Diet and Prey Size Selectivity of Semipalmated Plovers in Coastal Georgia

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<td>Pollock, Lisa; Ontario Ministry of Natural Resources and Forestry</td>
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Diet and Prey Size Selectivity of Semipalmated Plovers in Coastal Georgia

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Plover diet and prey selectivity

Abstract: We examined diet of non-breeding Semipalmated Plovers (Charadrius semipalmatus (Bonaparte, 1825)) in the Cumberland Island Estuary, Georgia, U.S.A., through fecal sample analysis. We also examined prey size selectivity by plovers, for the most common prey item found in the fecal samples, polychaetes in the Family Nereidae. We compared the size distribution of polychaetes in plover fecal samples from salt marshes and mudflats with the size distribution of polychaetes sampled from the two habitats. Plovers foraging on mudflats had less variable diets than those foraging on salt marshes, although the average number of prey per plover fecal sample was similar between the two habitats. Size selectivity by plovers of Nereid polychaetes varied as a function of habitat, with plovers eating larger polychaetes in salt marshes than in mudflats, although in both habitats plovers avoided extremely small and/or large ones. Plovers took fewer of the available prey groups and were more selective in sizes of the dominant prey group on mudflats, where prey densities were the highest; observations that are consistent with predictions from optimal foraging theory.

Key words: Semipalmated Plover, invertebrates, diet breadth, polychaete, coastal Georgia, optimal foraging
Plover diet and prey selectivity

Introduction

Non-breeding migratory shorebirds are the major vertebrate predators on intertidal communities of southern temperate and tropical environments (Piersma 1987; Wilson 1991). Shorebirds as a group are also exhibiting some of the steepest declines among Canadian birds (North American Bird Conservation Initiative Canada 2012). Understanding details of predator-prey relationships during the non-breeding season can help us to understand whether shorebird species are diet generalists (Kalejta 1993) that are resilient to changing environments or, alternatively, specialized on particular diet items and hence vulnerable to changes in their specialized prey as a result of anthropogenic disturbances (Botton et al. 1994; Palomo et al. 2003; Zharikov and Skilleter 2004).

Dietary flexibility is a valuable adaptation in migratory birds, as foraging habitats and invertebrate assemblages often differ between breeding, stopover and wintering sites (Parrish 2000). Prey availability can also vary with environmental conditions, habitat, competition, and seasonally as a result of resource depletion (Colwell and Landrum 1993; Kalejta 1993; Backwell et al. 1998; Thorne and Read 2013). Most shorebirds exhibit some diet flexibility (Skagen and Oman 1996) with greater diet breadth observed in shorebirds foraging on habitats with few food resources (Kober and Bairlein 2009).

Selective foraging, by contrast, implies some prey items are rejected (Weber and Haig 1997; Backwell et al. 1998; Pedro and Ramos 2009). Prey can be rejected due to insufficient gross energy gain (Zwarts and Blomert 1992; Zwarts et al. 1996), unprofitable handling costs (Backwell et al. 1998), the risk of kleptoparasitism (Kalejta
Plover diet and prey selectivity

1993) or the risk of damage by the prey to the foraging bird (Bildstein et al. 1989). The pattern of selectivity can vary in relation to the density of prey in a way similar to that seen with niche breadth. Greater selectivity should be exhibited where prey are more abundant, a pattern predicted by optimal foraging theory (Estabrook and Dunham 1976).

Semipalmated Plover (*Charadrius semipalmatus*, Bonaparte, 1825) is a small (< 50 g), visually foraging long-distance migrant shorebird, whose diet contains a range of invertebrates (Skagen and Oman 1996; Rose and Nol 2010). Diet, based on the chitinous material that passes through birds undigested but remains identifiable in fecal pellets, was previously described from a non-breeding site in coastal Venezuela (Smith and Nol 2000). Determining whether Semipalmated Plovers have a similar diet in a more northerly site can help to elucidate factors that could potentially limit the northern extent of the non-breeding distribution (Nol and Blanken 2014) and can provide a more complete picture of this species’ niche breadth.

We first describe the hard-shelled and chitinous portion of the diet of Semipalmated Plovers in salt marsh and mudflat habitats through the use of fecal pellet analyses. Salt marsh habitats contained less than half the density of prey of mudflat habitats in our coastal Georgia study area (Rose and Nol 2010). We predicted that plovers would forage on a smaller subset of the prey base from mudflats than from salt marshes because they could be more selective of prey type where there was more prey (Estabrook and Dunham 1976). We also compare the size distribution of the most common prey in the diet of plovers, marine polychaetes in the family Nereidae, to the size distribution of polychaetes sampled from the substrates of the two environments.
Plover diet and prey selectivity

As with diet breadth, plovers were predicted to become more size selective in the prey rich, mudflat habitats.

Materials and methods

Study system

The diet of non-breeding Semipalmated Plovers was studied within the Cumberland Island estuarine system (30°85′N, 81°45′W) from December 2001 to February 2002 and January to March 2003. Counts of up to 1,500 Semipalmated Plovers occurred on Cumberland Island and continue to do so annually, through 2016 (P. Leary pers. comm.). Plovers foraged in salt marshes and in the surrounding estuarine mudflats (Rose and Nol 2010). Salt marshes and mudflats were exposed by the tide semi-diurnally. The tidal amplitude is 1.7 m on the bay side of Cumberland Island (http://co-ops.nos.noaa.gov/noaatidepredictions/NOAATidesFacade.jsp?Stationid=8679758).

The extent of the tidal exposure of the main foraging areas that we studied ranged from 0.5 ha to 2-3 ha depending on the tide. Sediments varied in texture from silt (salt marsh) to clay (mudflats), organic content (from moderate in salt marsh to high in mudflats) and salinity (moderate in salt marsh to low in mudflats). The sampling areas included three mudflats and three salt marshes (Rose and Nol 2010).

Data collection

In the salt marsh sites individual fecal samples of Semipalmated Plovers were collected during ebb tide. Birds foraging during ebb tide came directly from the high tide roost where they spent the previous 2-3 h and where they did not forage (Rose and
Plover diet and prey selectivity

Nol 2010). As plovers defecate on average 1.6 times per hour (Rose and Nol 2010), any fecal samples collected during the ebb tide, must have contained evidence of prey eaten on the salt marsh. At the mudflat sites fecal samples of plovers were collected during the low and incoming tides. As low tide occurs 2 h after they begin to forage at the mudflats and plovers forage there for 4 h (Rose and Nol 2010), then the prey represented in these pellets are also very likely to be from the mudflats.

Fecal samples were collected in two ways. First we collected fecal samples opportunistically after an individual was observed defecating, during five-minute focal observations. We also collected samples from conspecific foraging groups of Semipalmated Plovers, immediately after they left an area. Whole fecal samples were carefully scraped off the substrate surface and preserved in 70% isopropyl alcohol. A fecal sample refers to a single sample that was collected from an individual bird observed defecating during a foraging event. The fecal sample consists of two parts; the fecal pellet, which contains indigestible material, and uric acid. The fecal pellet was the only part of the fecal sample that was used for the study. The entire fecal sample was collected in the field to ensure that the complete fecal pellet was intact. In the lab, the fecal pellet was removed from the fecal sample and homogenized in 70% isopropyl alcohol. All invertebrates or invertebrate parts indicating a single individual (bivalves, copepods, dipterans, gastropods, polychaete worms) from a fecal sample, were counted and identified to family using a 6x-50x dissecting microscope. Marine worms, larvae, amphipods, isopods and tanaids were identified from individual prey items that were not fully digested. Invertebrates collected using core samples were used to aid in the identification of remains from fecal samples (Rose 2006).
Plover diet and prey selectivity

Available invertebrates were collected at known foraging salt marsh and mudflat locations using core samples (beveled-edge PVC 6-cm diameter pipe inserted to a depth of 6 cm (162 cm$^3$; Weber and Haig 1997)). Samples were collected during the same tidal periods as when plovers were foraging (see Rose and Nol 2010 for full details) and fecal samples collected.

To obtain relationships between the jaw sizes that we collected from fecal pellets and the total body lengths of the polychaetes (Weber and Haig 1997), jaws were dissected from worms collected from core samples at mudflat (n = 106) and salt marsh sites (n = 409). Jaws were measured to the nearest 0.01 mm, from the base of the proximal tooth to the distal end of the jaw to accommodate for the slight curvature of the jaws (Ieno et al. 2000; Scheiffarth 2001). Due to variations in body length attributed to muscle retraction upon preservation (Ieno et al. 2000) a relaxing agent (Magnesium Chloride and Menthol) consisting of a 50:50 solution diluted with water, was applied to each individual prior to measuring total body length (Mackie 1994). We applied the resulting regression equations (Table 1) to the lengths of jaws of all polychaetes found in the fecal samples, according to the habitat in which they were found.

Analysis

We used a generalized linear model to compare the number of prey individuals per fecal sample from salt marshes with those from mudflats, using habitat (salt marsh or mudflat) as a fixed effect and site (3 of each of mudflat and salt marsh sites) as a random variable. A generalized linear model was also used to determine the effect of habitat on the size of polychaetes in the fecal samples, using site as a random variable.
Plover diet and prey selectivity

As there were on average 5 sets of jaws per pellet we nested the sizes of individual jaws within a fecal pellet to remove the potential impact of pseudoreplication on the results. As there was little added variance due to the effects of individual pellet on the size of jaws (< 3% of variance, see results) from the above analysis, we used all individual measurements of jaws (1 measurement per pair of similarly-sized jaw assumed to be from one individual) to compare with the jaws that we sampled from the environment. Plovers capture each polychaete individually. Thus, we assume that each capture event and hence possible selection of the size of that polychaete, is an independent event.

While we acknowledge that this method may violate the assumption of non-independence (i.e. > 1 jaw per fecal pellet), our total sample per habitat consisted of pairs of jaws collected from 40 fecal samples from the salt marsh sites (with a total of 280 jaws) and 54 fecal samples (with a total of 278 jaws) from the mudflat sites, so that the contribution of polychaetes from any one individual plover’s pattern of size selection, to the patterns we observed is probably not large.

We used individual jaws (and their conversion to total body lengths) as the experimental units in the analysis to determine whether the distribution of sizes of polychaetes in the diet differed from the distribution that we sampled in the environment, collapsing size categories so that there was a minimum of five jaw sizes in each class both from the prey and the environment (Manly et al. 2002). We first calculated whether the distribution of sizes of prey taken across the samples per habitat, differed from the sizes of prey available in that habitat, using a chi-square test (Manly et al. 2002). We then evaluated, for each size class of prey taken from each habitat (e.g., 5-10 mm, mudflat), the significance of \( w_i \), the selection index, where \( w_i = o_i / \pi_i \), \( o_i \) = the
Plover diet and prey selectivity

sample proportion used by the study species, and $\pi_i = \text{the sample proportion available to the study species.}$ We calculated the SE of $w_i$ and 99% confidence intervals using formulae in Manly et al. (2002), using a more conservative alpha (0.01) to account for multiple comparisons across size classes. If $w_i$ equals 1 there is no selection, if it is $< 1$ then plovers forage less on the size class than expected (- selection), and if it is greater than 1, they forage more on the size class than expected (+ selection). If the confidence interval included 1 then there was no evidence of selection for that size class (Manly et al. 2002).

Results

Diet from fecal samples

Invertebrates with chitonous material (e.g., bivalves, ostracods, dipteran larvae, gastropods, polychaetes) comprised 80% of invertebrate fragments present in fecal samples ($n = 126$ fecal samples; Table 2). In both salt marshes and mudflats, polychaetes were the most common prey group in fecal samples and, with gastropods and unidentified worms/larvae, the only taxonomic groups to be represented in both habitats (Table 2). More taxonomic groups were found in fecal samples from salt marsh than mudflats (12 and 5 taxonomic groups for salt marsh and mudflat respectively, Table 2). There was no difference in the average number of invertebrates per fecal sample between the two habitats (GLM: Habitat effect, $P = 0.69$) (Table 2).
Plover diet and prey selectivity

Size selection of polychaetes

Nereid polychaetes made up 32% of the 468 prey items identified in fecal samples from salt marsh sites and 36% of the 504 prey items identified from fecal samples collected from mud flat sites. Polychaetes collected from fecal samples at salt marsh sites were significantly longer than those collected at mudflat sites (LS means ± SE, salt marsh: 18.3 ± 0.34 mm, mud flat: 10.4 ± 0.42 mm, Habitat effect: $F_{1,44} = 70.4, P < 0.0001$, variance components for site and fecal pellet comprised 4.1% and 2.2% of the total variance, respectively). Semipalmated Plovers positively selected polychaetes measuring 10-15, and 20-25 mm, and avoided polychaetes in the smallest (<10 mm) size category and in the 25-30 mm category ($\chi^2_5 = 173.6, P < 0.00001$, Fig. 1). While $w_i$ for the 30-35 mm category also indicated a pattern of avoidance, the confidence intervals overlapped 1 (Table 3). In mudflat sites, foraging plovers also showed significant size-selection ($\chi^2_2 = 86.0, P < 0.00001$) although they foraged only on three of the six size classes that they consumed in salt marshes (Fig. 1). Plovers in mudflats avoided the smallest size class (5-10 mm) and strongly selected polychaetes in the 10-15 mm size classes ($w_{10-15} = 2.32$, Table 3). Plovers foraging on mudflats did not forage on any polychaete over 20 mm despite these comprising 18.4% of the total available from mudflats (contra 24.6% in salt marsh, Fig. 1).

Discussion

Foraging plovers in the Cumberland Island estuarine complex appear to have adopted an opportunistic and highly flexible foraging strategy, common in many migratory shorebird species (Thompson and Barnard 1984; Skagen and Oman 1996;
Plover diet and prey selectivity

Smith et al. 2012). However, the taxonomic diversity of the diets of Semipalmated Plover, and the degree to which they exhibit size selectivity of the Nereid polychaetes, the most common prey item in the diet, varied between their two major foraging habitats at our study sites. As reported in an earlier study (Rose and Nol 2010), there was similar diversity of prey in core samples collected from the same study sites (22 and 21 taxonomic groups from salt marsh and mudflats respectively) despite that the density of prey in mudflats was at least twice what was measured in salt marshes (Rose and Nol 2010). As predicted by optimal foraging theory (MacArthur and Pianka 1966; Kober and Bairlein 1997), there were fewer taxonomic groups represented in the fecal samples from mudflats where prey was more abundant, suggesting that plovers were more selective and exhibited greater diet specialization there than while foraging on the salt marshes.

Selection for specific size classes was also stronger at the mudflat than in the salt marsh. This result is also consistent with the theory that selectivity will increase when prey densities increase (Estabrook and Dunham 1976). Semipalmated Plovers foraged non-selectively on the most abundant size classes of polychaetes in salt marsh habitats but selectively for worms 10-15, and 20-25 mm, so that collectively, these intermediate sizes made up over 60% of the diet. By contrast at mudflats there was significant and strong selection for worms only in the 10-15 mm size class. The selection index calculated for this size class (2.33) indicated that they were taken in more than twice the proportion of their availability (Manly et al. 2002), the strongest selection index that was calculated in our study.
Avoidance of large (> 25 mm) size classes of polychaetes, as determined from our statistical analysis of selection, was only observed at salt marshes, although plovers at mudflats also appeared to strongly avoid these larger animals despite their relatively common occurrence in the environmental samples. At the salt marsh we often observed plovers struggle to pull the large polychaetes from their burrows. Plovers may have been unable to effectively eat the large polychaetes or they could have been avoided due to excessive handling times. At the mudflats, the softer, wetter substrate made up of finer particles (Rose and Nol 2010) may also have allowed the largest polychaetes to escape capture (Ribeiro et al. 2004).

Medium-sized polychaetes dominated at the salt marsh sites while smaller polychaetes were most common at mudflats. A preponderance of small individuals in the mudflats may indicate competition among the greater number of polychaetes, which could result in smaller sizes of individuals (Levin 1982). It is also possible that, despite similar jaw curvature and physical appearance, the Nereidae from the two habitats represent two difficult to distinguish species, *Alitta succinea* (Leuckart, 1847), and *Nereis (Alitta) virens* (Sars, 1835), that are both found on the Atlantic coast (Prezant et al. 2002) with the larger *N. (A.) virens* (Olive 1993) occurring in salt marshes.

No difference was found in the average number of chitonous prey items per fecal sample between salt marsh and mudflat sites. Foraging observations suggested that birds foraging at mudflats should have consumed about three times the number of invertebrates than birds foraging at salt marsh sites (Rose and Nol 2010). However, foraging birds at mudflats defecated 2 to 4 times more frequently than birds at salt
Plover diet and prey selectivity

marshes (Rose and Nol 2010) so the number of items per fecal pellet may have an upper limit depending on the capacity of the plover digestive system.

Several prey have been described in this study for the first time as part of the diet of Semipalmated Plovers, including Macoma (Leach, 1819) bivalves and Tanaidae isopods. While polychaetes dominated the diets of foraging Semipalmated Plovers at both salt marsh and mudflat sites in Georgia, they were not recorded from the fecal samples collected from plovers in coastal Venezuela (Smith and Nol 2000). Similarly, Dolichopodidae larvae, which occurred in over 50% of the fecal samples collected in Venezuela, comprised only a very small proportion of the diets from Southern Georgia, and occurred only in fecal samples collected from salt marsh foraging birds. The two studies of foraging were conducted at different times of the year (October in Smith and Nol 2000, January through March in current study), and Dolichopodidae larvae may not have been present in Georgia during the winter months.

Polychaete worms make up an important proportion of shorebird prey in benthic marine habitats across the world (Hutchings 1998; Kalejta 1993; Mouritsen 1994; Perez-Hurtado et al. 1997; Weber and Haig 1997; Scheffarth 2001; D’Amico and Bala 2004), with Nereidae worms among the most cosmopolitan polychaetes. Why these organisms were absent from the diets of plovers in the open beach and mangrove sites sampled in Venezuela (Smith and Nol 2000), despite their presence in 60-70% of the samples from Georgia is unknown. Fewer fecal samples (39 versus 116) were examined in the Venezuelan study so sampling bias may play a role. It is unlikely that polychaetes were entirely absent from the Venezuelan environments (Liñero-Arana and Díaz Díaz 2011) but the insect larvae that dominated the diets there may have been more
Plover diet and prey selectivity

profitable. Given the role of polychaetes to shorebird food webs in general (Weber and Haig 1997; Iwamatsu et al. 2007), evaluating impacts of anthropogenic disturbances to benthic regions (e.g., Kaiser et al. 2001) will be a critical component of understanding the conservation needs for plovers during their 6-7 month non-breeding seasons (Nol and Blanken 2014).

Individual fecal pellets of plovers from both Venezuela and southern Georgia contained substantial numbers of invertebrates (Smith and Nol 2000). Hence, prey abundance may not be a limiting factor in either study area. Studies of the diet of this species throughout the non-breeding season, accompanying studies measuring the density of plovers and their energetics, including the use of models of predator/prey relationships (e.g., Goss-Custard 1977; Stillman et al. 2005) are needed. If these studies are conducted at both the northern (North Carolina, U.S.A) and southern geographic limits (southern Brazil, Uruguay, Nol and Blanken 2014) of the Semipalmed Plover’s large distributional range, researchers will be able to further clarify whether food limitation plays a role in limiting this species’ non-breeding distribution.

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Literature Cited


Plover diet and prey selectivity

Goss-Custard, J.D. 1977. Optimal foraging and the size selection of worms by redshank


Ieno, E., Martin, J.P., and Bastida, R. 2000. Estimation of size classes in Laeonereis
acuta (Polychaeta: Nereididae) based on jaw length and body width usable in

http://www.ingentaconnect.com/content/umrsmas/bullmar/2000/00000067/00000001/ar
t00005

Iwamatsu, S., Suzuki, A., and Sato, M. 2007. Nereidid polychaetes as the major diet of

doi:10.1016/S1385-1101(01)00052-1

Kalejta, B. 1993. Diets of shorebirds at the Berg River estuary, South Africa: spatial
and temporal variation. Ostrich, **64**(3): 123-133. doi:
10.1080/00306525.1993.9632646

Kober, K., and Bairlein, F. 2009. Habitat choice and niche characteristics under poor
food conditions. A study on migratory Nearctic shorebirds in the intertidal flats
of Brazil. Ardea, **97**(1): 31-42. http://dx.doi.org/10.5253/078.097.0105

https://mc06.manuscriptcentral.com/cjz-pubs
Plover diet and prey selectivity


Plover diet and prey selectivity


Plover diet and prey selectivity


Rose, M.A. 2006. Semipalmated Plover, Charadrius semipalmatus, winter foraging behavior in a southern estuary. M.Sc. thesis, Biology Department, Trent University, Peterborough, ON.


Plover diet and prey selectivity


**Plover diet and prey selectivity**

**Figure Caption**

**Fig. 1.** Frequency distribution of the proportions of different size classes (mm) of Nereid polychaetes found in fecal samples (determined from regressions of jaw length to total length) and core samples at salt marsh (top panel) and mudflat (bottom panel) habitats in the Cumberland Island estuary. Significance of selection for or against particular size classes ($P < 0.05$) are indicated with an * and + or – for positive or negative selection indices, respectively. Sample sizes are 280 and 278 jaws from salt marsh and mudflat fecal samples and 389 and 123 whole polychaetes at salt marsh and mudflat sites, respectively.
Table 1. Regressions used to calculate total length of *Nereis* spp. from jaw lengths obtained from Semipalmated Plover fecal samples collected from the Cumberland Island, Georgia mudflat and salt marsh habitats. Samples collected for constructing regression equations were from the same locations that fecal samples were collected.

<table>
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<tr>
<th>Habitat</th>
<th>Regression equation (slope, SE)</th>
<th>$R^2$</th>
<th>P</th>
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<td>Mudflat (n = 106)</td>
<td>Total length (mm) = 3.75 (SE: 0.22) Jaw length + 6.29</td>
<td>0.73</td>
<td>0.00001</td>
</tr>
<tr>
<td>Salt marsh (n = 409)</td>
<td>Total length (mm) = 4.41 (SE: 0.11) Jaw length + 3.73</td>
<td>0.81</td>
<td>0.00001</td>
</tr>
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</table>
Table 2. Mean number of identifiable prey found per fecal sample from Semipalmated Plovers foraging in salt marsh (n = 58 fecal samples) and mudflat habitats (n = 68 fecal samples) collected in coastal Georgia. N = Number of fecal samples containing that particular taxon.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Salt Marsh</th>
<th></th>
<th>Min,Max</th>
<th>Mudflat</th>
<th></th>
<th>Min,Max</th>
</tr>
</thead>
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<tr>
<td></td>
<td>N</td>
<td>Mean±SE</td>
<td></td>
<td>N</td>
<td>Mean±SE</td>
<td></td>
</tr>
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<td>Amphipoda Spp.</td>
<td>5</td>
<td>1.4 ± 0.40</td>
<td>1,3</td>
<td>35</td>
<td>3.94 ± 0.52</td>
<td>1,15</td>
</tr>
<tr>
<td>Amplescia</td>
<td>2</td>
<td>2.25 ± 1.5</td>
<td>1,4</td>
<td></td>
<td></td>
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<tr>
<td>Bivalvia Spp.</td>
<td>3</td>
<td>1 ± 0.0</td>
<td>1,1</td>
<td></td>
<td></td>
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<tr>
<td>Venerida</td>
<td>4</td>
<td>1.25 ± 0.25</td>
<td>1,2</td>
<td></td>
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<tr>
<td>Macoma</td>
<td>7</td>
<td>1 ± 0.0</td>
<td>1,1</td>
<td></td>
<td></td>
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<tr>
<td>Copeopoda Ostracoda</td>
<td>35</td>
<td>3.94 ± 0.52</td>
<td>1,15</td>
<td></td>
<td></td>
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<tr>
<td>Diptera Canacida</td>
<td>13</td>
<td>1.38 ± 0.24</td>
<td>1,4</td>
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<tr>
<td>Chironomida</td>
<td>8</td>
<td>2.13 ± 0.3</td>
<td>1,3</td>
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<tr>
<td>Dolichopodida</td>
<td>10</td>
<td>1.3 ± 0.15</td>
<td>1,2</td>
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<tr>
<td>Gastropoda Spp.</td>
<td>8</td>
<td>1.13 ± 0.13</td>
<td>1,2</td>
<td>7</td>
<td>1.43 ± 0.30</td>
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<td>Isopoda Spp.</td>
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<td>Polychaeta Nereis</td>
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<td>54</td>
<td>5.13 ± 0.46</td>
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<td>Tanaidacea Tanaidae</td>
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<td>8 ± 3.67</td>
<td>1,18</td>
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<td>Unidentified Worm/Larvae</td>
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<td>1,15</td>
<td>48</td>
<td>1.5 ± 0.11</td>
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<td>Total Number of Fecal Samples</td>
<td>58</td>
<td>8.13 ± 0.83</td>
<td>1,29</td>
<td>68</td>
<td>7.41 ± 0.76</td>
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<tr>
<td>Average Number of Prey per Sample</td>
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</table>
Table 3. Selection indices \((w_i)\) and 99\% confidence intervals (CI) for size classes of *Nereis* taken by Semipalmated Plovers in salt marsh and mud flat environments in the Cumberland Island estuary, coastal Georgia, U.S.A. Calculations were made only for size classes for which prey was consumed.

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