

RESPONSE OF MIGRANT SHOREBIRDS TO SEVERE AUTUMN WEATHER

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Whereas food for migrant shorebirds (Charadrii) appears to be generally abundant (Recher, Ecology 47:393-407, 1966), its availability is a function of a number of factors including tide cycle, day length, temperature, endogenous cycles of the prey, and the reduction in biomass because of predation by the birds (Evans, Ardea 64:123-124, 1976). There is some evidence that shorebirds nevertheless can maintain at least a neutral energy balance even during severe weather (Evans and Smith, Wildfowl 26:70-71 and 73, 1975), and that fat reserves in wintering shorebirds are sufficient to provide maintenance energy for short periods when feeding is impossible (Evans and Smith, Wildfowl 26:69, 1975). Although oceanic storms frequently strike the mid-Atlantic coast in late autumn, few descriptions of the responses of shorebirds to these severe conditions are available. This note describes unusual feeding of shorebirds during such conditions and reports use of normally unavailable habitat by nine species of Charadrii.

While gathering data on diurnal avian use of Brigantine National Wildlife Refuge, south coastal New Jersey, I made observations on shorebird activity from first light until one hour after sunset during 10-16 October 1977. Additional observations were made from Ocean City to Cape May throughout the month of October in conjunction with waterfowl (Anatidae) investigations.

The dikes on Brigantine surround two brackish impoundments consisting of 364 ha of largely open water (west pool) and 243 ha of open water with scattered small islands (east pool). Water levels are controlled such that the only habitat normally usable by shorebirds is the thin margin along the water's edge and a few exposed unvegetated areas in the east pool. When water levels are at full pool, shorebirds normally use the impoundments only when resting. The surrounding area, however, is an extensive tract of salt marsh (largely *Spartina alterniflora*) with numerous natural drainages, man-made ditches established for mosquito control, salt marsh pannes, and small ponds, all open to daily tidal flow. Large mixed species flocks of shorebirds use this surrounding marsh for feeding and resting throughout the day.

High tides accompanying a large storm began before dawn on 13 October and submerged the entire marsh surface of the New Jersey coast. Strong north-east winds held this water on the marsh and increased its depth on the 13th and 14th until it reached a maximum depth of over 1 m. Sandbars and mudflats were inundated continuously for at least 48 hours. On sandy beaches, small numbers of shorebirds were observed feeding at the abnormally high and extremely rough surf line or resting in the dunes among debris. Flocks were also seen resting in the median and along the road embankments of the Garden State Parkway which runs parallel and adjacent to the upland margin of the salt marsh. Those flocks observed resting on upland margins and among debris at the surf line on the upper edge of the marsh did not remain in one spot for more than 3 minutes and none were observed feeding. In contrast, the shorebirds observed around marshes and impoundments [Dunlins (*Calidris alpina*), Semipalmated Sandpipers (*C. pusilla*), Greater Yellowlegs (*Tringa melanoleuca*), Lesser Yellowlegs (*T. flavipes*), Black-bellied Plovers (*Pluvialis squatarola*), Dowitchers (*Limnodromus* sp.), Willets (*Catoptrophorus semipalmatus*), and Semipalmated Plovers (*Charadrius semipalmatus*)] were quite active. All moving flocks were flying northeast approximately parallel to the coast; none were observed flying out to the barrier island beaches. Moreover, flocks continued these parallel movements on the 13th and 14th as the wind increased to its maximum of 88 k/hr.

The wind was of sufficient strength to expose the floor of the west impoundment during the early morning of the 14th. As much as one-third of the floor of the west impoundment was either exposed mud or covered by water shallow enough for even the smaller species of shorebirds to feed. Shorebirds foraged over this entire area. Although total counts were impossible because of low visibility caused by salt spray and rain, a count of birds near the dike enabled me to estimate that about 1500 shorebirds of at least eight species were foraging on a 0.5 ha area adjacent to my observation site. Dunlins made up about 80 percent of the flock. Individuals fed intensively, then rested on the impoundment, head into the wind. Dunlins rested where they finished feeding. The larger birds moved behind clumps of emergents and debris on the impoundment floor. Winds were so strong that a Lesser Yellowlegs and a Black-bellied Plover were blown off their feet and tumbled more than 3 m before they were able to fly. I did not observe birds leaving the impoundment until 1645 when the continuous rain broke into squalls.

Shorebirds often augment the time they feed in the intertidal zone with feeding on upper areas of marshes during periods of high water as noted by Evans (*Ardea* 64:132, 1965). Burger et al. (*Auk* 94:743-758, 1977) found that migrating shorebirds moved between habitats to the extent that all were feeding somewhere throughout the daylight hours with the exception of the hour immediately preceding high tide. Their supposition (Burger et al. *Auk* 94:756, 1977) that species using tidal feeding sites would evolve flexible foraging strategies and diversified feeding techniques is supported by the observations reported herein. Habitat normally unavailable was immediately occupied as soon as water levels dropped. Although shorebirds probably would use the impoundments if water levels were consistently low, an important conclusion is that some species retain much plasticity in their foraging repertoire, specific characteristics of which may be unexpected because they can only be observed during periods of extreme stress.

It may be that migratory pathways of shorebirds and other species have evolved partially in response to seasonally predictable short-term deprivations such as that observed. The existence of rather unnatural habitat, such as the diked brackish marsh surrounded by salt marsh at Brigantine, might, on occasion, profoundly affect the survival probabilities of birds using them as migratory habitat. To the extent that some of the birds observed may have actually been wintering rather than migrating individuals (e.g., Dunlins), long-term benefits from wintering in the vicinity of the refuge would certainly accrue throughout the ice-free period in fall and early spring when storms are common.

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