

Indirect Cannibalism by Crèche-aged American White Pelican (*Pelecanus erythrorhynchos*) Chicks

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At nesting colonies of American White Pelicans (*Pelecanus erythrorhynchos*), many chicks die from siblicide, severe weather, and disease; this results in carcasses available for scavenging by conspecifics (i.e., indirect cannibalism). Indirect cannibalism has not been reported previously for this species. We describe five cases of crèche-aged American White Pelican chicks consuming or attempting to consume dead younger chicks at two nesting colonies in the northern plains of North America. Cannibalism in the American White Pelican appears to be rare and likely plays no role in the species' population ecology or dynamics; however, it might be an important survival strategy of individual chicks when food resources are limited.

Key Words: American White Pelican, *Pelecanus erythrorhynchos*, indirect cannibalism, conspecific scavenging, colonial waterbirds, northern plains, North Dakota, South Dakota.

Cannibalism (ingestion of a conspecific) has been observed across many taxa, including birds—most commonly in hawks, owls, and waterbirds (Fox 1975; Polis 1981; Elgar and Crespi 1992; Stanback and Koenig 1992). Stanback and Koenig (1992) defined cannibalism as the consumption of any part of a conspecific egg or individual. This would include the scavenging of dead conspecifics, which was termed “indirect cannibalism” by Smith and Munro (2008) and “conspecific scavenging” by McGehee et al. (2008).

Many hypotheses have been proposed to explain the prevalence and role of cannibalism in nature (for a review, see Fox 1975; Elgar and Crespi 1992); cannibalism often is associated with food limitation. However, Fox (1975) argued that cannibalism is not confined to food-stressed individuals, and could involve other factors, such as density-dependence, physiological and psychological stressors, cannibal and victim behaviors, and victim availability.

Among avian taxa that display cannibalistic behavior, cannibalism often is restricted to the consumption of eggs and very young chicks because the majority of birds are gape-limited, excluding raptors and a few other taxa that are capable of dismembering prey (Mock 1984). In colonial-nesting waterbirds, cannibalism is an unusual behavior, but can be a notable source of mortality. For example, Davis and Dunn (1976) reported that Lesser Black-backed Gull (*Larus fuscus*) adults that had lost their young frequently cannibalized their neighbors' eggs. Safina and Burger (1983) noted that Black Skimmer (*Rynchops niger*) chicks occasionally ate younger conspecifics, ostensibly in response to human disturbance. On four different occasions, Chapman (1908) observed nearly full-grown Brown Pelican (*Pelecanus occidentalis*) chicks consume younger chicks when the adults had departed from the nests, and Cahn (1922*) observed Brown Pelican adults consume crèche-aged chicks (i.e., those old enough to

disassociate from their nest bowls and gather into groups) that relentlessly begged for food from unrelated adults. Daigre et al. (2012) reported three cases of full-grown Peruvian Pelican (*Pelecanus thagus*) fledglings attacking or consuming younger, unrelated conspecifics from unguarded nests. Gubiani et al. (2012) recorded several instances in which large immature chicks of the Socotra Cormorant (*Phalacrocorax nigrogularis*) consumed young chicks in unattended nests. Riehl (2006) found widespread cannibalism by Black-crowned Night-Heron (*Nycticorax nycticorax*) fledglings, which attacked nestlings or younger fledglings that had fallen or climbed out of nests.

Indirect cannibalism has been reported in several semi-colonial and colonial-nesting waterbirds, including the Socotra Cormorant (Gubiani et al. 2012), Australian Pelican (*Pelecanus conspicillatus*) (Smith and Munro 2008), Black-crowned Night-Heron (Riehl 2006), American White Ibis (*Eudocimus albus*) (Herring et al. 2005), Australian White Ibis (*Threskiornis molucca*) (Smith and Munro 2008), and South Polar Skua (*Stercorarius maccormicki*) (Pietz 1987). Indirect cannibalism also has been reported in non-colonial birds such as the Black Vulture (*Coragyps atratus*) (McGehee et al. 2008), Lesser Yellow-headed Vulture (*Cathartes burrovianus*) (Clinton-Eitniear and McGehee 1994), King Vulture (*Sarcoramphus papa*) (in captivity) (Clinton-Eitniear and McGehee 1994), and American Coot (*Fulica americana*) (Paullin 1987).

The American White Pelican (*Pelecanus erythrorhynchos*) consumes a variety of prey items during the breeding season, including fish, crayfish, and salamanders (Findholt and Anderson 1995; Knopf and Evans 2004). There are no published records of direct or indirect cannibalism in this species. Here, we report evidence of indirect cannibalism by American White Pelican chicks.

Methods

Study areas

We collected data from two American White Pelican breeding colonies in the northern plains of North America: Chase Lake in Chase Lake National Wildlife Refuge in central North Dakota (47°01'N, 99°27'W) and Bitter Lake in northeastern South Dakota (45°16'N, 97°19'W) (see Sovada et al. 2008 for description of study areas). These two colonies are among the four largest American White Pelican colonies in North America. Chase Lake had 17 302, 11 262, and 11 541 American White Pelican nests in 2006, 2007, and 2008, respectively; Bitter Lake had 14 762, 14 713, and 12 946 American White Pelican nests in 2006, 2007, and 2008, respectively.

Data collection

As part of a larger study of the American White Pelican at Bitter Lake and Chase Lake, we closely monitored the colonies for disease outbreaks, predation, and consequences of severe weather and disturbance. We collected data on nesting activities, behaviors, and interactions of American White Pelican adults and chicks from several remote vantage points (e.g., boat, mainland shore) and, when on the islands, from camouflaged blinds and observation points hidden from the American White Pelicans' view.

In addition, we deployed digital video-camera systems near nests to monitor nesting adults and their chicks. The camera systems consisted of a high-quality digital video-camera in a waterproof housing, a digital video-recorder in a weatherproof box, two sealed lead-acid AGM (absorbed glass mat) batteries (each with ≥ 100 amp-hour capacity), and a 120-watt solar panel. Time-lapse recordings from the cameras were used to document diurnal and crepuscular activities of American White Pelicans, focusing on parental care of chicks that were still in the nest. Each field of view in video-recordings included multiple American White Pelican nests.

In 2006–2008, we collected over 25 470 hours of digital recordings of American White Pelican nests. We viewed all recordings. When transcribing data from the recordings, we selected a sample of nests in close view of the camera and we quantified behaviors at those nests. In addition, we noted unusual events and behaviors, such as disturbances, predation, and sibling aggression. Behavioral data were collected largely from the late-incubation stage until chicks began to crèche (i.e., aggregation of chicks from multiple broods). This typically occurs when American White Pelican chicks are about 17 days old (Evans 1984). After the chicks formed crèches, they spent most of their time away from the nest sites, but they were occasionally in the camera's field of view.

Ages of live and dead chicks were estimated by using known hatch dates, culmen length, feather development, and chick size. The ages of some dead chicks were difficult or impossible to determine due to vari-

ability in decomposition rates, which can be influenced by temperature, moisture, insect activity, and exposure to sun or shade. In certain cases, the estimate of the dead chick's age was based on approximate lengths of leg and wing bones.

Observations

Many chick carcasses were observed at the two American White Pelican colonies during 2006–2008; most carcasses were scavenged by gulls or quickly decomposed. A total of five cases or attempts of indirect cannibalism by crèche-aged American White Pelican chicks were recorded at the nesting colonies at Bitter Lake (two cases and one attempt) and at Chase Lake (two cases). Three of the cases were digitally recorded on video; one case was documented by direct observations and photographed from a blind; and one attempt was recorded by video and observed directly. All cannibalistic birds appeared to be in good to excellent condition and lacked any visible injuries.

We also observed several instances of adults tossing eggs or nestlings from their own nests or from the nests of other American White Pelicans, and we observed one instance (Case 1) of chicks in a crèche fighting over a dead conspecific as surrounding adults jabbed at the carcass (Bitter Lake on 2 June 2006). We never observed an adult American White Pelican consuming a chick.

Case 1 (visual and video)

On 2 June 2006, at Bitter Lake, a 21-day-old chick in a crèche with 11 other similar-aged chicks was observed retrieving a dead 18-day-old chick from the ground and repeatedly attempting to swallow the entire carcass. However, part of the carcass was entangled with a stick, which wedged perpendicularly in the cannibalistic chick's bill, preventing the chick from swallowing the carcass. The carcass was exposed in the chick's pouch and vulnerable to theft by other chicks; two other crèche-aged chicks reacted by chasing the chick and jabbing at both the chick and the carcass.

Almost immediately, two adult American White Pelicans entered the crèche and jabbed at the carcass. One of the adults jabbed at the chick's bill, knocking the carcass to the ground, and the two adults fought over it. The first adult flipped the carcass into its pouch, then quickly dropped the carcass and walked away within seconds after stealing it. The behavior was similar to that observed when adults steal food items from each other. Ten minutes later, a chick repeatedly tried to swallow the carcass while being harassed by other crèche-aged chicks, but again the stick prevented successful consumption of the carcass.

Case 2 (visual and photograph)

On 16 June 2006, at Bitter Lake, a 21-day-old chick was observed regurgitating the carcass of another American White Pelican chick. The remains were partially digested, but the bones appeared intact. The con-

dition and level of decomposition of the regurgitated carcass made estimation of its age difficult, but the length of the leg and wing bones suggested that the chick was ≤ 15 days old.

Case 3 (video)

On 12 June 2007, at Chase Lake, a 24-day-old chick swallowed the carcass of a 20-day-old chick whole. The cannibalistic chick was alone, with no other solitary or crèched chicks nearby. Later that day during a rainstorm, the chick was observed being brooded by an adult that was not its parent.

Case 4 (video)

On 13 June 2007, at Chase Lake, two 25-day-old chicks visited the carcass of a chick approximately 15–20 days old. During a 5-hour span, one of the chicks returned to the carcass five different times, tearing off pieces of the carcass and consuming them. The second chick jabbed at the carcass several times but did not appear to consume any of the carcass.

Case 5 (video)

On 10 June 2008, at Bitter Lake, a crèche of four chicks of similar age (~21 days old) was observed pulling off and swallowing pieces of a dead conspecific 15–20 days old. The chicks jabbed and tugged at the carcass repeatedly until they were able to tear off pieces of the rotten flesh. In both cases 4 and 5, chicks did not hold the carcass down with their feet to facilitate tearing, but rather depended on repetitive tugging against the weight of the carcass to separate pieces they could swallow.

Discussion

During 2006–2008, we documented five cases (one attempted and four successful) of indirect cannibalism at two intensively monitored American White Pelican colonies in the northern plains. Human disturbance at the colonies was minimal, and we have no evidence that the cannibalistic behaviors that we observed were related to investigator-induced aggression.

Four of the five victims were dead when consumed and one was discovered in regurgitate of the cannibal, thus the status of the victim when consumed was unknown. All cannibalistic events or attempts involved crèche-aged chicks consuming younger chicks. The average age of the cannibalistic chicks was 23 days and the victims were estimated to be ≤ 20 days old. All cannibalism was observed within relatively small crèches (average 3 chicks/crèche), whereas most crèches contained 6 or more similar-aged chicks. We do not know if any of the cannibals were related to the chicks that they consumed.

Sibling aggression and siblicide were common at nests with chicks in both colonies during our observations (M. A. Sovada and P. J. Pietz, unpublished data). Johnson and Sloan (1978) similarly reported that the smaller nestling died from aggression by its larger

sibling in 90% of two-chick nests that they observed at Chase Lake. Brood reduction by siblicide occurs when chicks are small and nest bound, and when food provisioning by adults is usually adequate (Cash and Evans 1985). During periods when adults are forced to travel greater distances and spend more time away from the colony to forage (e.g., during a drought period), some chicks might die as a result of inadequate food provisioning (Johnson and Sloan 1978). Despite the high incidence of sibling aggression and siblicide in these nesting colonies, we did not note any cases of nestlings killing and then eating nest mates or of adults killing or eating their offspring (i.e., filial cannibalism). Siblicide in birds rarely leads to cannibalism (Mock et al. 1990).

Although siblicide contributed to high mortality of nestlings in these colonies, the greatest loss of older or crèche-aged chicks resulted from unfavorable weather during late May through mid-June and outbreaks of West Nile virus in mid-July through August (Sovada et al. 2008). All five cannibalistic events occurred in early to mid-June, and all but one attempt immediately followed several days of cold, wet, windy weather.

During periods of poor weather, adult nest attendance and the frequency and duration of chick feedings declined markedly on video recordings. As adult attendance waned, chicks were more vulnerable to the elements and some chicks eventually succumbed to exposure, harassment (by other chicks or unrelated adults), or starvation. This resulted in more carcasses than usual, augmenting cannibalistic opportunities for the surviving chicks. These surviving chicks may have been stressed by hunger and declining nutritional condition, which could have prompted cannibalism. However, in all cases, chicks that we observed cannibalizing conspecifics appeared to be in good to excellent body condition.

Gubiani et al. (2012) noted that opportunistic cannibalism in crèche-aged Socatra Cormorant chicks may have been triggered by starvation and the presence of altricial chicks from late nesting attempts. Daiege et al. (2012) suggested that food deprivation and opportunism might explain aggression and cannibalism by older Peruvian Pelican fledglings.

It is notable that during the late breeding season, when many American White Pelican chicks were killed during an outbreak of West Nile virus (Sovada et al. 2008), no cannibalism was observed. Chicks during this period were already 42–70 days old (Sovada et al. 2008); it is unclear if these carcasses were too large to be consumed by other chicks or if surviving chicks were not stressed by hunger.

Given the rarity of cannibalism during more than 25 000 hours of video-recording and direct observation of two large American White Pelican colonies, cannibalism by older American White Pelican chicks is clearly not affecting chick survival at the population

level. Yet, during periods when food resources are limited, cannibalistic behavior could benefit individual chicks by enhancing their survival.

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