

**OPPORTUNISTIC FORAGING ON NESTLING REGURGITANTS
BY ADULT SNOWY EGRETS (*Egretta thula*)**

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A fundamental process underlying wetland ecosystem functions is nutrient transfer, which in part can modify ecological communities and populations (Frederick and Powell 1994, Ellison et al. 1996). Nutrient transfer has been studied in wading birds (Pelecaniformes and Ciconiiformes), which nest in large colonies. Due to mobility and large aggregations at colonial nesting sites, wading birds play an important role in the transfer of energy throughout wetland ecosystems (Kushlan 1976). Several mechanisms by which nutrients are transferred by wading birds include chick mortality, bird guano and regurgitated food (Frederick and Powell 1994, Irick et al. 2015, Nell and Frederick 2015). While some mechanisms of nutrient transfer such as chick mortality due to brood reduction are well documented (Stoleson and Beissinger 1995, Mock and Parker 1997 p. 464, Nell and Frederick 2015, Nell et al. 2016), others are less well known, or all together novel. Here, we provide a new account of nutrient transfer, through the adult procurement of fallen nestling regurgitants (food boluses) in a Florida Everglades wading bird colony.

Fallen nestling regurgitants can occur, but not limited to, the following. First, the transfer of fresh boluses from parent to nestling is not always successful, and some may drop from the nest during aggressive nestling behavior due to interbrood competition (Quinney 1982, Herring et al. 2011). Second, nestlings, especially those being fed large quantities of crabs, crayfish, or the like, regurgitate digested hard parts, known as ejecta or pellets (Rosenberg and Cooper 1990). Lastly, wading bird nestlings voluntarily regurgitate in the presence of predators, which typically constitute whole undigested, or partially digested prey items (Byers 1951, Furness and Hislop 1981, Nell and Frederick 2015). The crowded nesting colonies in which regurgitation occurs may provide substantial nutritive value which can attract scavengers and opportunistic predators. On the Cedar Keys (Levy County) of the Florida peninsula's northern Gulf coast, cottonmouth snakes (*Agkistrodon conanti*) use ejecta from nestling Brown Pelicans (*Pelecanus occidentalis*) and Double-crested Cormorants (*Phalacrocorax auritus*) as a primary energy source (Lillywhite et al. 2002, Sandfoss et al. 2017). In the Florida Everglades, American alligators (*Alligator mississippiensis*) that reside in or near wading bird colonies are known to benefit from the consumption of fallen food boluses, though they constitute only a small portion of the alligators' food requirements due to the alligators' larger body size (Nell and Frederick 2015, Nell et al. 2016). However, wading birds, especially small herons (*Egretta* spp.) have lower caloric needs due to their smaller body size, thus may benefit greatly from fallen food boluses, especially during the nesting season, when dietary requirements are greater (Kahl 1964, Kushlan 1980, Loftus and Eklund 1994). The potential for energy transfer is

high in environments such as large, crowded wading bird colonies, where animals might exhibit opportunistic behaviors to respond to said potential.

On 20 April 2017 we observed Snowy Egret (*Egretta thula*) adults foraging on fallen wading bird nestling food boluses in Paurotis Pond wading bird colony, in Everglades National Park, Florida (25° 28' 15" N, 80° 80' 30" W). We observed individuals from a distance of 15-30 m from a red mangrove tree (*Rhizophora mangle*) approximately 5 m off the ground. The weather was 26 °C and sunny.

We observed six Snowy Egret adults actively foraging on and consuming food boluses that had been regurgitated by nestling wading birds and fallen into the water. After picking up fallen boluses, the birds flew to nearby branches where they remained on nests in the understory canopy for approximately 3-5 min, before returning to the water to forage on more fallen boluses and repeating the pattern of behavior. From our position, we were able to observe the birds with boluses in their bills prior to consumption. Five of the Snowy Egret adults flew to heavily vegetated branches between foraging bouts, which partially obstructed our view of their behavior with chicks at the nest. However, one Snowy Egret adult flew between foraging bouts to a nest unobstructed by foliage, approximately 10 m from our observation site. Due to our higher location in the tree, we were able to observe three Snowy Egret chicks approximately 14 days old in the nest. The adult proceeded to feed the two larger chicks with the newly foraged boluses. After approximately 5 min the Snowy Egret adult returned to the shallow water below and continued foraging. To minimize our disturbance in the colony we left our observation site after 30 min.

Species of wading bird nestlings we saw regurgitate into the water included Snowy Egret, Wood Stork (*Mycteria americana*), Tricolored Heron (*Egretta tricolor*), Roseate Spoonbill (*Platalea ajaja*), and Great Egret (*Ardea alba*). Wading birds nesting in Paurotis Pond readily regurgitated during site visits, although it is unclear whether this regurgitation was due to our presence or that of a large (approximately 2-3 m) American alligator beneath the nests. The adult Snowy Egrets did not appear disturbed, as they remained in close proximity (< 30 m) to our location and showed no behavioral signs of stress or defensive posturing. We also observed the American alligator feeding on freshly fallen boluses alongside Snowy Egret adults (within 5-20 m). All animals foraged in approximately 15 cm of turbid, brackish water.

To our knowledge, this is the first recorded account of wading birds consuming fallen boluses as a food resource and using them to feed chicks. Although Snowy Egrets are known as a diet specialist, foraging primarily on fish (Jenni 1969, Kushlan 1981, Klassen et al. 2016), studies have shown they can switch foraging strategies as hydrologic patterns change (Smith 1997, Gawlik 2002, Green and Leberg 2005, Boyle et al. 2012). This account is a new demonstration of the species' opportunistic and flexible feeding strategy during a time of great energetic demands.

Whole, undigested or partially digested prey items in close proximity to the nest provide wading birds with energetically advantageous mechanism to obtain an abundant food resource during the nesting season (April-June). Fallen boluses require minimal capture effort relative to live prey, while largely providing the same caloric density. The energy costs associated with prey handling, search time, and flying are to a great degree eliminated, the latter of which accounts for nearly a third of Snowy Egrets total energy budget (Maccarone et al. 2008). Also, the short travel distance further reduces energy expenditure and time away from the nest. This newly described opportunistic foraging behavior can provide energetic advantages to adult wading birds and may be a benefit of nesting colonially that has not previously been considered.

Previous studies including White Ibis (*Eudocimus albus*) intervening the bolus transfer from adult to nestling, or removing boluses from the throats of unattended ibis nestlings supports such opportunistic behaviors in colonial nesters (Frederick 1985). The occurrence of such behavioral opportunities in colonies may occur with more regularity

than what is currently reported. Furthermore, it is important to note that little is known about the frequency of bolus regurgitation in the absence of human disturbance, while one study suggests this is rare (Nell and Frederick 2015). This knowledge gap may leave readers questioning the importance of this novel feeding behavior if the trigger for regurgitation is indeed largely a response to human disturbance. However, as the urban landscape encroaches on wetland habitats, and more wading bird colonies are forced closer to human disturbances (i.e., golf courses, urban parks, and boating traffic), nestling regurgitations and therefore opportunistic feeding behaviors may become more common.

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