DIET OF POST-BREEDING ANTARCTIC SHAGS *PHALACROCORAX BRANSFIELDENSIS* AT COCKBURN ISLAND, ANTARCTIC PENINSULA

MARIANELA BELTRÁN[1], GABRIELA TAVELLA[2] & RICARDO CASAUX[3,4]

[1]*Centro para el Estudio de Sistemas Marinos (CESIMAR-CENPAT, CONICET), Bv. Brown 2915, (9120) Puerto Madryn, Chubut, Argentina (mbeltran@cenpat-conicet.gob.ar)*
[2]*Secretaría de Turismo y Áreas Protegidas, Sarmiento 635, (9200) Esquel, Chubut, Argentina*
[3]*Centro de Investigación Esquel de Montaña y Estepa Patagónica (CIEMEP, CONICET-UNPSJB), Roca 780, (9200) Esquel, Chubut, Argentina*
[4]*Instituto Antártico Argentino, 25 de Mayo 1143, (1650) General San Martín, Buenos Aires, Argentina*

Received 21 October 2016, accepted 25 October 2016

ABSTRACT

BELTRÁN, M., TAVELLA, G. & CASAUX, R. 2017. The diet of post-breeding Antarctic Shags *Phalacrocorax bransfieldensis* at Cockburn Island, Antarctic Peninsula. *Marine Ornithology* 45: 17–19.

The diet of post-breeding Antarctic shags *(Phalacrocorax bransfieldensis)* was investigated at Cockburn Island, in the Antarctic Peninsula, through the analysis of pellets collected in February 2015. Demersal-benthic fish were the most frequent and important prey, followed by invertebrates. Among the fish, nototheniids were most abundant in the diet in terms of numbers, whereas channichthyids, *Chionodraco rastrospinosus* in particular, represented most of the mass. The information provided here differs from that reported for post-breeding individuals belonging to other shag species and for post-breeding Antarctic shags. This article discusses our results and the differences with previous studies, in terms of prey availability among localities.

Key words: Antarctic Shag, post-breeding diet, Antarctica, demersal fish, regurgitated casts

INTRODUCTION

The Antarctic Shag *Phalacrocorax bransfieldensis* breeds in the summer along the Antarctic Peninsula (AP) and the South Shetland Islands (SSI; Orta 1992) in colonies of up to hundreds of pairs (Bernstein & Maxson 1985). Several studies deal with the foraging and reproductive behavior as well as population trends of breeding Antarctic Shags (see review in Casaux & Barrera-Oro 2006). However, due to logistical limitations as well as to adverse environmental conditions, little is known about these shags during the non-breeding period. A steady declining trend in the number of breeding Antarctic Shags has been reported for the last two decades at several colonies in the SSI and in the AP (see Casaux & Barrera-Oro 2006). Adequate post-breeding foraging is crucial to post-breeding adult survival and to improving juvenile recruitment, both factors that are likely to affect the population trend of this bird.

Despite the importance of studying the foraging ecology of this species, only two studies (Tomo 1970, Casaux *et al*. 2009) report post-breeding foraging behavior along the western AP coast. Also, the information provided in those studies applies only to that geographical area, and Tomo (1970) did not detail the type and number of samples analyzed or the methodology used to attain his results. Thus, the aim of the present study is to provide information on the post-breeding diet of *P. bransfieldensis* from an area off the eastern AP coast, which has never been previously studied.

STUDY AREA AND METHODS

A total of 37 pellets (regurgitated casts) of post-breeding Antarctic Shags were collected in February 2015 at the Cockburn Island colony (69°12′29″S, 56°49′28″W), on the east coast of the AP. Due to weather and sea conditions, the colony was accessible only on 12 February (19 samples) and 20 February (18 samples). To analyze the samples, we followed the methods described in Casaux *et al*. (2002), which in brief uses otoliths and other hard parts of prey and performs regression analyses of the size of the otoliths to estimate fish size (TL, total length) and mass. Left and right otoliths were counted, and the higher number indicates the number of fish of that species found in the sample.

RESULTS AND DISCUSSION

The analyses indicated that Antarctic Shags at Cockburn Island prey mostly on fish, both according to frequency of occurrence (FOO) and number, followed by polychaetes (FOO = 8.47% and N = 0.29%), octopods (3.39% and 0.12%), and gastropods (1.69% and 0.06%).

The samples contained 1 691 fish, mostly benthic-demersal species. Species belonging to the Nototheniidae family were found in higher numbers (59.25%), whereas those belonging to the Channichthyidae family provided the greatest mass (51.85%) (Table1). *Nototheniops nudifrons* and *Pagothenia bernacchii* were the fish with the highest frequencies and numbers, whereas *Chionodraco rastrospinosu* provided the greatest mass. The length of the fish ingested ranged between 3.3 cm TL (*Notothenia coriicep)* and 48.6 cm TL (*Cryodraco antarcticus)* (Table 1).

Several studies suggest that, after breeding, other shag species change their diet, preying less on fish and more on either invertebrates or other fish-prey species (Brothers 1985,

Espitalier-Noel *et al*. 1988, Green *et al*. 1990). In contrast, at Duthoit Point, SSI, and at Danco Coast, AP, Casaux (1998) and Casaux *et al*. (2002) observed that, after breeding, Antarctic Shags continue foraging almost exclusively on the same type of fish ingested during the breeding season, although relative species contributions and the size of the fish consumed varied. Although there is no information about Antarctic Shag diet at Cockburn Island during the breeding season, after breeding these birds forage almost exclusively on demersal-benthic fish, which is consistent with what has been observed at other localities (Casaux & Barrera Oro 1993, Favero *et al*. 1998, Casaux & Ramón 2002, Casaux *et al*. 2002).

Despite this consistency, the fish-prey species dominant varied by locality. Nototheniids largely dominated the diet in number and mass at both SSI (Casaux *et al*.1997, Favero *et al*. 1998) and Danco Coast, AP (Casaux *et al*. 2002). Also, although at Cockburn Island nototheniids were found in higher numbers (59.3%), channichthyids contributed the most in terms of mass (51.9%). By comparing the fish in pellets and in trammel-net catches, Casaux & Barrera-Oro (1993) and Casaux *et al.* (2002) observed that the diet of Antarctic Shags reflects local fish availability. We assume that this is the case at Cockburn Island as well. The lack of information on the structure of the fish community at the depths where shags forage around Cockburn Island precludes our testing whether this pattern applies to this locality as well.

ACKNOWLEDGEMENTS

We would like to thank J. Lusky, G. Mamani, and J. Dell Acha for their assistance in the field.

REFERENCES

BERNSTEIN, N. & MAXSON, S. 1985. Reproductive energetics of Blue-eyed Shags in Antarctica. *Wilson Bulletin* 97: 450-462.

BROTHERS, N. 1985. Breeding biology, diet and morphometrics of the king shag (*Phalacrocorax albiventer purpurascens*) at Macquarie Island. *Australian Wildlife Research* 12: 81-94. doi:10.1071/WR9850081.

CASAUX, R. 1998. Biología reproductiva y ecología alimentaria del Cormorán Antártico (*Phalacrocorax bransfieldensis)* (Aves, Phalacrocoracidae) en las Islas Shetland del Sur, Antártida. PhD thesis. La Plata, Argentina: University National of La Plata.

CASAUX, R., BARONI, A. & BARRERA-ORO, E. 2002. Fish in the diet of the Antarctic shag at four colonies on the Danco Coast, Antarctic Peninsula. *Antarctic Science* 14: 32-36. doi: 10.1017/S095410200200055X.

CASAUX, R., BARONI, A., RAMÓN, A., BERTOLIN, M. & DI PRINZIO, C.Y. 2009. The diet of post-breeding Antarctic shags (*Phalacrocorax bransfieldensis*) at the Danco Coast, Antarctic Peninsula. *Antarctic Science* 21: 221-227. doi:10.1017/S0954102009001746.

CASAUX, R. & BARRERA-ORO, E. 1993. The diet of the blue-eyed shag (*Phalacrocorax atriceps bransfieldensis*) feeding in the Bransfield Strait. *Antarctic Science* 5: 335-338. doi:10.1017/S0954102093000458

CASAUX, R. & BARRERA-ORO, E. 2006. Shags in Antarctica: their feeding behaviour and ecological role in the marine food web. *Antarctic Science* 18: 3-14. doi:10.1017/S0954102006000010.

CASAUX, R., 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.

TABLE 1
Fish represented in the diet of post-breeding Antarctic Shags at Cockburn Island, Antarctic Peninsula

Family and species	Frequency, %	N, %	Mass, %	Total length, mean (range)
Nototheniidae				
Gobionotothen gibberifrons	81.08	8.10	3.09	8.88 (3.61–3.71)
Notothenia coriiceps	56.76	2.42	3.77	10.48 (3.33–24.16)
Nototheniops larseni	10.81	0.35	0.17	10.85 (8.02–14.46)
Nototheniops nudifrons	100.00	22.12	4.91	7.93 (5.02–13.69)
Pagothenia bernacchii	97.30	14.55	16.66	14.98 (7.75–23.44)
Pagothenia hansoni	2.70	0.06	0.15	20.15 (20.15–20.15)
Trematomus newnesi	89.19	11.65	6.08	8.81 (6.24–12.03)
Channichthyidae				
Chaenocephalu saceratus	2.70	0.06	0.20	26.78 (26.78–26.78)
Chaenodraco wilsoni	5.41	0.18	0.51	20.45 (18.94–21.51)
Channichthys rhinoceratus	16.22	1.06	3.60	25.89 (19.69–36.92)
Chionodraco rastrospinosus	62.16	6.27	42.27	25.04 (16.57–38.19)
Cryodraco antarcticus	10.81	0.59	5.27	31.78 (18.05–48.59)
Bathydraconidae				
Parachaenichthys charcoti	59.46	3.73	9.45	25.86 (17.21–33.34)
Parachaenichthys georgianus	21.62	1.24	3.26	26.09 (20.57–34.60)
Harpagiferidae				
Harpagifer antarcticus	59.46	2.66	0.59	7.10 (6.04–7.91)

CASAUX, R. & RAMÓN, A. 2002.The diet of the South Georgia Shag (*Phalacrocorax georgianus)* at the South Orkney Islands in five consecutive years. *Polar Biology* 25: 557-561. doi: 10.1007/s00300-002-0389-4.

ESPITALIER-NOEL, G., ADAMS, N. & KLAGES, N. 1988. Diet of the Imperial Cormorant (*Phalacrocorax atriceps)* at sub-Antarctic Marion Island. *Emu* 88: 43-46. doi:10.1071/MU9880043.

FAVERO, M., CASAUX, R., SILVA, P., BARRERA-ORO, E. & CORIA, N. 1998. The diet of the Antarctic Shag during summer at Nelson Island, Antarctica. *Condor* 100: 112-118. dx.doi.org/doi:10.2307/1369902.

GREEN, K., WILLIAMS, R., WOEHLER, E., BURTON, H., GALES, N. & JONES, R. 1990. Diet of the Heard Island cormorant *(Phalacrocorax atriceps nivalis*). *Antarctic Scie*nce 2:139-141. doi:10.1017/S0954102090000177.

ORTA, J. 1992. Family Phalacrocoracidae (Cormorants). In: DEL HOYO, J., ELLIOT, A. & SARGATAL, J. (Eds). *Handbook of the Birds of the World, Vol 1*. Barcelona, Spain: Lynx Editions.

TOMO, A. 1970. Cadenas tróficas observadas en la bahía de Puerto Paraíso (Península Antártica) en relación con las variaciones de la fertilidad de sus aguas. *Contribución Científica del Instituto Antártico Argentino*131: 1-14.