Moist Substrate Habitats For Piping Plovers on the Atlantic and Gulf of Mexico Coasts

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Introduction

Moist substrates are important foraging habitats for piping plovers. Such habitats appear to enhance chick survival, particularly in the southern part of the plover's breeding range. Moreover, the distribution and size of such habitats play an important role in determining the distribution and abundance of breeding and wintering plovers. In this paper, I provide a brief overview of piping plover use of moist substrate habitats, and suggest the management implications of this information.

Moist Substrate Habitats Used by Piping Plovers

Moist substrate habitats used by piping plovers typically have few or no vascular plants, and they are rich in the invertebrates that plovers eat. Habitats used by piping plovers include bay and sound intertidal flats that are protected from high-energy waves, the ocean and gulf intertidal zones, beach pools, tidal ponds, algal flats and human-made impoundments. Ocean and gulf intertidal zones, which are subjected to high-energy waves, are the least preferred of these habitats. In contrast, use-availability analyses show that the others rank very high. Thus, for the remainder of this paper the term "moist substrate habitats" will exclude ocean and gulf high-energy intertidal zones.

Habitat use before breeding

Many piping plovers arrive in breeding areas well before the time of most active courtship. During this period, piping plovers use bay intertidal zones preferentially (Loegering 1992, Cohen, Houghton, and Keane, unpublished data). This use is tide dependent. During pre-breeding surveys conducted at low tide on Assateague Island, Loegering (1992) observed 9 times as many plovers on bay tidal flats as he did in the ocean intertidal zone. At high tide, however, when the bay intertidal flats were submerged, the number of piping plovers on the bay side of barrier islands was similar to the number on the ocean side. On South Monomoy Island, Massachusetts, foraging in sound and tidal pool intertidal zones was not spread uniformly across falling and rising tides. Rather the use was most concentrated on the lowest stage of the tide (Keane, unpublished data). This may be because benthic organisms are more abundant in the lower part of the intertidal zone where their habitat is covered by water much of the day (Bertness 1999).

Habitat use during breeding

Nest Site Selection – Piping plovers often select nest sites near moist substrate habitats. Patterson (1988:37) noted that most plover nesting on Assateague Island, Maryland and Virginia, occurred on beaches adjacent to one of the several types of moist substrate habitats available there. Elias et al. (2000) reported the pattern of nesting on three New

York barrier Islands. All 1-km beach segments that were adjacent to either beach pools or bay intertidal zone were used for nesting, whereas fewer than half of the beach segments without these habitats were used by nesting piping plovers. Beach segments adjacent to these habitats supported 48 % of nesting pairs in that study, despite comprising only 12% of the habitat.

Piping plovers colonized West Hampton Dunes, New York, after the island breached and large tidal flats were deposited (Houghton and Cohen, unpublished data). Similarly, the plover population on Assateague Island National Seashore increased dramatically after storms overwashed the island, increasing access to bay intertidal habitats (Kumer, unpublished data). On South Monomoy Island, more than 75% of plovers nested <400 m from large sound intertidal flats or a large intertidal pool (Keane, unpublished data).

Brood Habitat Selection -- In New York, when broods had access to beach pools, they spent more than 70% of their time in pool habitat. Compositional analysis, a technique for ranking habitats (Aebischer et al. 1993), showed that pool habitat ranked first in these areas (Elias et al. 1995). In the same study, broods with access to bay tidal flats spent 57% of their time in those habitats, which ranked first among habitats for that set of broods.

Habitat Use By Adults During Breeding -- Preliminary information from color marked birds in West Hampton Dunes, New York (Cohen, unpublished data), indicates that breeding adult plovers travel substantial distances to forage on tidal flats in Moriches Bay during incubation and brood rearing. Travel distances approaching 1 km have been recorded.

Habitat Use After Breeding

Habitat use immediately following breeding has received little formal study. However, we have observed fledgling piping plovers using the intertidal flats at West Hampton Dunes, New York, at the end of the breeding season. When chicks are first capable of flying, they only weigh about 70% of adult weight (Cohen, unpublished data). Foraging on the intertidal flats, which are rich in polychaetes, mollusks and arthropods (Loegering 1992, Loegering and Fraser 1995, Bertness 1999, Elias et al. 2000) may allow fledglings to put on fat required for successful migration to wintering areas.

Winter

On the Alabama coast, piping plovers used mudflats or sandflats 93% of the time observed (Johnson and Baldassare 1988). As before breeding, this use is tide-dependent. Johnson and Baldassarre (1988) reported a negative correlation between tide height and foraging activity. Nicholls and Baldassare (1990) Surveyed 1422 km of shoreline from Virginia to Key West, and 1283 km from Everglades National Park to Brownsville, Texas. Using discriminant analysis, they found that percent of habitat classified as mudflat, sand flat and tide pool helped distinguish used from unused habitats on the Atlantic coast, and percent mudflat helped discriminate used from unused areas on the gulf coast. They noted “piping plovers were observed foraging most frequently on sandflats and sandy mudflats.” Likewise, Zonick (2000) found that during the winter on the Texas Gulf Coast barrier islands, plover densities were greater in bay side feeding areas than on Gulf side areas. Drake et al. (2001) used radio telemetry and estimated use of algal flats, lower sandflats and mudflats to comprise 74%, 89% and 78 % of habitat use in Fall, Winter and Spring, respectively.

The Adaptive Value Of Using Moist Substrates

Loegering and Fraser (1995) compared the behavior and survival of chicks with access to bay intertidal habitats with behavior and survival of chicks with access only to the ocean intertidal zone on Assateague Island, Maryland. Compared to chicks with access only to the ocean intertidal zone, chicks with access to the bay intertidal zone were exposed to higher arthropod densities, foraged more rapidly, were heavier at 4 and 5 days of age, and were more likely to survive until fledging than chicks without such access. On 3 New York Barrier Islands, arthropod densities were likewise greater in beach pools and bay tidal flats than in other plover foraging habitats. In 1992, chicks with access to New York beach pools exhibited higher survival than chicks in ocean beach habitats, but, in 1993, a year of very good survival on the ocean beach, there was no difference among habitat types. Similarly, in Massachusetts, chick survival can be quite good on the ocean beach (A. Hecht, S. Melvin, Personnel communication). It is possible that the quality of the ocean beach for foraging plovers is better in northern latitudes. Intertidal communities north of Cape Cod differ substantially from communities south of the cape (Vermeij 1978). For example, there are more burrowing polychaetes on northern intertidal zones than on more southerly intertidal areas (Bertness 1999).

In contrast, Zonick (2000) found similar prey densities in beach and bayshore habitats in the winter on the Texas Gulf Coast. However, he speculated that net energy gain from foraging might be less on gulf side habitats because there plovers had to rush up and down the beach to avoid being struck by incoming waves. An additional possible liability of foraging on the ocean beach is that the sound of the surf and the concentration required to elude waves may reduce the distances at which predators are detected.

The Importance Of Other Habitats

While moist substrate habitats are extremely valuable to piping plovers, these habitats must be juxtaposed with other key habitats. Other foraging habitats, such as wrack and open vegetation, can be important when key moist substrate habitats are inundated or otherwise unavailable. Moreover, wide beaches and vegetation provide roosting habitat and escape cover. Elias et al. (in review) showed that, in the absence of bay intertidal zone and beach pools, the width of open vegetation was a key predictor of plover nesting sites. Several authors emphasized the need for habitat heterogeneity with a variety of important habitat types juxtaposed (Nicholls and Baldassare 1990, Elias et al. 2000). Indeed, Zonick (2000) wrote that, although piping plovers preferred bay side intertidal habitats to gulf shore beaches, beach vehicular density was a key variable for predicting plover abundance.

Use Of Moist Substrate Habitats By Other Species

Moist substrate habitats support a variety of species other than piping plovers. For example, in West Hampton Dunes New York, where overwashes and island breaches in 1992 and 1993 created some 27 ha of bay intertidal habitats, we conducted 445 shorebird surveys from mid-March to mid-August in 1997-2000 (Houghton, unpublished data). Although our transects covered only a portion of the bay intertidal zone, we tallied in that habitat more than 50,000 observations of 22 species of waders and shorebirds other than piping plovers.

Management Implications

An important goal of piping plover management should be to provide a sustained yield of unvegetated moist substrate habitats. Management plans should state specific targets (ha of habitat) for each region managed. But what should those targets be? Unvegetated intertidal flats on the bay side of barrier islands are the most common of these habitats. The variations in processes that form such habitats (e.g. Hesp and Short 1999) are well beyond the scope of this paper. However, it is clear that overwashes and/or breaches do so. Others flats are created by sediment transport near unstabilized inlets. Coastal management practices over the last century, such as dune building, beach stabilization, and beach nourishment (Dean 1999) have almost certainly reduced the size and amount of unvegetated moist substrates along the Atlantic and gulf coasts, reducing the suitability of these coasts for piping plovers and other moist substrate organisms. It seems reasonable, therefore to set our targets higher than the amount of habitat that currently exists. These habitats should be juxtaposed to sandy beaches and sparse vegetation that are subjected to minimal human disturbance and vehicular traffic and that are protected from unnaturally high levels of predation.

An obvious, though politically difficult, approach to conserving moist substrate ecosystems is to find places where the natural processes of overwash, island breaching and sand transport can take place unencumbered by human intervention. In addition to benefiting a host of moist-substrate dependent organisms, overwashes will benefit other denizens of drier, but still early-successional habitats, from seabeach amaranth to tiger beetles to terns.

In places where it is deemed too costly or too dangerous to allow natural processes to proceed unchecked (and some would argue this includes most of the Atlantic barrier islands) it may be possible to restore some components of these systems by purposeful movement of materials. Doing this successfully will require careful attention to such factors as habitat juxtapositions, invertebrate colonization and survival, predator densities, and likely human responses to the new habitats.

Restoring unvegetated tidal flats also will require new thinking in the management of tidal wetlands. A great deal of effort has been well spent protecting salt marshes and other aquatic vegetation. Thus, the notion of placing sand in the intertidal zone will seem alien to some regulators and conservationists. However, if restoration efforts are successful, treated areas will eventually succeed to salt marsh, just as they would after natural sand deposition.

Clearly, design of such restoration efforts will require careful attention to the abiotic and biotic forces that shape the habitats in question. Existent information is scattered through a variety of journals in diverse disciplines. Some needed information remains to be discovered. It is hard to think of an area that promises greater opportunity for fruitful multidisciplinary collaboration. Specialist who could contribute to this effort include benthic and aquatic biologists, plant ecologists, ornithologists, beach geomorphologists, fish and wildlife biologists, beach and wildlife manageers and others.

One approach to obtaining the information required for an informed restoration effort would be to seek out areas where overwashes are imminent and to initiate multidisciplinary studies before overwash occurs. These studies should then be carried through the post-overwash period. Such 'before and after' studies should include investigations of phenomena such as invertebrate larvae settlement rates, infauna population dynamics, habitat use by shorebirds, fish, crabs and other intertidal predators, and plant and animal succession.

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