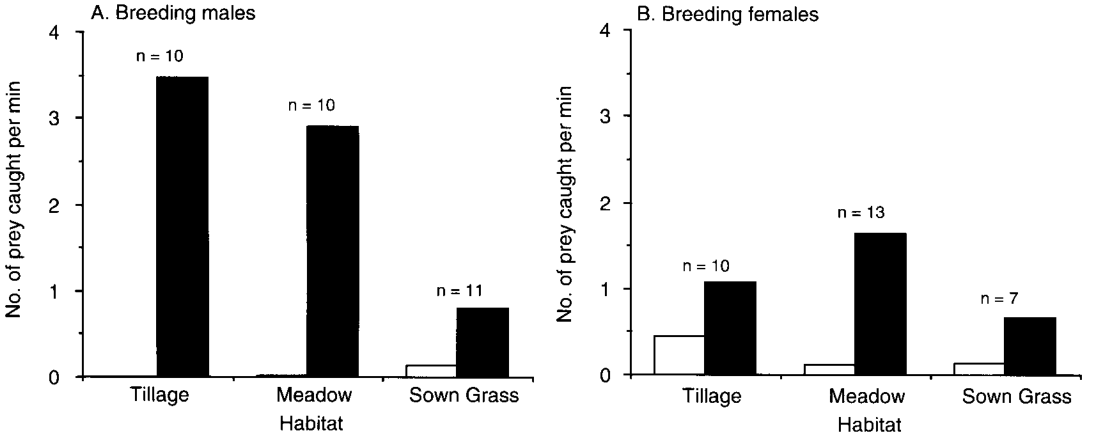

Fig. 4. Mean number of earthworms (light bars) and other prey (dark bars) caught per minute by male (A) and female (B) Curlews during foraging studies in the breeding period (6 May – 10 June). The foraging studies were made in tillage, meadows and sown grass. The foraging success of males and females was analysed separately, since there were some differences between sexes in foraging success. The number of foraging studies in each category is given above each bar.

grass than tillage (Tukey-type test, Q = 2.9, $P < 0.05$) and meadows (Q = 2.4, $P < 0.05$). Furthermore, the number of other prey caught per minute differed between habitats (H = 11.8, $P < 0.01$) due to significantly poorer success in sown grass than in tillage (Q = 2.8, $P < 0.05$) and meadows

Table 2. Mean number of earthworms and other prey items caught by Curlew males (M) and females (F) in different habitats during the breeding period (6 May – 10 June).

Habitat	Prey	Sex	n	Mean	SD	M-W U-test	P
Tillage	Lubricid	F	10	0.45	0.43	85.0	< 0.01
Tillage	Lumbricid	M	10	0.00	0.00		
Tillage	Other	F	10	1.06	0.96	20.0	< 0.05
Tillage	Other	M	10	3.46	3.02		
Meadow	Lumbricid	F	13	0.12	0.17	86.0	ns
Meadow	Lumbricid	M	10	0.02	0.06		
Meadow	Other	F	13	1.63	1.04	30.0	< 0.05
Meadow	Other	M	10	2.09	1.52		
S. Grass	Lumbricid	F	7	0.15	0.18	37.5	ns
S. Grass	Lumbricid	M	11	0.14	0.19		
S. Grass	Other	F	7	0.66	0.48	35.0	ns
S. Grass	Other	M	11	0.08	0.68		

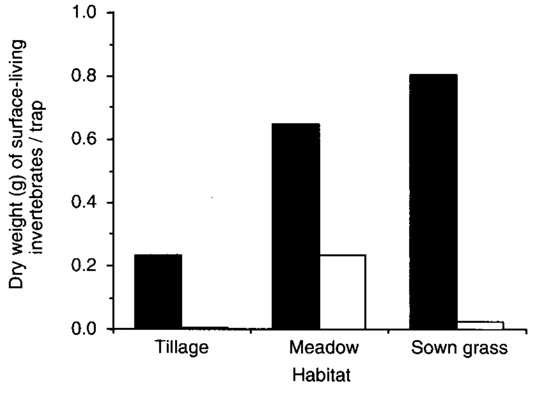

Fig. 5. Biomass (mean dry weight in g per trap) of surface-living invertebrates in ordinary pitfall traps (dark bars) and enclosed pitfall traps (light bars) in tillage (n=24 and 24, respectively), meadow (n = 18 and 18, respectively) and sown grass (n = 24 and 24, respectively) during the breeding period. The difference between habitats was significant for ordinary pitfall traps (Kruskal and Wallis test, $H = 19.9$, $P < 0.001$), due to significantly fewer invertebrates in tillage than in sown grass (Tukey-type test, $q = 4.3$, $P < 0.05$). The difference between habitats was also significant for enclosed pitfall traps ($H = 28.0$, $P < 0.001$), due to significantly fewer invertebrates in tillage than in meadow ($q = 5.2$, $P < 0.05$).

($Q = 3.0$, $P < 0.05$). For females (Fig. 4b) there was no significant difference in the capture rate between habitats of either earthworms (Kruskal and Wallis test, $H = 3.9$, $P > 0.10$) or other prey ($H = 5.1$, $P > 0.05$).

The biomass of surface-living invertebrates (total dry weight per trap) differed significantly between habitats in the breeding period (Fig. 5). For the enclosed pitfall traps, the dry weight of surface-living invertebrates was significantly higher in meadows than in tillage. The dry weight of surface-living invertebrates caught in ordinary pitfall traps was significantly higher in sown grass than in tillage (Fig. 5).

3.4. Comparisons between periods

The proportion of prey caught by probing (tillage, sown grass and meadows combined) was significantly higher (Mann-Whitney U-test, $U = 1581.5$, $P < 0.01$) in the pre-breeding period (57.9% of prey) than in the breeding period (30.4% of prey). This difference was not the result of differences between habitats or sexes, since the number of foraging studies of males and females in tillage, meadows and sown grass was kept constant by taking a random subsample. The number of earthworms caught per minute was also significantly higher in the pre-breeding than in the breeding period (Mann-Whitney U-test, $U = 1490.5$, $P < 0.05$), which indicates that earthworms were an important resource for Curlews during the pre-breeding period. Surface-living invertebrates were more important during the breeding period than during the pre-breeding period, since a significantly higher proportion (69.6%) of the prey was caught by pecks during the breeding than during the pre-breeding period (42.1%). The dry weight of other invertebrates was also significantly higher during the breeding period for ordinary pitfall traps in sown grass (Mann-Whitney U-test, $U = 58.5$, $P < 0.001$) and tillage (Mann-Whitney U-test, $U = 56$, $P < 0.001$) than in the pre-breeding period. There were, however, no differences between periods in these two habitats for enclosed pitfall traps (Mann-Whitney U-test, $U = 249$, $P > 0.4$ and $U = 150.5$, $P > 0.3$, respectively).

4. Discussion

4.1. Availability of earthworms

The number of earthworms caught per minute by Curlews was significantly higher in sown grass than in tillage during the pre-breeding period, even though the biomass of earthworms was slightly lower in sown grass than in tillage. Some studies have reported more earthworms in sown grass than in tillage (Evans and Guild 1948, Heath 1962), but the biomass of earthworms in tillage and sown grass (leys) has also been found to be similar (Hansson et al. 1989). This indicates that the biomass of earthworms does not always differ between these habitats, and that factors other than earthworm biomass can be important for their availability to birds in different habitats. Earthworms are probably easier for Curlews to catch in sown grass than in tillage since the earthworm burrow systems are intact and not destroyed by cultivation during autumn, as in most tilled fields.

The biomass of earthworms was significantly lower in flooded tillage than in sown grass and tillage, probably because the fields were flooded for a relatively long time (about three weeks), which decreases the number of earthworms. However, the number of earthworms caught per minute in flooded tillage did not differ significantly from that in tillage and sown grass, which suggests that the earthworms in flooded tillage were easy to catch. This was probably an effect of the wetness, since earthworms are found closer to the surface in very moist soil (Gerard 1967), which makes them more available.

Earthworm availability during the pre-breeding period seems to be important to Curlews and they spend a significantly larger proportion of their foraging time in sown grass than in other habitats at the main study site during this period (Berg in press). In most habitats the number of other prey caught per minute was 2–3 times as large as the number of earthworms caught per minute during the pre-breeding period (Fig. 1), but the mean earthworm dry weight (0.044 g) was about 20 times as great as the mean dry weight (0.002 g) of the surface-living invertebrates. This suggests that earthworms were the most important food organisms in terms of biomass during the pre-breeding period and that the Curlews preferred to forage in habitats where these were readily available.

4.2. Availability of surface-living invertebrates

Surface-living invertebrates played a minor role as food organisms in the pre-breeding period. During the breeding period they were more important as food items; they were not only caught in higher numbers, but the mean invertebrate dry weight in the breeding period (mean = 0.0045 g, n = 2429) was several times as great as in the pre-breeding period (mean = 0.0017 g, n = 1348). There was a difference between habitats in the number of pecks and probes per prey (Kruskal and Wallis test, $H = 11.8$, $P = 0.003$). The number of pecks and probes per prey was significantly higher in sown grass than in tillage and meadows (Tukey-type test, $Q = 3.0$, $P < 0.05$ and $Q = 2.9$, $P < 0.05$, respectively). This was probably the result of the early start of vegetation growth in sown grass, compared to tillage, which was sown in early May, and meadows, where vegetation growth started later because of yearly flooding in April and early May. The high and dense vegetation in sown grasslands probably made the relatively large numbers of invertebrates difficult to catch. In arable fields surface-living invertebrates were more available, despite lower biomass, probably because of the low vegetation. Surface-living invertebrates were also easy to catch in meadows, where their biomass was high and the vegetation lower and more patchy than in sown grasslands. Vegetation height and density thus seem to be factors influencing the availability of invertebrates for Curlews in different habitats. Curlews have been shown to spend a significantly lower proportion of their total feeding time in sown grassland (and a larger proportion in tillage) at the main study site in the breeding period than in the pre-breeding period (Berg in press), as might be expected from differences in food choice and food availability between the two periods. Curlews showed no habitat preferences when foraging during the breeding period, but they preferred fields close to the nest (Berg in press).

4.3. Comparisons between ordinary and enclosed pitfall traps

A comparison of mean invertebrate weight within habitats (in the same period) between enclosed and ordinary pitfall traps showed that the mean weight was significantly greater in the ordinary traps (Wilcoxon´s signed ranks test, $Z = 2.2$, $P < 0.05$). This is probably because large insects, such as carabid beetles, are found in lower densities than smaller invertebrates and therefore are not often caught in the enclosed traps (0.28 m^2), but since they are mobile (Mascanzoni and Wallin 1986), they were often caught in the ordinary traps and the pitfall trap catch was determined by population size and activity in an unknown combination. Enclosed pitfall traps should, however, give a truer picture of actual carabid density, if the traps are maintained over a period of weeks so that they catch beetles buried in the soil and emerging later in the enclosed area. The enclosed traps did not show the difference in invertebrate biomass between periods that was found for the ordinary traps, which indicates that the latter were better indicators of invertebrate availability to Curlews, since invertebrates were a more important part of the Curlew diet in the breeding period. However, invertebrate availability is a complex problem and is probably affected by density, vegetation cover and possibly also invertebrate mobility, since less mobile insects may be more difficult to locate.

4.4. Differences between the sexes

During the pre-breeding period, when the ground was still moist, there was no difference in the number of earthworms caught per minute between males and females. In the breeding period, when the soil was drier, females caught more earthworms than males in tillage. The number of earthworms per probe in tillage was also significantly higher for females than for males (Mann-Whitney U-test, $U = 25.0$, $P < 0.05$). This is probably because females had significantly longer bills than males, and therefore could catch earthworms deeper down in the ground than males. During the breeding period males seemed to specialize in surface-living invertebrates, as they caught significantly more than females in tillage and meadows. Differences in foraging ecology between male and female Curlews have also been found in coastal areas (Zwarts 1979, Townshend 1981). Therefore it is difficult to determine whether differences in morphology between sexes have evolved due to differences in foraging ecology during breeding or in wintering areas.

4.5. Food availability and Curlew densities

Meadow was the only habitat where earthworms were readily available that also held a high biomass of available surface-living invertebrates. Sown grass is the most important Curlew habitat in modern farmland (Berg in press, Berg & Sjöberg in press) and this was also the habitat where earthworms were most available to the Curlews. Curlew density has been shown to be positively correlated to the proportion of grassland in farmland (Berg and Sjöberg in press), which indicates the importance of food availability for Curlew density in farmland. Earthworms were more available to Curlews in flooded tillage than in dry tillage and more invertebrates were caught in flooded tillage than in dry tillage in the pre-breeding period, which indicates the importance of wetness for food availability. The low Curlew density in modern farmland (dominated by dry tillage) might be a result of limited food resources early in the season.

To sum up, grasslands and flooded tillage were better foraging habitats than tillage early in the season, and these results support the hypothesis that differences in food availability between habitats can explain corresponding differences in Curlew densities between habitats (Pettersson 1988). Grasslands have, however, also been shown to be a preferred nesting habitat, with a higher hatching success than tillage at the main study site (Berg 1992). Differences in the availability of potential nests sites and the reproductive success of Curlews in modern farmland (small areas of grasslands) and traditional farmland (relatively large proportions of ley and meadow) are therefore probably also a reason for differences in Curlew densities between modern and traditional farmland.

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Sammanfattning: **Födotillgång och fångstframgång hos storspovar**

Födotillgång och fångstframgång hos storspovar som födosökte på jordbruksmark studerades i ett område i mellersta Sverige under åren 1987–1991. Mask var den viktigaste födan innan häckningen och under denna period fångades signifikant fler maskar per minut på sådd gräsmark än på sädesåkrar. Biomassan av mask var emellertid inte högre på sådd gråsmark än på sädesåkrar. Den högre tillgängligheten på sådd gräsmark

berodde troligen på de intakta gångsystemen, som gjorde maskarna lättare att fånga jämfört med på sädesåkrar där gångsystemen förstördes årligen då åkrarna plöjdes. Ytlevande evertebrater var mindre viktiga som föda före häckningen, speciellt om hänsyn tas till biomassan. Under häckningen fångade de kortnäbbade hanarna signifikant fler ytlevande evertebrater än de långnäbbade honorna i sädesåkrar och på ängar, medan honorna fångade mer mask än hanarna. Signifikant färre maskar fångades emellertid under häckningstiden än under perioden före häckningen. Tillgängligheten av ytlevande evertebrater för storspovar påverkades troligen både av tätheten av evertebrater och av vegetationens struktur. Ett stort antal ytlevande evertebrater fångades per minut på sädesåkrar där tätheten av evertebrater var låg och vegetationen sparsam. På sådd gräsmark (med hög och tät vegetationen) var biomassan av ytlevande evertebrater hög, men antalet som fångades per minut var lågt, trots många fångstförsök. Den större tillgängligheten (inte biomassan) av födoorganismer i gräsmark och på översvämmad åkermark tidigt på säsongen är troligen en faktor som orsakar de högre tätheterna av storspov i dessa biotoper än i det moderna jordbrukslandskapet, där torra sädesåkrar är dominerande.

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