The Effects of Prey Availability on the Feeding Tactics of Wading Birds

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A noticeable decline in several wading bird populations since the 1930s was one of the first signs that the Everglades ecosystem was being degraded. The relationship between hydrologic properties and wading bird nesting has helped define how the Everglades functions, and wading bird population levels are now being used as performance measures to monitor the progress of restoration. One common explanation for the population declines is that changes in hydrologic properties of the Everglades have reduced the amount of prey available to wading birds. An under appreciated point is that not all species have declined at the same rate, or perhaps even declined at all, even though they often nest and feed in the same locations. Furthermore, prey availability is not equivalent to prey density because availability may be affected by prey vulnerability to capture. In wetlands the influence of prey vulnerability may be particularly important for wading birds because they forage in an ecosystem with widely fluctuating water levels that influence the distribution, behavior, and vulnerability of prey. There currently is no mechanistic understanding of how prey become available to wading birds in a wetland, nor is there an understanding of how individual species in a wading bird assemblage respond to fluctuations in prey availability.

In 1996, I manipulated prey density and water depth in 12, 0.2-ha ponds to determine their relative effects on the feeding tactics of eight species of free-ranging wading birds. The experiment was conducted in a constructed wetland adjacent to, and west of, the northern tip of the remnant Everglades, in Palm Beach County, Florida. Each pond was set to one of three water depths (10 cm, 19 cm, or 28 cm) and stocked with golden shiners at a density of either 3 fish/m^2 or 10 fish/m^2.

Total bird use (all treatments pooled) increased from day 1 (day after stocking) to day 6, stabilized for several days at approximately 280 birds, and then decreased until day 16 when bird use nearly ceased. Fish were depleted most rapidly in the shallow and least rapidly in the deep treatment. Giving-up-density of prey (GUD), which is a measure of energetic foraging costs, increased with increasing water depth. In the deepest treatment, the White Ibis, Wood Stork, and Snowy Egret, had higher GUDs than did the Glossy Ibis, Great Egret, Tricolored Heron, Great Blue Heron, and Little Blue Heron. Also, the first 3 species were affected by both prey density and water depth whereas the latter 5 species showed a decidedly weaker response to one or the other component of food availability. The first three species never occurred in large numbers in the deep treatment and they abandoned the study site before other species reached their maximum levels. Their feeding strategy was to search for new high quality food patches (i.e., searchers) rather than stay and exploit food patches that were declining in quality (i.e., exploiters). Species that used a searching strategy also have shown the most severe population declines since the 1930s, suggesting that the loss of high-quality feeding sites may have resulted in the population changes. Based on the concordance between the experimental results and long-term population data, I hypothesize that what has changed in the ecosystem is the simultaneous occurrence of both high prey densities and shallow water (i.e., high quality patches), either in overall frequency, or the spatial and temporal pattern of their occurrence. This is distinct from the suggestion that average prey availability levels have declined or overall prey population levels have decreased because it only addresses the highest quality patches. In the natural system, high-quality patches contain shallow water and high fish densities.

They mainly occur as a result of a strong seasonal water level recession, often preceded by several years of wet conditions, which increase fish populations. These processes are not mutually exclusive and indeed an increase in overall fish population size coupled with a seasonal recession would produce the highest quality patches. High prey-density patches produce by a seasonal recession are fundamentally different from fish population increases solely as a result of increased hydroperiod or nutrient inputs because season recessions produce small-scale patches (1-20 m) that are clumped at any one time and moving across the landscape. Only one component of those patches (i.e., high prey density or shallow water) needs to have changed to produce a reduction the simultaneous occurrence of shallow water and high prey density, suggesting a delicate balance between them.

When water depths are deeper than optimal, species with higher GUDs (searchers), like Wood Storks, White Ibises, and Snowy Egrets, require a larger spatial extent of marsh to provide suitable feeding conditions than do the other species. These spatial requirements support the notion that overall loss of spatial extent could have contributed to population declines and it provides an explanation for why those declines would differ among species. Because differences in GUDs were only apparent in deep water, the loss of short hydroperiod wetlands, which are used by wading birds early in the dry season when adults are building energy reserves for nesting and during very wet years, may have had particularly serious consequences. The encouraging news from this experiment is that if hydrologic conditions that produce high-quality feeding sites at a landscape scale are restored, the species that will benefit most, the searchers, are those that are currently most impacted.

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