# Predation of Common Sandpiper *Actitis hypoleucos* on *Orchestia gammarellus* (Pallas 1766), (Crustacea: Amphipoda): problems in assessing its diet from pellet and dropping analysis

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## INTRODUCTION

When an investigator tries to estimate the total amount of prey taken by a wader species, regardless of the chosen method (i.e. pellets, droppings, flushes, etc.), he is faced with the problem of differential resistance of prey to digestion (i.e. Goss-Custard 1973; Verkuil 1996; Arcas 1998). Some biases have also been noted when prey size has to be assessed by analysing pellet and droppings separately since big remains seem to be more frequent in pellets whereas small ones are more frequent in droppings (Worrall 1984; Holt & Warrington 1996).

In the present study, another problem is raised and must be borne in mind for future studies concerning wader diets. This problem relates to the sexual dimorphism shown by some groups of prey such as several genera of Talitriidae family (Crustacea: Amphipoda) (Lincoln 1979; Hayward & Rylan 1996). Such dimorphism is noticeable in the greater development of the terminal dactilus in the second gnatopod in males, called by Maze (1988) the subchelae gnatopod or "robust type". However, females have a simple structure which I called "normal type" (Figure 1). Arcas (in prep.) in a study of the diet of Common Sandpiper *Actitis hypoleucos* in north-west Spain during autumn migration, analysed pellets and droppings. Talitriidae amphipods, mainly *Orchestia gammarellus* (Pallas 1766), were found as the third most frequent prey group preceded by isopods of Sphaeroma genera and nereid worms, *Nereis diversicolor*. To estimate the number of individuals of this amphipod eaten by Common Sandpipers, body fragments (very scarce) and anatomic pieces, such as the dactilus of second gnatopod were counted. The dactili of males were the most abundant prey remains found in diet and due to this, an underestimation in the total number of prey ingested could have been be made. The aim of the present study is to see how such dimorphism can affect to the quantification of prey found in both pellets and droppings.

## STUDY SITE AND METHODS

This study was carried out in Lagares marsh (42° 15´N; 05° 01´W), a 17 ha mesohalophile marsh where *Juncus* sp. and *Agrostis* sp. are the main vegetation species, but a large proportion of which is pasture. Lagares river carries both domestic and industrial waste into the ria of Vigo. Common Sandpipers are frequent throughout the year, especially during autumn migration (Arcas 1999). To estimate the ratio of robust type individuals to those without this character in a population of *Orchestia gammarellus*, and to detect significant temporal variations between them, random samples were taken using a circular plastic corer (15 cm in diameter) following the technique described by Mouritsen (1994). Samples were taken from those places most frequented by feeding birds. Mud core samples were sieved in the field through a 1 mm mesh and retained amphipods fixed in 70% alcohol. Samples were collected in August, September and October

## RESULTS

Monthly captures of amphipods in Lagares marsh and the number of each amphipod type (robust / normal) are shown in Table 1. Figures of individuals found in pellets and droppings are in the same table. In field samples, 554 amphipods were captured and distributed as follows: 216 in August, 194 in September and 144 in October. Significant differences between months were found in the number of individuals of each type caught (($2 = 11.25; $p< 0.05; 2 d.f.). The ratio of normal to robust type also varied: 4.0 normal type for each robust type in the

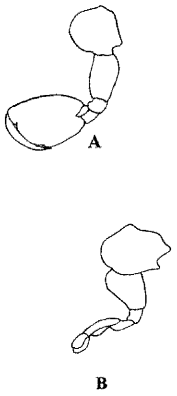


Figure 1. Male (A) and female (B) second gnatopods in *Orchestia gammarellus*

first month, 6.1 in the second and 2.1 in the last one. There were significant differences between the ratios of males/females obtained in field samples, pellets and droppings (Table 1). Females were predominant only in the field samples being scarce in both pellets and droppings. Although males were more frequent in droppings, both sexes were found in low numbers in this type of sample. Proportions between the two different types obtained in pellets (n = 92), droppings (n = 68) and those in the field are shown in Figure 2. Proportions among individuals observed in pellets were higher than those captured in field samples because so few fragments of normal type were found in pellets. Neither proportional values for droppings could be made due to the same reason, with the exception of droppings of the last month.

## DISCUSSION

*Orchestia gammarellus* is an amphipod species with sexual dimorphism (Lincoln 1979; Hayward & Ryland 1996). The dactilus of the second gnatopod marks the difference between both sexes, and this is the most frequent prey remains, among other remains, that appears in pellets and droppings of Common Sandpiper in autumn in Lagares marsh (Arcas in prep.). Comparing

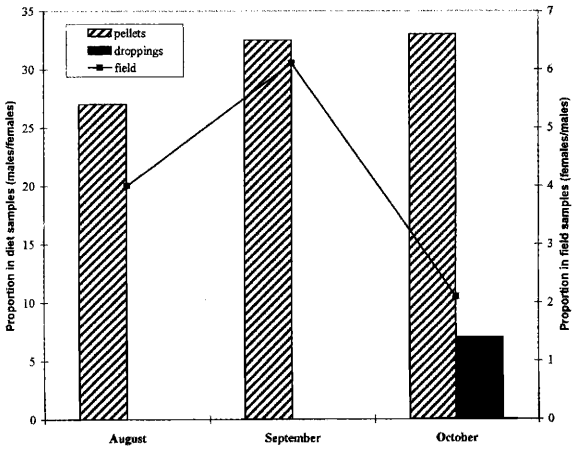


Figure 2. Rates between normal and robust type of *Orchestia gammarellus* found in: field samples, pellets and droppings of common sandpipers *Actitis hypoleucos*

Table 1. Number of males and females counted in A: field samples; B: pellets and C: droppings

| | August | September | October | Total |
|---|---|---|---|---|
| A | | | | |
| males | 43 | 27 | 46 | 116 |
| females | 173 | 167 | 98 | 438 |
| B | | | | |
| males | 81 | 65 | 46 | 192 |
| females | 3 | 2 | 0 | 5 |
| C | | | | |
| males | 5 | 8 | 7 | 20 |
| females | 0 | 0 | 1 | 1 |

results obtained from field samples and those from pellets and droppings noticeable differences were obtained. Proportions obtained in pellets and droppings should reflect those from the field or vice versa. There are three possible reasons for this inconsistency: 1) a sex-related selection by birds, 2) a sex-difference in availability in the field or 3) a sex-difference in the probability that the remains will stay intact long enough to be recognised in pellets/droppings.

Although waders can select their prey by size to maximise intake rates (i.e. Goss-Custard 1977; Cayford & Goss-Custard 1990) there seem to be no noticeable differences in size and shape between both sexes of *Orchestia gammarellus*, although slight differences can exist in antennae length (Lincoln 1979). It therefore seems unlikely that Common Sandpipers could differentiate between the sexes. Although there was a significant temporal variation in the ratio of robust to normal type found in the populations sampled that may be due to factors such as temperature (see Ginsburger-Vogel 1975; Ginsburger-Vogel & Magniette-Mergault 1981), overall, a greater frequency of occurrence of female remains in pellets and droppings would be expected taking into account field abundance. If we assume that Common Sandpipers capture this prey species randomly and not through sexual selection, females had a higher probability of being captured than did males. Differential passage of prey remains through the digestive tract can be due to their size and composition (Rosenberg & Cooper 1990). The dactilus is the uniquely different piece between male and female gnatopods and it is probably just like other remains (mandibles, antennae, etc.) the only part of gnatopod which is resistant to digestion. If smaller remains pass through the digestive tract more quickly, then female remains (smaller than those of males) would be more abundant in droppings and this didn't occur. However, soft-bodied prey are easily attacked by gastric acids and remains of any kind are very difficult to obtain (Arcas 1998).

This means that there is a trend to overestimate those prey with a bigger size or resistance to digestion compared with smaller or soft-bodied ones (Worrall 1984;

Holt & Warrington 1996; Pérez-Hurtado *et al.* 1997; Arcas 1998). To minimise these errors, different solutions have been proposed, for example, calculating correction factors (Goss-Custard 1973) or combining several data sources (pellets, droppings, emetics, etc.) to give more complete information about prey consumed and their size (Worrall 1984; Arcas 1998). To get round the problem described here, an approximate estimation of prey eaten can be made using data collected on male/female ratios from field samples collected in the study area during the same period for which the study is carried out. In our case this means that we found a proportion of one female to 27 males from pellets analysed in August when the ratio in field samples taken in the same month was four females to each male. This would give us a figure of 108 females not originally counted. Obviously, the proposed method is subject to the habitat characteristics and the wader and prey species concerned. Because of this, special attention must be paid when choose the method to study diet composition since wader behaviour can vary among areas (Puttick 1984; Ormerod & Tyler 1988).

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