

## **Piping Plover Foraging Distribution and Prey Abundance in the Pre-laying Period**

Author(s) :Jonathan B. Cohen and James D. Fraser

Source: The Wilson Journal of Ornithology, 122(3):578-582. 2010.

Published By: The Wilson Ornithological Society

DOI: 10.1676/09-145.1

URL: <http://www.bioone.org/doi/full/10.1676/09-145.1>

---

BioOne ([www.bioone.org](http://www.bioone.org)) is a nonprofit, online aggregation of core research in the biological, ecological, and environmental sciences. BioOne provides a sustainable online platform for over 170 journals and books published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Web site, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at [www.bioone.org/page/terms\\_of\\_use](http://www.bioone.org/page/terms_of_use).

Usage of BioOne content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

# Short Communications

*The Wilson Journal of Ornithology* 122(3):578–582, 2010

## Piping Plover Foraging Distribution and Prey Abundance in the Pre-laying Period

Jonathan B. Cohen<sup>1,2</sup> and James D. Fraser<sup>1</sup>

**ABSTRACT.**—Migratory birds arriving in breeding areas should select territories that maximize reproduction and survival. Prey available prior to egg laying may be as important as prey availability for chicks later in the season. We sampled benthic and terrestrial prey items in Piping Plover (*Charadrius melodus*) foraging habitat soon after they arrived in breeding areas in New York during 2001–2003. Benthic invertebrates in the sand flats were abundant and available to adults, whereas terrestrial arthropods typically used later in the season were sparse in all cover types. Foraging adults selected intertidal sand flats over other microhabitats. One benefit of nesting near sand flats apparently is abundant food upon arrival in breeding areas. Protecting habitat between arrival in breeding areas and territory establishment is uncommon but warranted for this threatened species. *Received 4 September 2009. Accepted 17 March 2010.*

Choice of a breeding territory is a key determinant of avian fitness and is made based on proximate cues that, in good habitat, will be correlated with fitness benefits (Fretwell and Lucas 1970). These cues may be related to cover from predators (Benson et al. 2009), intraspecific social attraction (Harrison et al. 2009), nest site availability (Rhodes et al. 2009), and food availability (Earnst and Rothe 2004). Food abundance during egg-laying may be critical both to current and future avian reproductive success via effects on adult energy reserves (Martin 1987). Lack (1954) proposed that breeding should be timed so chicks should hatch at the time of greatest food abundance. However, habitat quality during territory establishment (i.e., between the start of the breeding season and egg-laying) and during brood-rearing may not be correlated (Nooner et al. 2005). Thus, adults cannot forecast availability of food for chicks by prey abundance leading up to and during egg-laying (Kirstan et al. 2007).

Selecting habitat that does not provide adequate food for chicks is not a viable strategy, but food availability for the young may not necessarily be a proximate cue for decisions about territory location and size. Prey used by adults and chicks during the breeding season may be entirely different for some bird species, (Wilson et al. 2004) or partially overlap (Shealer 1998, Jiguet 2002). Diets of adult and chick Eurasian Dotterels (*Charadrius morinellus*) differed early in the breeding season and became more similar as soft-bodied prey became more prevalent (Galbraith et al. 1993).

Precocial birds may benefit more than altricial species from settlement decisions based on habitat conditions at time of territory establishment, rather than on a forecast of future conditions, because they can move their broods to high-quality foraging habitat soon after hatch (Kosztolanyi et al. 2007). Our objective was to examine the types and distribution of prey available to Piping Plover (*Charadrius melodus*) adults upon arrival in breeding areas. Foraging adults tend to concentrate in intertidal flats upon arrival at East Coast breeding sites where those habitat features are available (Fraser et al. 2005), whereas after the breeding season chicks forage in a range of upland and intertidal habitats (Elias et al. 2000). We predicted that intertidal flats would provide abundant prey between arrival and egg-laying.

### METHODS

Our study area was West Hampton Dunes, New York, USA (40 46.5' N, 72 43' W) from 2001 to 2003. This 2.8-km long barrier island village was 200–500 m wide, bounded by the Atlantic Ocean to the south and Moriches Bay to the north. The ocean shoreline of the island was characterized by a relatively linear high-wave energy intertidal zone with fresh wrack (washed-up organic debris) at the daily high tide line. The bay shoreline of the island was a low-wave energy intertidal zone, including portions of linear shoreline interrupted

<sup>1</sup>Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061, USA.

<sup>2</sup>Corresponding author; e-mail: jocohen1@vt.edu

by 27 ha of irregularly shaped sand flats with fresh wrack at the daily high tide line.

Piping Plover adults arriving to breed on the Atlantic Coast forage primarily on intertidal sand flats and mudflats that may or may not be contiguous with sandy beaches used for nesting (Cairns 1982, Fraser et al. 2005). Nesting pair density is higher at sites that contain sand flats adjacent to nesting areas than at sites that do not (Patterson et al. 1991, Elias et al. 2000, Cohen et al. 2009), suggesting a fitness benefit of nesting near sand flats. Adults forage on benthic polychaetes and crustaceans (Cairns 1977) and terrestrial arthropods (Shaffer and Laporte 1994). Adults lead chicks to foraging sites after the eggs hatch where they prey primarily on adult arthropods (Cuthbert et al. 1999); chicks generally do not prey on benthic invertebrates until they are near fledging. Sand flats provide abundant arthropods in summer (Cohen et al. 2009), but nesting Piping Plovers arrive before insects typically emerge. Thus, prey for chicks cannot be a proximate influence on territory selection.

We collected 10-cm diameter  $\times$  2-cm deep sediment cores from randomly-selected sites from the bay side intertidal flats using sections of PVC pipe. We collected all samples on 1 day, within a week of the first large arrival of Piping Plovers. Piping Plovers forage on invertebrates at or just under the surface, and our cores represented the zone with the most readily available prey. Sediment samples were stored in 1-L Nalgene jars filled with 100% ethanol. We later sorted organisms from the sediment samples and counted them by general category (polychaete worms, crustaceans, insect larvae, and other organisms).

We sampled adult arthropods in several cover types on the ocean and bay side of the island using paint stirrers coated, except for the handles, with Tanglefoot Insect Trap Coating (The Tanglefoot Company, Grand Rapids, MI, USA). These cover types included intertidal zone (the zone between the water and the day's high tide line, which on the bay side contained the sand flats), fresh wrack (washed up organic debris from the most recent high tide), old wrack (clumps of sand-covered wrack deposited by earlier high tides), backshore (flat, dry sandy area between the mean high tide line and the dune, including bare and vegetated substrates), and dune (a low sandy ridge). We placed one pair of paint stirrers in each cover type on each of six transects, the first of which was placed at random within 100 m of the edge of the

site and the rest were evenly-spaced at 420-m intervals. We placed one stirrer vertically in the sand with the uncoated handle buried and the flat surface facing the water's edge. The other stirrer was horizontal on the ground 10 cm south of the vertical stick with its long axis parallel to the water's edge. The area exposed was 64.5 cm<sup>2</sup> (21.5  $\times$  3 cm) for the horizontal stick (coated on the upper side only) and 129 cm<sup>2</sup> for the vertical stick (coated on both sides, Loegering and Fraser 1995). We collected sticky trap samples in 1 day within 1 week of collecting sediment samples. The sticks were exposed for 3 hrs between mid-falling and mid-rising tide, starting between 0700 and 1000 hrs, after which we recorded the number of arthropods in different taxa.

We performed a census of Piping Plovers in the study area concurrent with arthropod sampling, and recorded the numbers that were foraging in 2002 and 2003. We calculated the proportion of birds in each cover type on the bay and ocean side of the island, including upland and intertidal areas. We also measured the area of the intertidal zones and upland zones (the aggregation of non-intertidal cover types) from aerial photographs taken before 5 May each year by tracing polygons on digitized versions of the photographs in ArcView 3.1 (ESRI, Redlands, CA, USA). We then calculated the percent area of those cover types.

## RESULTS

We observed the first Piping Plovers at the site between 12 and 15 March with larger numbers ( $\sim$  20) arriving between 18 and 21 March. The earliest recorded nest at the site was on 17 April.

We found low numbers of terrestrial arthropods, and many sticky traps caught no arthropods (Table 1). By contrast, there were abundant benthic invertebrates in the bayside intertidal zone (Table 1). No sediment cores were totally devoid of organisms. The benthos in the cores comprised mainly polychaete worms, crustaceans, and insect larvae with the proportions of each depending on year (Fig. 1).

We observed  $93 \pm 1\%$  ( $\bar{x} \pm SE$ ) ( $n = 46$ ) of foraging Piping Plovers in the bay intertidal zone in 2002, which comprised 32% of the habitat area. The other  $7 \pm 1\%$  were using the ocean intertidal zone which comprised 8% of the habitat area. The remaining 60% of the area was unused upland. We only observed seven foraging Piping Plovers

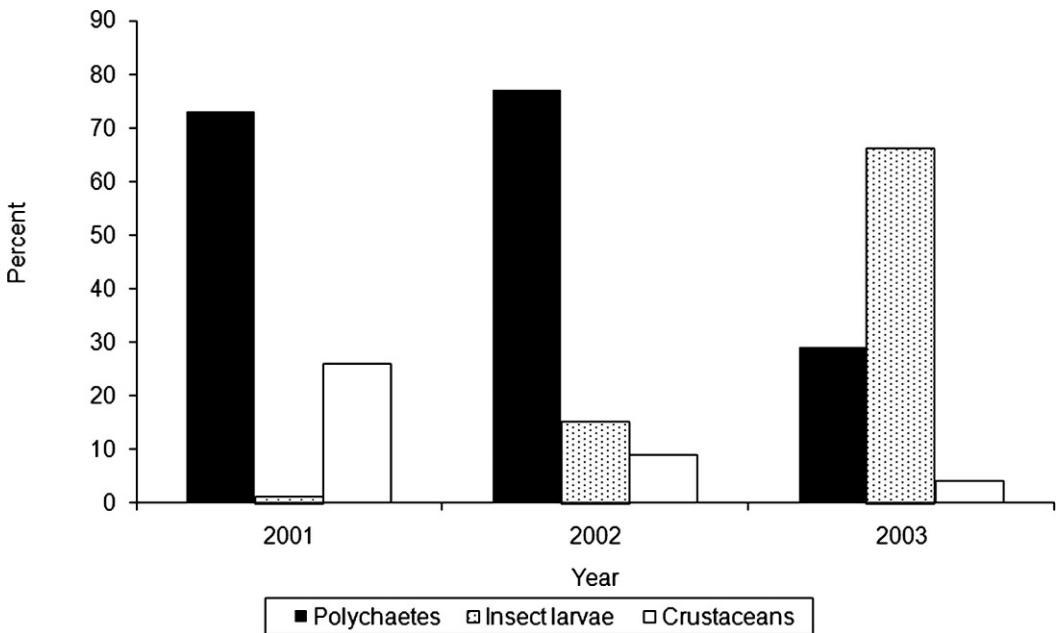


FIG. 1. Mean percent abundance of polychaete worms, insect larvae, and crustaceans in benthic cores from intertidal sand flats in a Piping Plover breeding area, West Hampton Dunes, New York, 2001–2003.

in 2003, all of which were in the bay intertidal zone, which comprised 38% of the habitat area.

DISCUSSION

The prey base when Piping Plovers arrived in breeding areas largely consisted of intertidal zone

benthos. We did not have the resources to sample and analyze the ocean intertidal zone benthos, but in casual observations we noted Piping Plovers foraging on worms there. The plovers were distributed between two habitats (sand flats and ocean intertidal zone) that provided benthic prey. The substrate in upland areas was dry sand and

TABLE 1. Prey organisms in Piping Plover foraging habitat, caught in terrestrial sticky trap samples and benthic core samples, West Hampton Dunes, New York, 2001–2003.

Prey type	Cover type	Date	n	No. >0 <sup>a</sup>	Organism counts		
					Min	Max	Median
Terrestrial	Bay ITZ <sup>b</sup>	19 Mar 2001	5	0 (0%)	0	0	0
		24 Mar 2002	5	2 (40%)	0	5	0
		25 Mar 2003	5	0 (0%)	0	0	0
	Ocean ITZ	19 Mar 2001	6	0 (0%)	0	0	0
		24 Mar 2002	6	1 (17%)	0	1	0
		25 Mar 2003	6	0 (0%)	0	0	0
	Upland <sup>c</sup>	19 Mar 2001	40	1 (3%)	0	1	0
		24 Mar 2002	43	20 (47%)	0	8	0
		25 Mar 2003	48	4 (8%)	0	2	0
Benthic	Bay ITZ	18 Mar 2001	6	6 (100%)	3	18	11
		24 Mar 2002	6	6 (100%)	4	135	43
		25 Mar 2003	9	9 (100%)	11	349	34

<sup>a</sup> No. >0 = number of samples (sticky traps or sediment cores) with at least one prey organism.

<sup>b</sup> ITZ = intertidal zone.

<sup>c</sup> Upland = pooled samples from all strata (cover types) at or above the tide line. These include fresh wrack, old wrack, backshore (bare and vegetated strata), and dune.

would not be expected to host benthos. Terrestrial arthropods were virtually absent from all zones, even though large numbers are caught in sticky traps later in spring and summer (Cohen et al. 2009). Thus, early season prey abundance and distribution could affect Piping Plover territory location and size, and could help explain why nesting pair density of Piping Plovers is high where sand flats are available (Patterson et al. 1991, Elias et al. 2000, Cohen et al. 2009). There often is a tidal lag between the bay and ocean side of barrier islands as water passes through tidal inlets, and the presence of bay side intertidal flats could increase the potential time each day that benthic organisms are available as prey.

A connection between early season foraging opportunities and fitness may not require adults to forecast prey availability for chicks. Reproductive success in many avian studies decreases with time from onset of breeding (Martin 1987). Insect abundance during egg-laying and chick-rearing were uncorrelated for Tree Swallows (*Tachycineta bicolor*), but reproductive success was correlated with insect abundance during egg-laying by affecting timing of breeding and egg mass (Nooker et al. 2005). Thus, it likely benefits female Piping Plovers to nest adjacent to high-quality foraging habitat that allows them to quickly enter breeding condition. Maternal nutrition has been shown to influence quality of offspring of many avian species with offspring ranging from fully altricial to fully precocial (Blomqvist et al. 1997, Parker 2002, Reynolds et al. 2003, Verboven et al. 2003).

Perhaps more importantly in our study area, intertidal flats usually host a higher abundance of arthropods in late spring than other cover types (Loefering and Fraser 1995, Elias et al. 2000, Cohen et al. 2009). Thus, the same cover type provides prey for adults upon arrival and different but still abundant prey for chicks later in the season. However, chicks in some breeding areas cannot access intertidal sand flats, and there is a difference between pre-laying and chick-rearing foraging areas. Piping Plover broods in Virginia without access to bay side flats starved, because the ocean beaches were arthropod-poor and only chicks that accessed intertidal flats survived (Loefering and Fraser 1995). Some adults in that case settled within easy flight range of early-season foraging habitat but, when their eggs hatched, there was insufficient food for their chicks. Sand flats were used by foraging adults in

a site adjacent to our study area in New York, but were not available to any broods (Cohen et al. 2009). Chick survival was unaffected in that case (Cohen et al. 2009).

Most strategies commonly used for Piping Plover conservation focus on enhancing survival of eggs and chicks to improve productivity (fledglings produced per breeding pair), and protections often are established after birds have settled on their territories (USDI 1996). However, true productivity is number of recruits into the breeding population per breeding pair (Martin 1987). The correlation between recruitment and fledglings produced depends in part on natal site philopatry which can be a function of density and habitat quality (Sedgwick 2004, Wrege et al. 2006), and which was low (~ 12%) at our site (Cohen et al. 2006). Site fidelity of adults and immigration of new breeders may depend on habitat conditions during pre-laying (Wrege et al. 2006). Thus, protecting habitat from disturbance or degradation during the pre-laying period is important.

#### ACKNOWLEDGMENTS

The U.S. Army Corps of Engineers, New York District, provided funding for this study. Amy Alsfeld, Elizabeth Forbus, Sarah Gibson, Stephen Hartsfield, Jed Hayden, Emilie Masiello, Melissa Neely, Dawn Romaine, and Donald Wardwell assisted with data collection. Steven Deso assisted with laboratory work.

#### LITERATURE CITED

- BENSON, T. J., N. M. ANICH, J. D. BROWN, AND J. C. BEDNARZ. 2009. Swainson's Warbler nest-site selection in eastern Arkansas. *Condor* 111:694-705.
- BLOMQVIST, D., O. C. JOHANSSON, AND F. GOTMARK. 1997. Parental quality and egg size affect chick survival in a precocial bird, the Lapwing *Vanellus vanellus*. *Oecologia* 110:18-24.
- CAIRNS, W. E. 1977. Breeding biology and behaviour of the Piping Plover (*Charadrius melodus*) in southern Nova Scotia. Thesis. Dalhousie University, Halifax, Nova Scotia, Canada.
- CAIRNS, W. E. 1982. Biology and behavior of breeding Piping Plovers. *Wilson Bulletin* 94:531-545.
- COHEN, J. B., J. D. FRASER, AND D. H. CATLIN. 2006. Survival and site fidelity of Piping Plovers on Long Island, New York. *Journal of Field Ornithology* 77:409-417.
- COHEN, J. B., L. M. HOUGHTON, AND J. D. FRASER. 2009. Nesting density and reproductive success of Piping Plovers in relation to storm- and human-created habitat changes. *Wildlife Monographs* 173.
- CUTHBERT, F. J., B. SCHOLTENS, L. C. WEMMER, AND R. McLAIN. 1999. Gizzard contents of Piping Plover

- chicks in northern Michigan. *Wilson Bulletin* 111: 121–123.
- EARNST, S. L. AND T. C. ROTHE. 2004. Habitat selection by Tundra Swans on northern Alaska breeding grounds. *Waterbirds* 27:224–233.
- ELIAS, S. P., J. D. FRASER, AND P. A. BUCKLEY. 2000. Piping Plover brood foraging ecology on New York barrier islands. *Journal of Wildlife Management* 64: 346–354.
- FRASER, J. D., S. E. KEANE, AND P. A. BUCKLEY. 2005. Prenesting use of intertidal habitats by Piping Plovers on South Monomoy Island, Massachusetts. *Journal of Wildlife Management* 69: 1731–1736.
- FRETWELL, S. D. AND H. L. LUCAS JR. 1970. On territorial behavior and other factors influencing habitat distribution in birds. *Acta Biotheoretica* 19:16–36.
- GALBRAITH, H., S. MURRAY, K. DUNCAN, R. SMITH, D. P. WHITFIELD, AND D. B. A. THOMPSON. 1993. Diet and habitat use of the Dotterel *Charadrius morinellus* in Scotland. *Ibis* 135: 148–155.
- HARRISON, M. L., D. J. GREEN, AND P. G. KRANNITZ. 2009. Conspecifics influence the settlement decisions of male Brewer's Sparrows at the northern edge of their range. *Condor* 111:722–729.
- JIGUET, F. 2002. Arthropods in the diet of Little Bustards *Tetrax tetrax* during the breeding season in western France. *Bird Study* 49:105–109.
- KIRSTAN III, W. B., M. D. JOHNSON, AND J. T. ROTENBERRY. 2007. Choices and consequences of habitat selection for birds. *Condor* 109:485–488.
- KOSZTOLANYI, A., T. SZEKELY, AND I. C. CUTHILL. 2007. The function of habitat change during brood-rearing in the precocial Kentish Plover *Charadrius alexandrinus*. *Acta Ethologica* 10:73–79.
- LACK, D. 1954. *The natural regulation of animal numbers*. Oxford University Press, Oxford, United Kingdom.
- LOEGERING, J. P. AND J. D. FRASER. 1995. Factors affecting Piping Plover chick survival in different brood-rearing habitats. *Journal of Wildlife Management* 59: 646–655.
- MARTIN, T. E. 1987. Food as a limit on breeding birds: a life-history perspective. *Annual Review of Ecology and Systematics* 18:453–487.
- NOOKER, J. K., P. O. DUNN, AND L. A. WHITTINGHAM. 2005. Effects of food abundance, weather, and female condition on reproduction in Tree Swallows (*Tachycineta bicolor*). *Auk* 122:1225–1238.
- PARKER, T. H. 2002. Maternal condition, reproductive investment, and offspring sex ratio in captive Red Junglefowl (*Gallus gallus*). *Auk* 119:840–845.
- PATTERSON, M. E., J. D. FRASER, AND J. W. ROGGENBUCK. 1991. Factors affecting Piping Plover productivity on Assateague Island. *Journal of Wildlife Management* 55: 525–531.
- REYNOLDS, S. J., S. J. SCHOECH, AND R. BOWMAN. 2003. Diet quality during pre-laying and nestling periods influences growth and survival of Florida Scrub-Jay (*Aphelocoma coerulescens*) chicks. *Journal of Zoology*, London 261:217–226.
- RHODES, B., C. O'DONNELL, AND I. JAMIESON. 2009. Microclimate of natural cavity nests and its implications for a threatened secondary-cavity-nesting passerine of New Zealand, the South Island Saddleback. *Condor* 111: 462–469.
- SEDGWICK, J. A. 2004. Site fidelity, territory fidelity, and natal philopatry in Willow Flycatchers (*Empidonax traillii*). *Auk* 121:1103–1121.
- SHAFFER, F. AND P. LAPORTE. 1994. Diet of Piping Plovers on the Magdalen Islands, Quebec. *Wilson Bulletin* 106: 531–536.
- SHEALER, D. A. 1998. Differences in diet of chick provisioning between adult Roseate and Sandwich terns in Puerto Rico. *Condor* 100:131–140.
- U. S. DEPARTMENT OF INTERIOR (USDI). 1996. Piping Plover (*Charadrius melodus*), Atlantic Coast Population. Revised Recovery Plan. USDI, Fish and Wildlife Service, Hadley, Massachusetts, USA.
- VERBOVEN, N., P. MONAGHAN, D. M. EVANS, H. SCHWABL, N. EVANS, C. WHITELAW, AND R. G. NAGER. 2003. Maternal condition, yolk androgens and offspring performance: a supplemental feeding experiment in the Lesser Black-backed Gull (*Larus fuscus*). *Proceedings of the Royal Society of London, Series B* 270: 2223–2232.
- WREGE, P. H., W. D. SHUFORD, D. W. WINKLER, AND R. JELLISON. 2006. Annual variation in numbers of breeding California Gulls at Mono Lake, California: the importance of natal philopatry and local and regional conditions. *Condor* 108: 82–96.
- WILSON, L. J., F. DAUNT, AND S. WANLESS. 2004. Self-feeding and chick provisioning diet differ in the Common Guillemot *Uria aalge*. *Ardea* 92: 197–208.