

Sacred Ibis and Gray Heron Predation of Cape Cormorant Eggs and Chicks; and a Review of Ciconiiform Birds as Seabird Predators

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Abstract.—The literature indicates that predation of seabirds by ciconiiform birds is limited to terns and is generally of little impact. We monitored predation of the eggs and chicks of Cape Cormorants (*Phalacrocorax capensis*) by Sacred Ibises (*Threskiornis aethiopicus*), and Gray Herons (*Ardea cinerea*) for 46 days over three breeding seasons at Penguin Island, Lambert's Bay, South Africa. The ibises were observed to take at least 152 cormorant eggs and chicks and 37 heron chicks. Extrapolation of the results to the full season of availability indicates that these ciconiiform predators may take as many as 960 cormorant eggs or chicks in a season. If so, they would be the third most serious cause of mortality among the 4,800 pairs of Cape Cormorants at Penguin Island. The observed combined effect of ciconiiform predation was greater than that of the local, predatory, Khoisan Gulls (*Larus (dominicanus) vetula*). We document the seasonality and diel timing of predation, behavior of the predators, and the cormorants' responses. To place our observations in context we review the global literature concerning the incidence of ciconiiform predation upon seabirds, which we consider to be under-reported, and factors affecting it. Finally we consider the effects of ciconiiform predation on seabirds at Penguin Island relative to a broader, five-year, study of the causes of seabird mortality there, and make recommendations for conservation management. Received 11 August 2005, accepted 15 December 2005.

Key words.—*Threskiornis aethiopicus*, *Ardea cinerea*, *Phalacrocorax capensis*, ciconiiform predation, Penguin Island. Waterbirds 29(3): 321-327, 2006

Ciconiiform birds are primarily species of freshwater wetlands and rocky shores. With two exceptions they have seldom been recorded as even incidental predators of seabirds. The exceptions are Black-crowned Night Herons (*Nycticorax nycticorax*) and Sacred Ibises (*Threskiornis aethiopicus*). The night heron is an established predator of tern and gull colonies in North America (Collins 1970; Hunter and Morris 1976; Shealer and Kress 1991). Predation by Sacred Ibis is less well known. Early reports (Stark and Sclater 1906; Bolster 1931) indicate ibis predation on seabirds, and Hockey *et al.* (1989) describe this ibis as a "voracious" predator of seabird eggs and chicks in southwestern Africa but no source provides supportive information. Recently, a feral population of Sacred Ibises in France was found to prey on tern eggs (Vaslin 2005). Here we report observations of predation by Sacred Ibises and Gray Herons (*Ardea cinerea*) on the eggs and chicks of Cape Cormorants (*Phalacrocorax capensis*) at Penguin Island on the Atlantic Ocean coast of South Africa. To place our observations in context we also review the incidence of predation by ciconiiform

birds upon seabirds globally. Our discussion considers whether predation by ciconiiforms upon seabirds is being under-reported.

STUDY AREA AND METHODS

Penguin Island, 32°05'S, 18018'E, is a 3.2 hectare, rocky island 60 m offshore. It provides protection for the fishing harbor and town of Lambert's Bay, population 7,000, to which it is linked by a harbor wall/ causeway (Barnes 1998). The island supports some 17, 000 pairs of seabirds (Ward and Williams 2005a). Most numerous are Cape Gannets (*Morus capensis*) (11,700 pairs) followed in diminishing numbers by Cape Cormorants (4,800), Khoisan Gulls (*Larus (dominicanus) vetula*) (115 pairs; see Williams 2004 for use of this vernacular name), and African Penguins (*Spheniscus demersus*) (27 pairs) The island also supports a breeding population of Cape Fur Seals (*Arctocephalus pusillus*) (median maximum number of pups 180 in the period 1997-2001, VLW pers. obs.) and non-breeding males of this species are primary predators of seabirds in waters adjacent to the island (Ward and Williams 2004, unpublished). On the island it had previously been assumed that the main predators of seabird eggs and chicks were the Khoisan Gulls. The smaller Benguela Gulls (*Larus hartlaubii*) and Grayheaded Gulls (*L. cirrocephalus*), also resident at Penguin Island, have not been recorded as predators. No mammalian predators were resident at the island but during the study period Water Mongoose (*Atilax paludinosus*), Black Rats (*Rattus rattus*) and Feral Cats (*Felis catus*) all occurred there irregularly and in very small numbers (VLW pers. obs.). However no individuals of these mammals were implicated in predation

upon eggs or chicks of cormorants on the island during the three-year period of predation observation.

Recording of ciconiiform predation at Penguin Island began in 1998 through observation, and recording, of what were originally thought to be incidental occurrences of predation. Two approaches were used: observations of attacks; and assessment of chick carcasses found near cormorant colonies.

With appreciation that predation by ciconiiforms was more frequent than anticipated, observations were incorporated into routine scans for seal predation during the 1999 and 2000 field seasons (detailed in Ward and Williams, unpublished). Routine scans for, and observations of, ciconiiform predation were made on a total of 46 days during October 1998–April 2000 during periods when Cape Cormorants were breeding. Cormorant chicks seen being taken by ciconiiform predators were allocated to one of three groups according to plumage features. “Small” chicks had no observable flight feathers and were between 0 and two weeks old. “Medium” chicks had flight feathers but no emerged contour feathers and were aged between three and four weeks. “Large” chicks were those with emergent contour feathers and were five or more weeks old.

Cormorant chicks found dead during daily patrols for carcasses were considered as preyed upon by avian predators if they had neck injuries—cuts and or torn skin—the result of being picked up and carried away from their nest. The predator concerned was identified through the type of injuries which reflected the predator’s bill structure. Ibises caused only moderate neck injuries. Injuries inflicted by gulls and herons were distinctly deeper than those of ibises (assessed after examination of chick carcasses recovered after observed predations). The predator of chick carcasses with deep neck injuries could be further identified because herons removed only the viscera whereas gulls also ate chest and/or leg muscles. Carcasses were classed as scavenged when the viscera or muscles had been eaten but there were no neck injuries. Chicks that were scavenged could have died of starvation or disease. Some carcasses were too decayed or dismembered for predator/scavenger assessment. Scavenged carcasses include chicks that died of starvation or disease.

Numbers of Sacred Ibises and Gray Herons using the island were assessed by weekly morning (0800–1200h) counts made from fixed points. At monthly intervals counts from the mainland were made in the early evening of the number of ibises flying to the island to roost. Data presented are the median of all weekly counts for each calendar month through the five-year period.

RESULTS

Gray Herons visited Penguin Island throughout the year, primarily to hunt fish in the islands’ rock pools. No more than two occurred at any one time. Sacred Ibises occurred on the island seasonally, being largely absent during September to December (Fig. 1) when they moved to inland wetlands to breed. Between January and April each year up to 400 roosted on the island over-

night (Ward and Williams 2005b). Most roosting ibises left the island to forage on the mainland but a small number of apparent “specialists” (though none could be individually identified) foraged on the island among cormorant colonies to take pellets regurgitated by the cormorants, to scavenge carcasses, and especially to kleptoparasitise cormorants by scaring them during parent to chick regurgitation (Ward and Williams 2005b). Once regional winter rains began, Sacred Ibises dispersed and only small numbers occurred at Penguin Island between May and August.

The main breeding season of Cape Cormorants at Penguin Island was between September and December (Fig. 1). This largely coincided with the breeding season absence of most ibises. The cormorants had a smaller, secondary, breeding peak between March and April. This coincided with the peak occurrence of Sacred Ibises at the island and was the period in which most predation, by both ibises and herons, was observed.

Predation

Single Gray Herons were observed to prey upon Cape Cormorant chicks on 17 occasions. They were observed taking a total of 37 cormorant chicks and took between one and four, small (15) to large (8), but mainly (18) “medium” sized nestlings at a time. Predation by herons was recorded in October 1998, February to March 1999, and in January to March 2000.

Predation by Sacred Ibises on cormorants was observed on 65 occasions, all be-

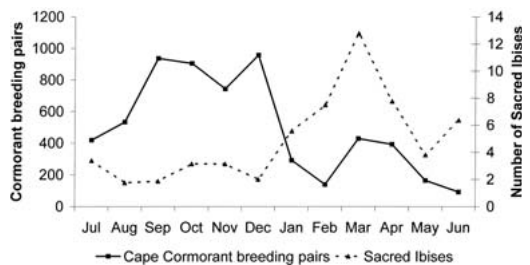


Figure 1. Median numbers of Cape Cormorant *Phalacrocorax capensis* breeding pairs and Sacred Ibises *Threskiornis aethiopicus* at Penguin Island: 1997–2002.

tween January and April, during which a total of at least 20 cormorant eggs and 132 chicks (small: 58, medium: 71, large: 2) were taken. Ciconiiform predators were not seen to prey upon the eggs or chicks of other seabirds at Penguin Island.

Predatory Behavior

Gray Herons employed a ‘scare and grab’ tactic, in which an adult cormorant was scared off its nest by a heron giving a series of bill strikes towards it. The attacking Gray Heron added to the threatening effect by raising its crown feathers and opening its wings. Once the cormorant was off the nest a chick was seized and carried off to a feeding site either at the edge of the colony or some distance away. There were never more than two Gray Herons on the island at any time and, although they were not identifiable individually, it is believed that the same “specialist” individuals were involved throughout.

Sacred Ibises used a ‘mob and rob’ tactic. A group of, on average three, birds would continuously walk around a sub-colony of breeding Cape Cormorants until a nest with a “nervous” adult was found. The adult cormorant was surrounded and pecked from different directions by the ibises until the bird was forced off the nest and the eggs or chicks were exposed. Although individual ibises could not be identified, it was thought that there was a core group of specialists which relied on food obtained at the island whereas the majority of ibises which roosted on the island overnight moved inland to feed during the day.

Time of Day

All of the observed predation occurred in the afternoon between 15h00 and sunset (1800-1900h) (Fig. 2) and 79% of 82 observed predations occurred between 1600 and 1900h, with a peak of predatory activity between 1600 and 1700h. This period coincides with the return of foraging adult cormorants and was the period during which most klepto-parasitism occurred (Ward and Williams 2005b).

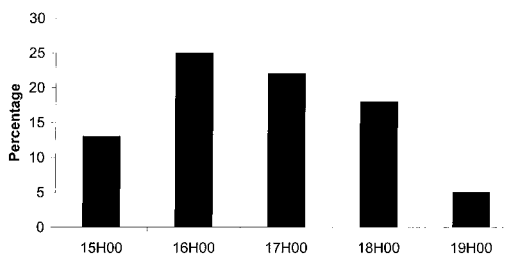


Figure 2. Relative proportions of Cape Cormorant *Phalacrocorax capensis* eggs and chicks taken by ciconiiform predators per hour.

Response to Predators

Cape Cormorants showed immediate behavioral and vocal responses to the presence of Gray Herons, which only moved within cormorant colonies when at least some nests contained chicks. There was less immediate response to the presence of Sacred Ibises, which commonly walked between nests of cormorants to scavenge regurgitated cormorant pellets, spilt fish regurgitate, and abandoned eggs and carcasses. However, nesting cormorants became increasingly agitated and vocal the closer a group of ibises came to their nest.

Gray Herons took only chicks and these generally of medium size. Sacred Ibises took a wider range of prey, from eggs to large chicks, though 89% of the prey taken were small and medium chicks (Fig. 3). Because of their larger size, herons were able to take a greater proportion of large chicks than Sacred Ibises.

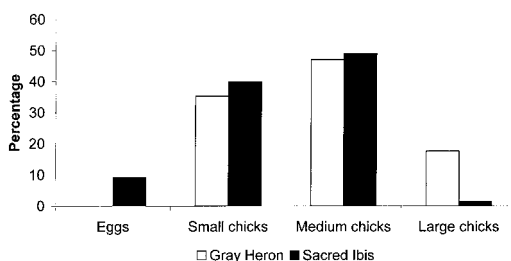


Figure 3. Proportions of different prey items taken by Gray Herons *Ardea cinerea* and Sacred Ibises *Threskiornis aethiopicus*.

Ciconiiform Impact Relative to Khoisan Gulls

It is generally assumed that, at mammal-free localities, the primary nest-predators of seabirds are the regionally dominant large gulls. At Penguin Island 806 dead cormorant nestlings were examined for cause of death. Of these at least 233 had been killed by predators. Based on carcasses recovered in predation events and on the types of injuries inflicted by different predators it was possible to be reasonably sure which species of predator had killed the chicks. Of these 233 cases Gray Herons had killed 15.8%, Khoisan Gulls 18.4%, and Sacred Ibis 65.2%.

DISCUSSION

Ciconiiforms Relative to Other Predators and Prey at Penguin Island

There are several reasons why ciconiiform predators appear to kill more cormorant chicks than do predatory gulls at Penguin Island. Cormorant nestling availability at Penguin Island occurs in two peaks. The largest of these peaks occurs in November to December (Fig. 1). Pupping in the local Cape Fur Seal population occurs from late October to late December with a November peak. During November, Khoisan Gulls preferentially feed on seal after-birth, and fresh seal pup carcasses. These resources are relatively easy, and risk-free, for the gulls to exploit. In addition the Khoisan Gulls at Penguin Island also have access to a wide variety of other easily available foods in and around the adjacent town of Lambert's Bay. Such additional foods include domestic refuse, washed up marine invertebrates, blood worms, and, in particular, dumped substandard chips from the local potato factory. Thus Khoisan Gulls were not significant predators of Cape Cormorant chicks during the cormorants' first breeding peak. Most Khoisan Gull predation on cormorant chicks occurred in January to February when seal pupping was over and the gulls had large chicks to feed. Even then most predation by gulls was observed in concert with human disturbance.

Several other seabird species at Penguin Island had eggs or chicks in nests that would have been physically accessible to, yet were never recorded suffering from, ciconiiform predators. Two of these species, White-breasted Cormorant (*Phalacrocorax carbo lucidus*) and Benguela Gull bred during the winter when most of the Sacred Ibises were absent. African Penguins bred in holes and so were effectively inaccessible to ciconiiform predators. Several of the smaller species, some Cape and Crowned Cormorants (*Phalacrocorax coronatus*), Gray-headed and some Benguela Gulls, and Greater Crested Terns (*Sterna bergii*) bred on disused boats anchored in the harbor (Ward and Williams 2005a). Neither ibises nor herons were ever seen on these boats.

The two species physically most accessible to ciconiiform predators, because they breed colonially on flat sectors of the island, were the Khoisan Gull and Cape Gannet. Khoisan Gulls aggressively defend their nests using aerial attacks. Cape Gannets breed densely with most birds in some physical contact with birds on adjacent nests (Nelson 1978). They are large birds, 2.6 kg, with a long (90+ mm) beaks. Their dense colonies are able to present a "spear-wall" of beaks which deters any predators from walking into the colony. Thus at Penguin Island over the five-year study period ciconiiforms were never seen in the Cape Gannet colony nor having interactions with nesting Khoisan Gulls.

Global Situation

To place our observations in a wider context we searched the literature for evidence of predation on seabirds by ciconiiform birds. The only species of ciconiiform with substantial documentation of preying upon seabirds is the Black-crowned Night Heron, a nocturnal predator of tern eggs and chicks in North America (Marshall 1942; Emlen *et al.* 1966; Collins 1970; Nisbet 1975; Hunter and Morris 1976; Duffy 1977; Nisbet and Welton 1984; Brunton 1997; Barbour *et al.* 2000).

Diurnal Ciconiiform Predation

The only detailed references we found on Sacred Ibises preying upon seabirds was

of predation of small, one- to three-day old, chicks of Benguela Gulls at Schaapen Island, South Africa (Williams 1977) and of predation on the eggs of terns in France (Vaslin 2005). To this we can add two additional personal observations of predation at Marcus Island, South Africa. In the first a Sacred Ibis seized an incubating Benguela Gull by the wing and pulled it off its nest. The ibis then lunged in and ate the gulls' eggs. In the second, Sacred Ibises consumed some 20, two to three day-old, Greater Crested Tern chicks.

Intriguingly, although not a ciconiiform, the morphologically ibis-like Bristle-thighed Curlew (*Numenius tahitiensis*), a curve-beaked, terrestrial forager is an established predator of tern eggs at Laysan Island, Hawaii (Ely and Clapp 1973). At the same locality this curlew has also been recorded eating eggs of albatrosses, boobies and frigatebirds although it is unclear from the published reports whether this was through active predation or merely scavenging of already deserted eggs.

We have found three references to Gray/Blue Heron predation upon seabirds. Harris (1969) states that Gray Herons eat Madeiran Stormpetrels (*Oceanodroma castro*) in the Galapagos Island. At Aldabra Island a pellet, which contained the remains of several Brown Noddy (*Anous stolidus*) chicks, was attributed, on the basis of the pellet size and species occurrence, to Gray Heron (Diamond and Prys-Jones 1986). The Blue Heron (*Ardea occidentalis*), the equivalent of the Gray Heron in North America, takes Sooty Tern chicks at the Dry Tortugas (Robertson 1964).

Three other herons have been reported preying upon seabirds. In Kenya Yellowbilled Egrets (*Egretta intermedia*) eat small chicks of Whitecheeked Terns (*Sterna repressa*) (Britton and Brown 1974). Cattle Egrets (*Bubulcus ibis*) take chicks of Sooty Terns *Sterna fuscata* at Bird Island in the Seychelles Islands (Feare 1973), in the Dry Tortugas (Robertson 1964), and at Culebra Island (Saliva and Burger 1989), and are believed to take Benguela Gull chicks in South Africa (Williams 1977). Eastern Reef Egrets (*Egretta sacra*) eat eggs and young of Lesser Noddies (*Anous*

tenuirostris) at Heron Island, Australia (Braithwaite 1973), usually killing chicks after they have been blown out of their tree nests (Ogden 1993).

The only other ciconiiform bird reported as a seabird predator is the Yellow-billed Stork (*Mycteria ibis*) that also takes small White-cheeked Tern chicks in Kenya (Britton and Brown 1974). The mobbing of White-faced Herons (*Ardea novaeseelandiae*) by Sub-Antarctic Skuas (*Catharacta lonnbergi*) at New Zealand's Chatham Islands (Hemmings and Chappell 1988) suggests that this ciconiiform is also a predator of seabird nest contents.

Judging from the published evidence it would seem that, with the exception of the Black-crowned Night Heron, and of the Gray Herons and Sacred Ibises at Penguin Island, there is no, or only very little, predation of seabirds by ciconiiforms. We suspect that this under-represents the true situation. The available literature indicates that ciconiiform predation on seabirds is geographically widespread with reports from North America, the Caribbean, the Galapagos Islands, South Africa, Kenya, and the Seychelles Islands.

Most reported incidences of ciconiiform predation on seabirds concern feeding upon chicks, and in most reported cases the chicks are taken within the first few days after hatching (e.g., Collins 1970; Hunter and Morris 1976; Williams 1977; Shealer and Kress 1991). This suggests that there may be a brief window of opportunity for ciconiiform predation of chicks. In order to exploit this, the ciconiiform predators must monitor the status of the breeding seabirds by repeated non-predatory visits to the colony. Thus local predation can be suspected whenever a ciconiiform bird is seen within or close to a seabird colony when the seabirds are incubating. To demonstrate predation then requires monitoring of the colony through the small-chick phase and both by day and, if night herons occur locally, also by night.

Our observations indicate that, at least in Cape Cormorants, ciconiiform predation is not confined to a brief, immediate post-hatching period but extends from incubation until the cormorant chicks are several weeks old.

Impact on Species at Risk

At Penguin Island an average of 2.7 (1.5 Sacred Ibis and 1.2 Gray Heron) predation incidents were observed per day over the 46 daily observation sessions during January-March. At this rate there could be some 324 predation incidents through the 120-day period of late season Cape Cormorant breeding. At an average of two or three eggs or chicks taken per event an overall number of between 648-972 eggs or chicks would be preyed upon. Assuming an average of 3 eggs/chicks per nest (pers. obs.) this represents between 10% and 15% of the estimated annual production of the 4,800 breeding pairs of Cape Cormorants at Penguin Island. However, almost all this predation occurs during the late February to late May breeding peak when, overall, some 500 Cape Cormorant pairs breed, although seldom more than 400 at any one time (Fig. 1). This suggests that, unless cormorant pairs rapidly replace eggs or chicks, ciconiiform predation removes between 43% and 64% of the potential productivity of the secondary breeding peak of Cape Cormorants at Penguin Island. The estimated number of Cape Cormorant eggs and chicks taken by ciconiiform predators is roughly equivalent to the number of Cape Cormorants killed by Cape Fur Seals at Penguin Island (Ward and Williams, unpublished).

The context of the impact depends on the trends in the populations of the species concerned during the past few decades. In South Africa's Western Cape Province both the Sacred Ibis and Gray Heron have experienced increasing populations whilst the Cape Cormorant has been decreasing. The provincial Sacred Ibis population has experienced major expansion since the 1960s. This has been through a combination of reduction in persecution, the availability of an introduced, non-African, land snail (*Theba pisana*) as a new food source, and, in this region where most shallow wetlands dry out during the long, effectively rain-free, summers, their adaptability to roost and breed in permanent urban wetlands (Hockey *et al.* 1989, pers. obs.). Though to a lesser extent,

Gray Herons have also increased provincially, as they have benefited from planting of alien trees in generally treeless areas and from the construction of artificial water bodies (Hockey *et al.* 1989).

Cape Cormorants, on the other hand, have experienced a major regional population decrease. This has been due to the combined effects of a series of impacts, notably a reduction in food availability (Crawford and Dyer 1995), predation by Cape Fur Seals on fledging young and adults (Ward and Williams 2004, unpublished), and Pasteurellosis (avian cholera) outbreaks which have caused the death of 29,000 Cape Cormorants between 2002 and 2004 (Williams and Ward 2002; Williams and Parsons 2004). As a result the Cape Cormorant, which is endemic to southwestern Africa, has been classified as "Near-threatened" (based on IUCN criteria) in South Africa in the latest national conservation assessment (Barnes 2000).

Conservation and Management Options?

The cormorant population at Penguin Island was heavily impacted by the 2002 Pasteurellosis (avian cholera) outbreak which killed c. 7000 individuals (Ward and Williams 2002). The cormorant population is currently being depleted at an unsustainable rate through the combined effects of heavy Cape Fur Seal predation upon fledging and adult Cape Cormorants, and through the predation of eggs and chicks by ibises and, to a lesser extent, by herons and Khoisan Gulls. In addition the seal colony at the island is expanding and this is displacing cormorants from their preferred breeding sites. Though ample suitable areas for breeding are available for the displaced cormorants, these areas are closer to human activities on the island and, because this species is sensitive to human disturbances, are currently being avoided by the cormorants. Present management policy is for control first of seal predation, which focuses on the biologically more valuable adults and near-fledged young cormorants, and also for a reduction of the area occupied by seals. In the interim, predation by ibises and herons requires further moni-

toring, especially to establish whether such predation is increasing in amount or impact. Only once the seal control actions have been successful is it recommended that action be considered to reduce predation on Cape Cormorants by ibises and herons as deterring or shooting the predators is likely to cause substantial disturbance (with accompanying egg or chick loss to gulls) among the cormorants and other seabirds on the island.

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