3

PRELIMINARY INFORMATION ON THE DIET OF THE IMPERIAL SHAG *Phalacrocorax atriceps* BREEDING ON ELEPHANT ISLAND, ANTARCTICA

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Abstract: *The aim of the study was to describe prey items in the diet of Imperial Shag through pellets analysis. The collection of pellets occurred in the breeding site during the austral summer of 2011/12 in Stinker Point, Elephant Island. A total of 34 pellets of Imperial Shag were analyzed and their frequency of occurrence was calculated. Fish remains were found in all pellets. Two families of demersal-benthic fish were identified through otoliths: Harpagiferidae and Nototheniidae. Nematodes occurred frequently. Other invertebrates such as molluscs and polychaetes occurred occasionally, so as vegetable matter (algae) and stones. These items are probably from stomach contents of ingested fish or were accidentally ingested by the bird while building the nest. Our preliminary analysis showed that Imperial Shags breeding on Elephant Island have a similar diet composition to other shag species which breed in the sub-Antarctic islands and in the Antarctic Peninsula, with some items absent. However, further analysis will present more concrete data on the mass, volume and taxonomic species level of each item.*

Keywords: Pellets, Otoliths, Nototheniidae, Harpagiferidae

Introduction

Seabirds are great indicators of changes in the marine environment (Furness & Camphuysen, 1997). Their dietary data can be used to assess these modifications, such as fluctuation in fish stocks (Montevecchi, 1993; Barrett *et al.*, 2007). The Imperial Shag (*Phalacrocorax atriceps*) breeds along the Antarctic Peninsula and the South Shetlands Islands during austral summer (Watson, 1975). The species is a potential indicator of diversity and abundance of populations of benthic-demersal fish which occur in the coastal waters of this region (Casaux & Barrera-Oro, 1993; Furness & Camphuysen, 1997).

The analysis of regurgitated pellets is a simple and non-invasive method to assess diet composition of shags. Fish, cephalopods, gastropods, bivalves and polychaetes are some of the benthic organisms known to be the prey of the Imperial Shag (e.g., Schlatter & Moreno, 1976; Casaux & Barrera-Oro, 1993). Several studies on their diet were conducted in the South Shetland Islands and in the Antarctic Peninsula (Green *et al.*, 1990; Casaux & Barrera-Oro, 1993; Coria *et al.*, 1995; Casaux *et al.*, 2002); nevertheless, only one study was performed on Elephant Island (Petry & Sander, 1987). Thus, the aim of this study is to provide data on the diet of the breeding Imperial shag on Elephant Island.

Materials and Methods

Pellets of Imperial Shags (Figure 1) were collected in a colony (20 breeding pairs) at Stinker Point (61º13'20.5"S, 55º21'35"W), Elephant Island, during austral summer on February 2012. Samples were frozen for conservation and subsequently defrost for the sorting of contents under a binocular stereomicroscope. Each item was identified to

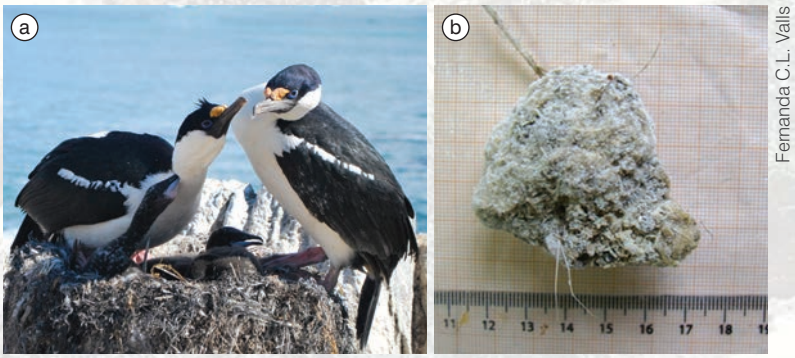

Figure 1. (a) The Imperial Shag at breeding site located at Stinker Point. (b) Regurgitated pellet.

Table 1. Diet composition of the Imperial Shag *Phalacrocorax atriceps* at Stinker Point, Elephant Island. Number (N) and frequency of occurrence (FO) of each item.

Items	N = 34	FO (%)
Fish (bones)	34	100
Fish (otoliths)	32	94.1
Stones	32	94.1
Algae	29	85.3
Feathers	27	79.4
Nematodes	22	64.7
Gastropods (shells and periostracum)	10	29.4
Polychaetes (mandibles)	10	29.4
Bivalves (shells)	3	8.8
Mites	3	8.8
Pinniped (tegument)	1	2.9
Amphipod	1	2.9

the most specific taxonomic level possible. Due to erosion of otoliths, they were only identified to family. We used the descriptions and illustrations in North *et al.*, (1984) and Williams & Mc Eldowney, (1990). Then, the frequency of occurrence (FO) of each item was calculated.

Results

We identified 11 different items. Fish remains (bones) were found in all samples and usually constituted the bulk of the pellets, proving it to be the main prey of Imperial Shag in Elephant Island (Table 1). Two families of demersal-benthic fish were found: Harpagiferidae and Nototheniidae (Figure 2). Algae and nematodes were the second most frequent item (FO= 85.3 % and 64.7% respectively). Two classes of Molluscs occurred occasionally: Gastropoda (snails) (FO = 29.4%) and Bivalvia (clams) (FO = 8.8%). Mandibles of polychaetes occurred in 10 samples (FO = 29.4%) while mites (FO = 8.8%) occurred only in three. We also found a pinniped's tegument fragment (Figure 2) and the exoskeleton of one amphipod in different samples. Stones occurred in 94.1 % of the pellets, but do not represent an energetic source to the bird.

Discussion

As previously observed fish were the most abundant prey of the Imperial Shag (Wanless *et al.*, 1992; Casaux & Barrera-Oro, 1993; Casaux *et al.*, 1997). As expected, we found otoliths from two families of demersal-benthic

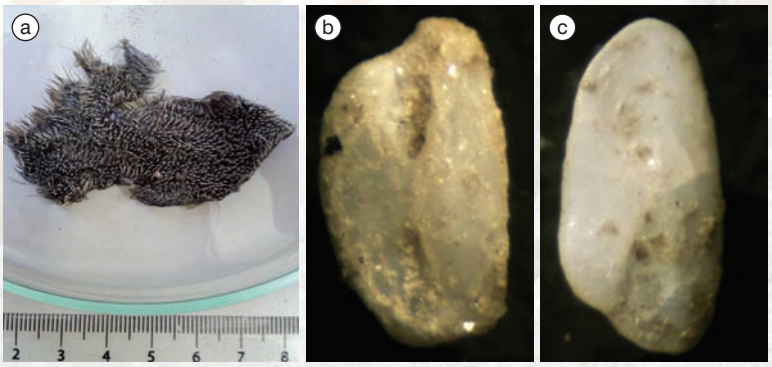

Figure 2. Prey items: (a) Pinniped tegument. (b) Otolith of Nototheniidae (c) Otolith of Harpagiferidae.

fish in our samples: Harpagiferidae and Nothoteniidae. Octopod beaks were usually the second most frequent prey item in the previously mentioned studies (Wanless *et al.*, 1992; Casaux & Barrera-Oro, 1993; Casaux *et al.*, 1997), however, no evidence of beaks was found in the pellets of Elephant Island shags. Given that shags are opportunistic feeders, these differences could be explained by different prey availability around the colony (Casaux *et al.*, 2002) or different marine relief, which could affect dive depths and fauna composition. Invertebrates such as polychaetes and molluscs and other items such as algae could be derived from fish stomachs which were ingested by the birds. In a feeding trial study, a captive Imperial Shag fed only with fish produced pellets which contained mandibles of polychaetes and algae (Casaux *et al.*, 1995), thus supporting the hypothesis that these items could be from the prey's diet. Though, shags use algae for nest building (Schlatter & Moreno, 1976) and it could have also been ingested accidentally during transport to the nest (Casaux & Barrera-Oro, 1993). This might have also been the reason to the occurrence of a fragment of pinniped's tegument, since it is not an usual prey item and has not been found in any other study.

The presence of stones might be explained by the provenance from fish stomachs as well or by ingestion for pellet formation (Casaux & Barrera-Oro, 1993; Casaux *et al.*, 1997). This hypothesis is supported by a study that compared Imperial Shags stomach content with pellets and observed that stones were present in the pellets but absent in stomach contents (Casaux *et al.*, 1997). Feathers and mites are probably provenient from the environment or the bird itself.

Fish, algae, nematodes, gastropods, bivalves and polychaetes are some of the items which were also found in other studies conducted in the South Shetlands (Coria *et al.*, 1995; Casaux & Barrera-Oro, 1993). Our preliminary analysis showed that Imperial Shags breeding on Elephant Island have a similar diet composition to other shag species which breed in the sub-Antarctic islands and in the Antarctic Peninsula, with some items absent. However, further analysis will present more concrete data on the mass, volume and taxonomic species level of each item.

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References

Barrett, R. T., Camphuysen, C. J., Anker-Nilssen, T., Chardine, J. W., Furness, R. W., Garthe, S., Hüppop, O., Leopold, M. F., Montevecchi, W. A., & Veit, R. R. (2007). Diet studies of seabirds: a review and recommendations. *ICES Journal of Marine Science*, *64*(9), 1675-1691.

Casaux, R. J., & Barrera-Oro, E. R. (1993). The diet of the blue-eyed shag, *Phalacrocorax atriceps bransfieldensis* feeding in the Bransfield Strait. *Antarctic Science*, *4*, 335-338.

Casaux, R. J., Baroni, A., & Barrera-Oro, E. R. (2002). Fish in the diet of the Antarctic shag at four colonies on the Danco Coast, Antarctic Peninsula. *Antarctic Science*, *14*(1), 32-36.

Casaux, R. J., Favero, M., Barrera-Oro, E. R., & Silva, P. (1995). Feeding trial on an Imperial Cormorant *Phalacrocorax atriceps*: preliminary results on fish intake and otolith digestion. *Marine Ornithology*, *23*, 101-106.

Casaux, R. J., Favero, M., Coria, N., & Silva, P. (1997). Diet of the Imperial Cormorant *Phalacrocorax atriceps*: comparison of pellets and stomach contents. *Marine Ornithology*, *25*, 1-4.

Coria, N., Casaux, R., Favero, M., & Silva, P. (1995). Analysis of the stomach content of the blue-eyed shag *Phalacrocorax atriceps bransfieldensis* at Nelson Island, South Shetland Islands. *Polar Biology*, *15*(5), 349-352.

Furness, R. W., & Camphuysen, C. J. (1997). Seabirds as monitors of the marine environment. *ICES Journal of Marine Science*, *54*(4), 726-737.

Green, K., Williams, R. K., Woehler, E. J., Burton, H. R., Gales, N. J., & Jones, R. T. (1990). Diet of the Heard Island cormorant *Phalacrocorax atriceps nivalis. Antarctic Science*, *2*(2), 139-141. .

Montevecchi, W. A. (1993). Birds as indicators of change in marine prey stocks. In R. W. Furness & J. J. J. Greenwood (Orgs.), *Birds as monitors of environmental change* (pp. 219-266). London: Chapman & Hall.

North, A. W., Burchett, M.S., Gilbert, C. J. & White, M. G. (1984). Identification of fish from the Southern Ocean by means of otoliths. *British Antarctic Survey*, *62*, 83-94.

Petry, M. V., & Sander, M. (1987). Nota sobre o conteúdo estomacal regurgitado de Phalacrocorax atriceps (King, 1828) da Baía do Almirantado (62° 05'S 58° 23'W), Ilha Rei George. *Acta Biologica Leopoldensia*, *9*, 129-132.

Schlatter, R., & Moreno, C. (1976). Hábitos alimentarios del cormorán antártico, *Phalacrocorax atriceps bransfieldensis* (Murphy) en Isla Green, Antártida. *Serie Científica del Instituto Antártico Chileno*, *4*, 69-88.

Wanless, S., Harris, M. P., & Morris, J. A. (1992). Diving behaviour and diet of the blue-eyed shag at South Georgia. *Polar Biology*, *12*(8), 713-719. .

Watson, E. (1975). *Birds of the Antarctic and Sub-Antarctic, American Geophysical Union*, *24*, 1-362.

Williams, R. & Mc Eldowney. A. (1990). *A guide to the fish otoliths from waters off the Australian Antarctic Territory, Heard and Macquarie Islands* (Vol. 75). ANARE Research Notes.