# INFANTICIDE IN HIGHLY URBANIZED COLONIES OF BLACK SKIMMERS *RYNCHOPS NIGER*

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**ABSTRACT**

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Infanticide, which is the killing of dependent offspring, occurs in many species of colonial seabirds. Most infanticide attempts are made when chicks wander outside their parents' territories and are more likely to occur when the colony experiences a disturbance or food is limited. Our objective was to determine the rate of infanticide at three Black Skimmer *Rynchops niger* colonies located on highly urbanized beaches in Pinellas County, Florida, USA. Infanticide occurred 42 times during 3 223 hours of monitoring (0.013 attempts per hour) over four breeding seasons (2018–2021). More than one third of the infanticide attempts occurred after a disturbance, and most of the attackers were not the chick's parents. However, in 10 attempts, parents were observed killing or attempting to kill their own chicks, and these attacks were primarily at a colony experiencing high stress due to coyote *Canis latrans* predation. We recommend reducing disturbance through a robust bird stewardship program and targeted predator management to reduce infanticide at Black Skimmer colonies in human-dominated ecosystems.

**Key words:** Black Skimmer, coastal ecosystems, disturbance, Florida, Gulf of Mexico, infanticide, urban ecology

## INTRODUCTION

Infanticide, the killing of dependent offspring, occurs in many species of colonial seabirds (Mock 1984, Quinn *et al.* 1994, Ramos 2003, Xi *et al.* 2003, Villanueva-Gomila *et al.* 2009, Kazama *et al.* 2012). In most cases, this occurs when a chick wanders into the territory of an unrelated adult (Mock 1984, Ramos 2003, Ashbrook *et al.* 2008), possibly as a mechanism for adults to avoid adopting and/or feeding non-kin chicks (Ashmole 1963, Feare 1976, Quinn *et al.* 1994). During times of lower food availability, chicks may be more likely to wander or be left unattended, resulting in increased rates of infanticide (Fetterolf 1983, Ashbrook *et al.* 2008). Chicks also tend to wander more during a disturbance, so beaches where visitors and human-adapted predators cause seabirds to flush frequently might experience more infanticide (Feare 1976, Anderson & Keith 1980, Brown & Morris 1995).

Black Skimmers *Rynchops niger* nest primarily in colonies on open beaches and sandbars in the Americas (Gochfeld *et al.* 2020). Relatively little is known about infanticide or the adoption of chicks by non-related parents in this species. Researchers have occasionally documented adult skimmers killing conspecific chicks (Burger 1981, Quinn *et al.* 1994). Burger (1981) observed two different adults kill three chicks in two well-monitored colonies of 200 pairs, on a relatively undisturbed island in New York. Quinn *et al.* (1994) observed 14 infanticide attacks at two colonies with a total of 104 nesting skimmer pairs on relatively undeveloped islands off the coast of Texas.

Black Skimmer colonies in Florida occur primarily on barrier islands. These islands were once a sanctuary, but many have become highly developed and attached to the mainland by bridges, which have facilitated colonization of the islands by terrestrial mammals (e.g., coyotes *Canis latrans*, Virginia opossum *Didelphis virginiana*, raccoons *Procyon lotor*). The presence of human refuse can also attract and sustain a higher number of avian predators such as Fish Crows *Corvus ossifragus* and Laughing Gulls *Leucophaeus atricilla*. These urban-adapted wildlife, combined with people using the beaches, can cause frequent disturbances to the colonies (Forys *et al.* 2020). The objective of this paper is to examine the rate of infanticide in Black Skimmer colonies on these highly urbanized beaches and to determine if management is needed to decrease this source of mortality.

## METHODS

We studied three Black Skimmer colonies in Pinellas County in the state of Florida, USA (27.89°N, 082.74°W) during the 2018–2021 breeding seasons, which generally occur from early May until the end of August or September (Fig. 1). Pinellas County is located in southwestern Florida and is the state's most densely populated county, with > 1200 people/km$^2$ (Rayer & Wang 2014). The colonies in our study ranged from 0.3–0.4 ha (3 000–4 000 m$^2$) in size and occurred on highly developed barrier islands that are linked to the mainland by bridges. The northernmost colony, Clearwater Point, is on a private beach behind a condominium, with little other public access. Further south, the Indian Shores colony occupies a crowded beach adjacent to a volleyball net and condominiums that are rented by tourists. The southernmost colony, St. Pete Beach, is close to several large hotels and condominiums, and it was disturbed frequently by people during our observations. The boundaries of nearly all colonies in Florida are identified during the breeding season with stakes, signs, and twine by Audubon Florida staff, following state guidelines (FWC 2020); our colonies were among the marked colonies. These three colonies represent ~15% of the breeding pairs in Florida (FWC 2021).

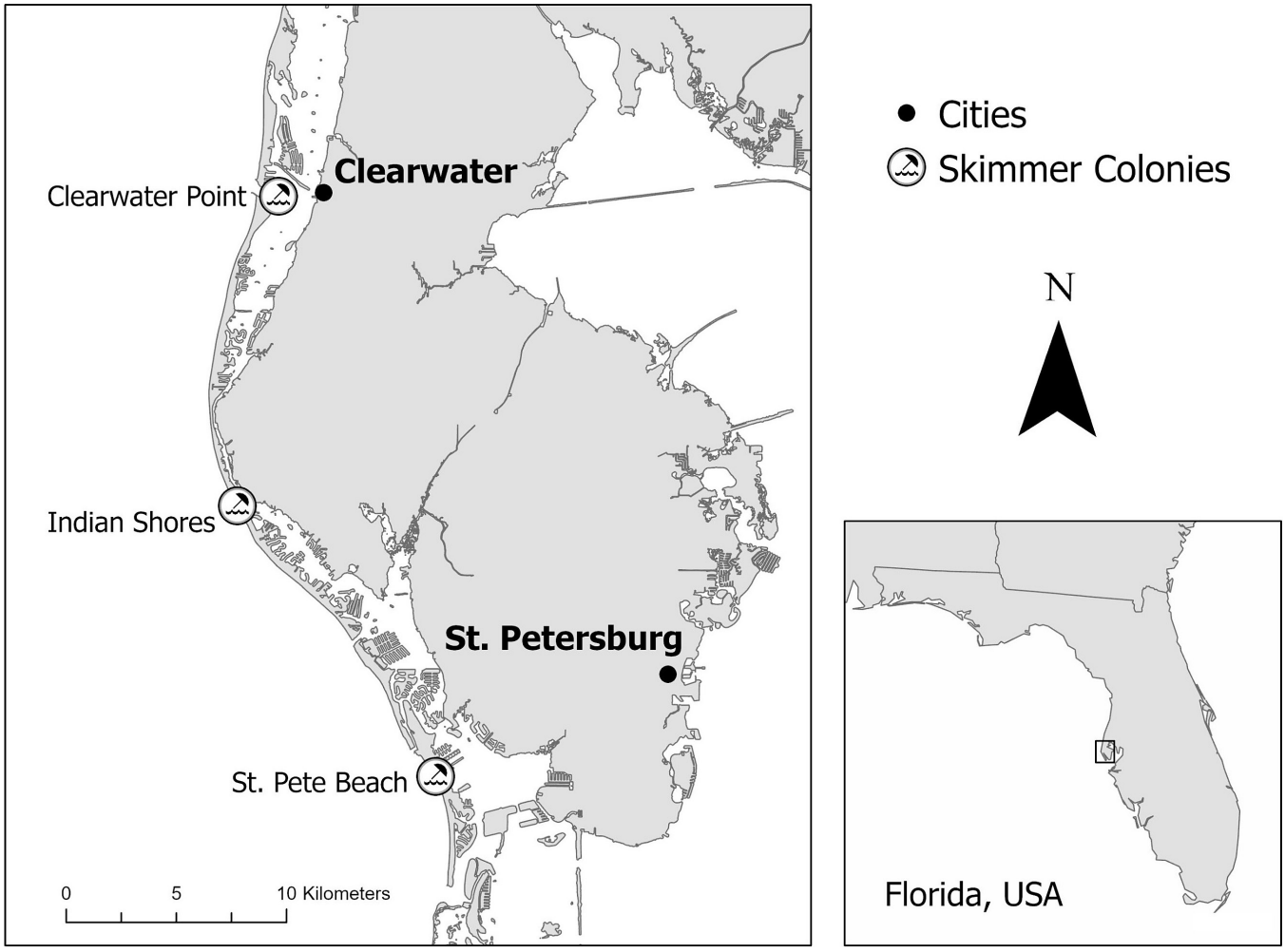


**Fig. 1.** Location of three Black Skimmer *Rynchops niger* colonies in Pinellas County, Florida, USA.

Colonies were protected by trained Audubon Florida bird stewards (including the authors), who educated the public and collected data. Most stewardship hours occurred on weekends, 09h00–21h00 Eastern Standard Time, when there were more people and potential disturbances on the beach. Each time a steward began a shift, they counted (if possible) the number of adults, nests, downy chicks, feathered chicks, and fledglings according to a protocol created by the Florida Shorebird Alliance (FWC 2021).

In addition, we asked all stewards to record acts of predation and infanticide attempts. Infanticide attempts were defined as actions made by an adult that could cause the death of a chick, generally through the closing of the adult's bill on the chick's neck followed by violent shaking (Fig. 2). This process is easily detected and recognizable because it generally occurs for > 10 min (Burger 1981). When possible, the steward determined the general age of the chick based on stage of development (downy, feathered, or fledgling), if the attack came from a parent, and any activities that immediately preceded (< 5 min) the infanticide attempt (e.g., feeding, predation, disturbance). Adult skimmers were identified as a chick's parents when they had recently fed or brooded the chick. If we were able to observe the chick and the adult prior to the infanticide attempt and did not see any parental activities, we labeled the adults as being non-kin. If we were not able to observe the chick and adult before the infanticide, we labeled the relationship as being unknown.

All statistical tests were done using SPSS, version 27 (Chicago, USA). To determine if the number of infanticides was greater than


**Fig. 2.** Black Skimmer *Rynchops niger* adult killing downy chick. (Photo: Jim Gray)

expected for the number of hours of observation (i.e., stewardship hours) at a colony, we conducted a chi-squared test of independence for each year. To determine if parents were more or less likely to kill a chick than non-kin adults, we removed from analysis those infanticides in which the adult/chick relationship was unknown and conducted a chi-squared test of independence.

## RESULTS

Colonies were monitored during a total observation period of 3 223 hours spread over four breeding seasons, with more stewarding at the colonies with the most beach users (St. Pete Beach and Indian Shores) and less stewarding at the relatively quiet Clearwater Point colony (Table 1). Colony size ranged from 61 to 250 nests, and all but one colony produced flight-capable young (mean fledglings/pair ± standard deviation: 0.49 ± 0.27). Productivity was lowest during the 2021 breeding season, when the Clearwater Point colony was over-washed multiple times during high tides and storms (causing the death of all but two chicks) and the St. Pete Beach colony was abandoned because of intense predation from a pair of coyotes (Table 1).

A total of 42 attempted infanticides occurred during the four breeding seasons (Appendix 1, available on the website). Infanticide was observed twice at Clearwater Point (on a private beach), 10 times at Indian Shores, and 30 times at St. Pete Beach (which had the highest human visitation). The colony with the highest number of infanticides in a single breeding season was the St. Pete Beach colony during 2021 (17 out of 42). A chi-squared test of independence that compared the number of infanticides at each location to the number of hours of observations was not significant for any of the years ($P < 0.05$).

All infanticide attempts were on downy chicks that were less than two weeks of age. Of the 42 chicks involved in these incidents, 27 died, 14 survived, and we could not determine the outcome in one case. None of the chicks that were killed were eaten by adults or fed to other chicks. During 55% of infanticide attempts, the steward did not observe any unusual behavior or disturbance preceding the attack (Fig. 3). However, disturbances were known to have occurred in 36% of the infanticide attempts, with the causal factors being avian predators (Fish Crows, Laughing Gulls) attacking other chicks, people entering the colony, a dog walking too close to the colony, and a Laughing Gull stealing fish from an adult skimmer (piracy). Three of the attempts (7%) occurred when the adult brought in a fish and the begging chick was killed by the adult with the fish.

Among all attacks, 24% were made by a parent and 45% were made by non-kin adults; the relationship of the adult to the chick was unclear in 31% of attacks. Parents killed the chick in 50% of the attempts while non-kin adults killed the chick 53% of the time; the difference in these proportions was not significant ($\chi^2 = 0.525$, $df = 2$, $P = 0.731$). While we did not explicitly ask stewards to identify the sex of the attacker, descriptions in the stewarding reports coupled with photographs enabled this determination in 48% of the attacks. Pairs of adults attacked the chick in nine instances (22%), a lone female attacked eight times (19%), and a lone male attacked three times (7%). During most attempts (83%), the steward was able to identify the behavior of the chick and its parents in the moments before and during the attack (Fig. 4). In eighteen instances, the chick was wandering away from its nest area into the territories of non-kin adults and was killed either by its parent when the parent returned to the nest or by the non-kin adult. This wandering was often caused by a disturbance. In nine instances, the chick was left unattended at the nest by parents and was attacked either by a parent when the parent eventually returned or by a non-kin adult. In eight instances, the chick was attacked in its own nest by an adult inferred to be its parent.

## DISCUSSION

Although the colonies were in highly urbanized areas, levels of infanticide were similar or lower than studies of seabirds in more

**TABLE 1**
**Nesting and infanticide statistics for three Black Simmer *Rynchops niger* colonies monitored during 2018–2021 in Pinellas County, Florida, USA**

| Year | Colony | Observation hours | Max nests (*n*) | Chicks hatched (*n*) | Chicks fledged (*n*) | Productivity (fledglings/nest) | Infanticide attempts | Rate (*n*/h) |
|---|---|---|---|---|---|---|---|---|
| 2018 | Clearwater Point | 39 | 65 | 39 | 41 | 0.63 | 0 | 0 |
| 2019 | Clearwater Point | 117 | 128 | 79 | 91 | 0.71 | 2 | 0.017 |
| 2020 | Clearwater Point | 139 | 115 | 42 | 82 | 0.71 | 0 | 0 |
| 2021 | Clearwater Point | 114 | 141 | 14 | 2 | 0.01 | 0 | 0 |
| 2018 | Indian Shores | 267 | 70 | 40 | 34 | 0.49 | 3 | 0.011 |
| 2019 | Indian Shores | 286 | 152 | 70 | 85 | 0.56 | 2 | 0.007 |
| 2020 | Indian Shores | 180 | 61 | 42 | 25 | 0.41 | 0 | 0 |
| 2021 | Indian Shores | 420 | 115 | 33 | 41 | 0.36 | 5 | 0.012 |
| 2018 | St. Pete Beach | 222 | 230 | 144 | 149 | 0.65 | 5 | 0.023 |
| 2019 | St. Pete Beach | 379 | 250 | 186 | 227 | 0.91 | 6 | 0.017 |
| 2020 | St. Pete Beach | 446 | 225 | 36 | 87 | 0.39 | 2 | 0.004 |
| 2021 | St. Pete Beach | 614 | 153 | 12 | 0 | 0 | 17 | 0.028 |

natural environments (Burger 1981, Quinn *et al.* 1994, Villanueva-Gomila *et al.* 2009, Kazama *et al.* 2012). Most of the infanticide attempts were consistent with situations described in previous research on Black Skimmers and other species of colonial beach nesters: chicks that wander or are left alone are killed by non-kin adults (Quinn *et al.* 1994, Ramos 2003, Villanueva-Gomila *et al.* 2009, Kazama *et al.* 2012).

Disturbance was a factor in over a third of these infanticide attempts, and the number of attempts would likely be higher without the robust bird steward program in this area (Darrah 2020). Food availability might also have played a role, particularly for infanticide attempts during the 2021 breeding season, when a prolonged outbreak of red tide *Karenia brevis* caused major fish kills. The latter required the removal of 676 tons (613 tonnes) of fish from Pinellas County beaches, much of it from Indian Shores (Pinellas County News 2021).

What is unusual in our study is the number of times a parent attacked a chick (10 of 42 total infanticide attempts). Otherwise, only one study has documented parental infanticide in larids: Urrutia & Drummond (1990) observed Heermann's Gull *Larus heermanni* parents killing chicks of their own that hatched after the first chick, 1–4 days after hatching. They suggested that parental infanticide may be a method of brood reduction, particularly in species with asynchronous hatching, which includes Black Skimmers (Gochfeld *et al.* 2020). If adults have more surviving chicks than they can feed, killing smaller chicks could prevent them from taking food from the bigger chicks that are most likely to survive. This is the strategy of skuas, e.g., South Polar Skua *Stercorarius maccormicki*, who also utilize asynchronous hatching and hatch two chicks but never fledge more than one; if the first-hatched chick survives, parents eat the second-hatched chick in the first few days after hatching or drive it off the territory where it is eaten by the neighbors (Young 1994). In our study, we observed adults killing or attempting to kill the smallest (youngest) chick on four occasions, indicating brood reduction might be a possible underlying cause. Unlike other species where brood reduction occurs frequently (e.g., Sulidae; Anderson 1995), there was no evidence of siblicide (killing of a chick by its sibling) or fatal attacks by non-sibling chicks within the colony (Russell *et al.* 2011).

While the observation of a high number of infanticide attempts (17) at St. Pete Beach in 2021 could have been due to the longer observation time, the number was particularly surprising because there were fewer than 15 chicks alive in the colony each day. The colony consisted of ~150 nesting pairs, and infrared video cameras that were placed at the beginning of the nesting season recorded a pair of coyotes depredating eggs and chicks nearly every night from 25 June 2021 until the colony was abandoned after all the chicks were depredated 2.5 weeks later, on 15 July 2021. Despite the low number of chicks, there were 17 infanticide attempts (11 successful) during the 2.5-week time span, and three of the attacks were parents killing their last surviving chick. We hypothesize that some of these attempts were due to high environmental stress, as observed in a study of Crested Ibis *Nipponia nippon* in which parents killed their chicks when kept in small cages, yet stopped doing so once moved to a more natural environment (Xi *et al.* 2003).

Our study did have some limitations. We were very conservative when categorizing an attacker as a parent or an unrelated adult, but there may be some error in these assignments because we did not individually mark each nest and chick to identify them; while we have not observed adoption of unrelated chicks by adult Black Skimmers, this does occur in other larid species (Pierotti & Murphy 1987). Nearly all of our data came from daylight monitoring due to personnel and equipment limitations, but Black Skimmers are most active from sunset to sunrise (Yancey & Forys 2010). While we did have five infrared cameras at St. Pete Beach, our cameras were not close enough to individual nests to document infanticide. Future research should include metrics of disturbance in relation to infanticide, as well as quantification of other predation events during both day and night to determine the role of infanticide in productivity.

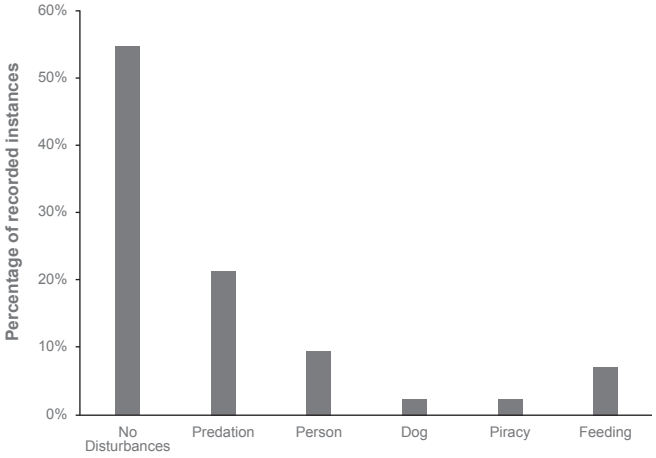


**Fig. 3.** Percentage of recorded instances of infanticide attempts among Black Skimmer *Rynchops niger* colonies, based on preceding events ($n = 42$). The headings Predation, Person, and Dog refers to instances in which a predator, a human, or a pet dog caused a major disturbance. Piracy refers to instances when Laughing Gulls *Leucophaeus atricilla* attempted to steal a fish that an adult skimmer was bringing to feed a chick. Feeding referred to instances in which an adult brought a fish into the colony and the chick begged for food. Data was collected during 2018–2021 in Pinellas County, Florida, USA.

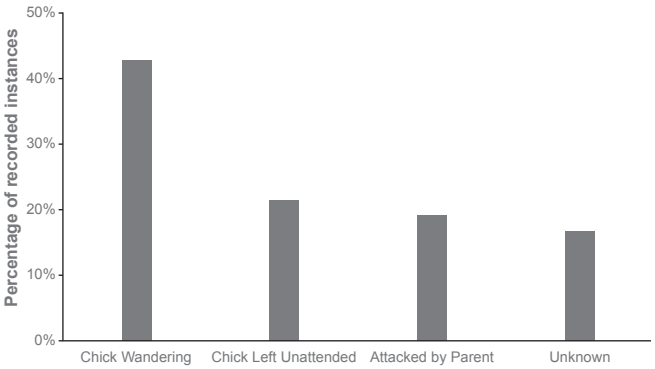


**Fig. 4.** Percentage of recorded instances of chick behavior before an infanticide attempt at the three Black Skimmer *Rynchops niger* colonies in Pinellas County, Florida, USA, during the 2018–2021 breeding seasons. "Chick Wandering" and "Chick Left Unattended" preceded infanticide attempts by both non-kin adults and parents. An attack was classified as "Attacked by Parent" when the chick and parent were together at the nest for five minutes before the attack. The "Unknown" category was used when we were unable to observe what occurred in the five minutes before the attack.

In terms of Black Skimmer conservation and management, bird steward programs have been found to decrease disturbance (Darrah 2020). Thus, maintaining an active stewardship program will likely decrease infanticide rates, even in highly urbanized areas. In addition, predator management is also critically needed to decrease infanticide and colony abandonment.

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