Diet of the Two-banded Plover at Caleta Valdés, Península Valdés, Argentina

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The diet of the Two-banded Plover *Charadrius falklandicus* was studied during the non-breeding season, March–May 2000, by means of an analysis of 49 droppings collected on the beach at Caleta Valdés, Península Valdés, Argentina. From invertebrate sampling, three potential prey types were identified: polychaetes, insects and crabs. The polychaete *Laeonereis acuta* occurred most frequently in the droppings and this was also the most abundant invertebrate in the substrate of the beach. The average biomass of *L. acuta* in each of the 40 droppings that contained any was 8.9 mgAFDM. This suggests that the Two-banded Plovers feeding on this prey consume 1.77 individuals per minute or an intake rate for *L. acuta* alone of 0.26 mgAFDM/s based on the average defecation rate.

INTRODUCTION

The beaches of Peninsula Valdés, Patagonia, Argentina (42°30'S, 64°00'W) are used as a regular stop-over site by several species of waders, mainly Red Knots *Calidris canutus rufa*, Hudsonian Godwits *Limosa haemastica*, Sanderlings *C. alba*, White-rumped Sandpipers *C. fuscicollis*, Rufous-chested Dotterels *Charadrius modestus*, Magellanic Plovers *Pluvianellus socialis* and Two-banded Plovers *Ch. falklandicus* (Bala *et al.* 2001, Bala *et al.* 2002). The beach at Caleta Valdés on the NE end of the peninsula is regularly visited by Two-banded Plovers during the non-breeding season with counts of up to 1,500 individuals (Bala *et al.* 2002).

The Two-banded Plover is a Neotropical shorebird that has rarely been studied (Piersma *et al.* 1997) with a Patagonian population in the range 25,000–100,000 (Wetlands International 2002). Some of this population remains in Patagonia during the non-breeding season while the remainder migrates north as far as Uruguay and S Brazil (Hayman *et al.* 1986). Two-banded Plovers are common along the beaches of Patagonia (Narosky & Yzurieta 1987) and some are used for breeding, including Caleta Valdés.

The aim of this study was to describe the diet of the Two-banded Plover at Caleta Valdés during the non-breeding season.

METHODS

Caleta Valdés is a sandy beach located in a creek on the east coast of Peninsula Valdés (Fig. 1). It comprises fine sand and mud sediments and, at low water, has an area of about 3 km^2 that is used by feeding shorebirds.

In mid-February 2000 (before the main arrival of migrant shorebirds), the intertidal invertebrate fauna was sampled with a corer of 5 cm diameter to a depth of 15 cm, in order to assess the trophic offer available to the shorebirds and the full results of this part of the study are reported in Gravina *et al.* (2000).

Our fieldwork was carried out during seven one-week visits between March and May 2000. Feeding Two-banded Plovers were observed using 15–60× telescopes and their defecation rates were measured by recording the time (to the nearest second) between successive droppings with a stopwatch. Up to two successive dropping intervals were recorded for individual birds after which a different bird was selected for observation. None of the birds was individually marked so it is possible that some were observed more than once. However, this is unlikely to have happened often in view of the number of birds present (range 600–1,500 (Bala *et al.* 2002)).

Diet composition was determined by faecal analysis. Droppings were collected and kept individually at –20°C. Each dropping was analysed under a zoom binocular microscope (5–20× magnification) and the key structures of food remaining were identified as, for example, polychaete mandibles, chaetes or fragments of crustacean or insect (after Dekinga & Piersma 1993). In this way, the proportional occurrence of each prey species in the droppings was estimated. In addition, the droppings were found to contain mandibles of the polychaete *Laeonereis acuta*. These were measured and used to estimate the relative contribution of this prey species to the diet in terms of biomass. Dry mass of the polychaetes was estimated using a sample of 30 individuals collected from the beach. The mandible of each polychaete was measured (to the nearest 0.1 mm) and they were then dried in an oven at 85°C for 48 hours after which they were weighed individually. Dry mass was then regressed against the size of the mandible resulting in the following model:

$$\text{Dry mass} = 0.0073 * \text{Mandible}^{2,326};\ r^2 = 0.6,\ DS = 0.0014,\ p < 0.01,\ N = 30.$$

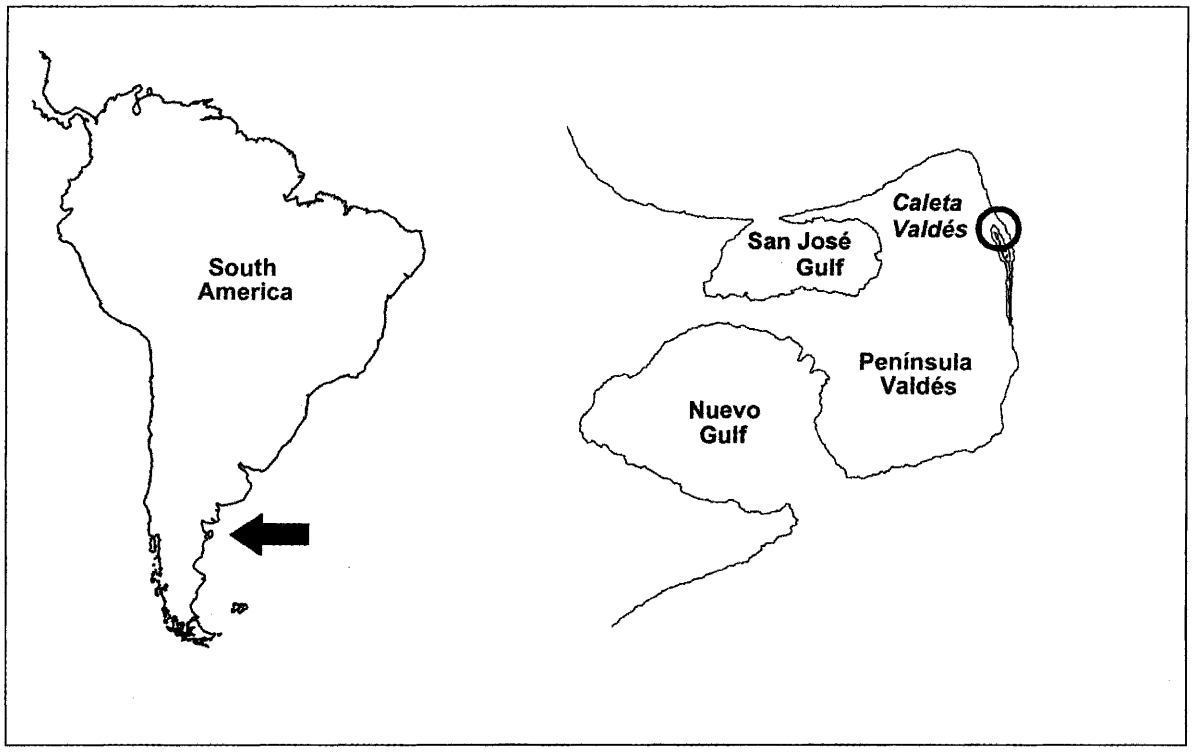

Fig. 1. Location of Caleta Valdés on the NE of Península Valdés, Patagonia, Argentina.

Biomass was recalculated to ash-free dry mass by multiplying the dry mass values derived from this equation by 0.85. This value was estimated from samples of dried worm that were weighed, incinerated for 5 h at 550°C and then reweighed to determine ash mass, and by subtraction ash-free dry mass (AFDM).

We recorded the distribution of Two-banded Plovers during both low- and high-water periods as well as where and when they fed.

RESULTS

The polychaetes *Laeonereis acuta* and *Clymenella sp.* accounted for 76.9% of the prey individuals in a square metre of mud (to a depth of 15 cm). However, other species of polychaetes and crustaceans were also recorded at low densities (Gravina *et al.* 2000) (Table 1).

Table 1. Mean density (indiv/m^{-2}) of invertebrates in the mudflats at Caleta Valdés to a depth of 15 cm (Gravina *et al.* 2000).

	Species	Density (indiv.m^{-2})
Polychaetes	*Laeonereis acuta*	1,464
	Clymenella sp.	1,207
	Capitella capitata	182
	Axiothella sp.	160
	Polychaete indeterminate	75
	Polydora sp.	43
	Orbiniidae (Scoloplos)	21
Nematodes	Nematode indeterminate	43
Crustaceans	*Aniacallax argentiniensis*	107
	Amphipods indeterminate	107
	Kalliapseudes schubartti	53
	Cyrtograpsus affinis	11

Between March and May 2000 the number of Two-banded Plovers at Caleta Valdés averaged 800 and ranged from 600 to 1,500 (Bala *et al.* 2002). During low tide, the birds foraged on the intertidal mudflats and at high tide they went to supra-tidal sites where they roosted and did not feed. Because of the difficulty of following individual birds for long periods in a large flock, which was exacerbated by high winds, only 9 defecation interval records were obtained. The average was 359 s (N = 9, SD = 145).

We collected 49 Two-banded Plover droppings. Of these, 40 (82%) contained the polychaete *Laeonereis acuta*, 29 (59%) contained unidentified insects and 8 the crab *Cyrtograpsus affinis*. The *Laeonereis acuta* totalled 425 individuals or 10.6 for each of the 40 droppings that contained any. Thus, assuming that only the Two-banded Plovers whose droppings contained *Laeonereis acuta* were feeding on them, at a defecation interval of 359s, they were consuming an average of 1.77 *Laeonereis acuta* per minute. The average biomass was 8.9 mgAFDM (SD = 7.8, N = 425). Therefore the average contribution of *Laeonereis acuta* to each dropping was 94 mgAFDM, which is equivalent to an intake rate for this prey alone of 0.26 mgAFDM/s.

DISCUSSION

It should be noted that not only was our measurement of defecation interval based on a small sample (9), but, as pointed out by Goss-Custard *et al.* (2002), our method was potentially flawed as a means of measuring defecation rate. Nevertheless our result is likely to be of sufficient accuracy for our estimated intake rate for feeding on *Laeonereis acuta* (of 0.26 mgAFDM/s) to be of the right order.

Analysis of a bird's diet in terms of biomass provides information about the energetic importance of each component (Dekinga & Piersma 1993). In our study, measurement of

biomass was restricted to just one of the three main prey types. Nevertheless it allows us to infer that the polychaete contribution to the diet was important. Two-banded Plovers weigh 62–72 g (del Hoyo *et al.* 1996) and our rough measurement of intake rate from *Laeonereis acuta* was 0.26 mgAFDM/s which is similar to intake rates recorded in the literature for similar-weight species: 0.44 mgAFDM/s for Purple sandpiper *Calidris maritima* (68 g) (Dierschke 1993) and 0.35 mgAFDM/s for Terek sandpiper *Tringa cinerea* (74 g) (Piersma 1986).

Two-banded Plovers at Caleta Valdés only foraged on the mudflats at low tide, so it is clear that they were able to meet their daily energy requirements from intertidal invertebrates alone. However, their diet consisted of only three prey types despite the fact that more than 12 potential prey species were available (Tables 1). Although it is possible that faecal analysis underestimates the importance of those prey species that do not have persistent hard structures, it would seem likely that these results reflect a strong degree of prey selection by the birds.

The high occurrence of the polychaete *Laeonereis acuta* in the droppings is no doubt a reflection of its abundance among the intertidal invertebrate fauna. Polychaetes of the genus *Clymenella* were also available at high density. However, it was not possible to determine to what extent they were taken by the birds because they do not have hard structures that survive digestion.

The large number of insects in the droppings could have been the result of opportunistic feeding at a time of unusual abundance because they do not normally occur in the intertidal areas where the birds usually fed.

Despite the fact that the crab *Cyrtograpsus affinis* only occurred on the mudflats at low densities, they were moderately abundant in the droppings. The number of crabs in the droppings could be overestimated because identifiable shell fragments of a single crab might be found in more than one dropping as they are relatively large prey and may take some time to digest. On the other hand, crabs can be quite active on the surface of the mud during low tide. Therefore it may be that they are particularly vulnerable to capture by visually hunting Two-banded Plovers.

The diet of Two-banded Plovers is probably determined by two important characteristics of their potential prey: abundance and detectability. The polychaete *Laeonereis acuta* is very abundant and the crab *Cyrtograpsus affinis* is very detectable. Therefore these are taken in larger quantities than other suitable prey that are less abundant and/or less detectable. Insects may be similar to crabs in that they are easily detected; moreover occasionally they may be abundant.

If Two-banded Plovers take prey that does not survive the digestive system, faecal analyses will be biased and intake rate will be underestimated. Therefore such studies should be complemented by direct observations of foraging birds. This may show, for instance, what proportion of ingested prey items were crabs, worms, etc. and from what micro-habitat they were taken. This may show whether any of the other benthic invertebrates present form part of the diet but are missed by faecal sampling. In our study, the number of droppings containing each prey species gives a general picture of the diet. However, an analysis based on biomass gives a better idea of the relative contribution of each prey species towards daily consumption. We have been able to do this in respect of the polychaete *Laeonereis acuta*. Eventually we hope that it will be possibly to describe the complete diet of the Two-banded Plovers at Caleta Valdés stop-over site in these terms.

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