STRUCTURAL AND CYTOCHEMICAL STUDY OF SALIVARY GLANDS IN THE MAGELLANIC PENGUIN *SPHENISCUS MAGELLANICUS* AND THE KELP GULL *LARUS DOMINICANUS*

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It has been reported that salivary gland development of avian species is related to diet (Grasee 1950, Pisanó & Barbieri 1967, Farner & Ziswiller 1972). Hence, granivorous birds that feed on dry food possess better developed salivary glands than do rapacious species. On the other hand, in birds having access to naturally well-lubricated foods, the buccal glands show little development (Forstner 1978, McLelland 1979).

Nevertheless, Avila *et al.* (1989) and Samar *et al.* (1987, 1988, 1993) have demonstrated a considerable development of buccal and lingual glands in the chick embryo and in the adult chicken. The same authors have described in the Lorikeet *Myiopsitta monacha* the presence of buccal glands with a well-structured conformation and intraepithelial acini within the tongue of this species (Samar *et al.* 1992).

To analyse the existence of the buccal salivary glands and their probable functional role, an histological and cytochemical analysis was undertaken on two seabirds, the Magellanic Penguin *Spheniscus magellanicus*, which feeds on fish, crustaceans and cephalopods (Vigil 1973, Yofre *et al.* 1983) and the Kelp Gull *Larus dominicanus*, which is a predatory and scavenging species (Narovsky *et al.* 1984, Ward 1991).

Magellanic Penguins (n=4) and Kelp Gulls (n=5) were collected from the southeast coast of Argentina. The animals were sacrificed in accordance to international protocols for biomedical investigations and samples of salivary glands from the walls of the buccal cavity and tongue removed. Samples were subjected to perfusion fixation and afterwards fixed in 10% formalin at pH 7.4 in a phosphate buffer. The tissues were then dehydrated and embedded in paraffin. Serial sections were cut at 3–4 µm, deparaffinized, hydrated and then subjected to the following procedures (Samar & Avila 1991).

1. Histological staining procedure. *Hematoxylin-eosin*: Routinely used for the general observation of histological structures.

2. Cytochemical staining procedures. These were carried out to identify the chemical products elaborated by the salivary glands' cells.

Periodic Acid – Schiff (PAS): For demonstrating vicinal diol-containing glycoconjugates. A PAS positive reaction produces an intense magenta colour, mainly indicating the presence of glycoproteins and glycogen. *PAS-amylase*: Samples were exposed to enzymatic digestion with salivary amylase. PAS positive substances which disappear after enzymatic action represent glycogen. *Toluidine blue at pH 3.8*: This stain acquires histochemical significance when used at this pH; basophilic (nuclei and ergastoplasm) and metachromatic substances can be identified; sulphated glycosamineglycans (GAG) give a strong alcohol-resistant metachromasia, while non-sulphated GAG and nucleoproteins give a weak metachromasia that is susceptible to alcohol extraction. *Alcian Blue*: was used to study the interaction with tissue polyanions. This polivalent basic dye is selective for the staining of negatively charged macromolecules, and was used at pH 2.5 and 1.0. At pH 1.0 it reacts with sulphated acidic glycosamineglycans and results in a deep blue colour, because of the presence of copper in the molecule.

Blocking (methylation) and saponification (demethylation) reactions: Used to confirm the presence of glycosamineglycans with sulphated and carboxyle groups stained with Alcian blue. Methylation at 37°C esterifies carboxylic groups and blocks the alcianophilia of mucosubstances containing these groups; substances having sulphate groups remain unaffected. Methylation at 60°C blocks alcianophilia of carboxyle groups and hydrolizes

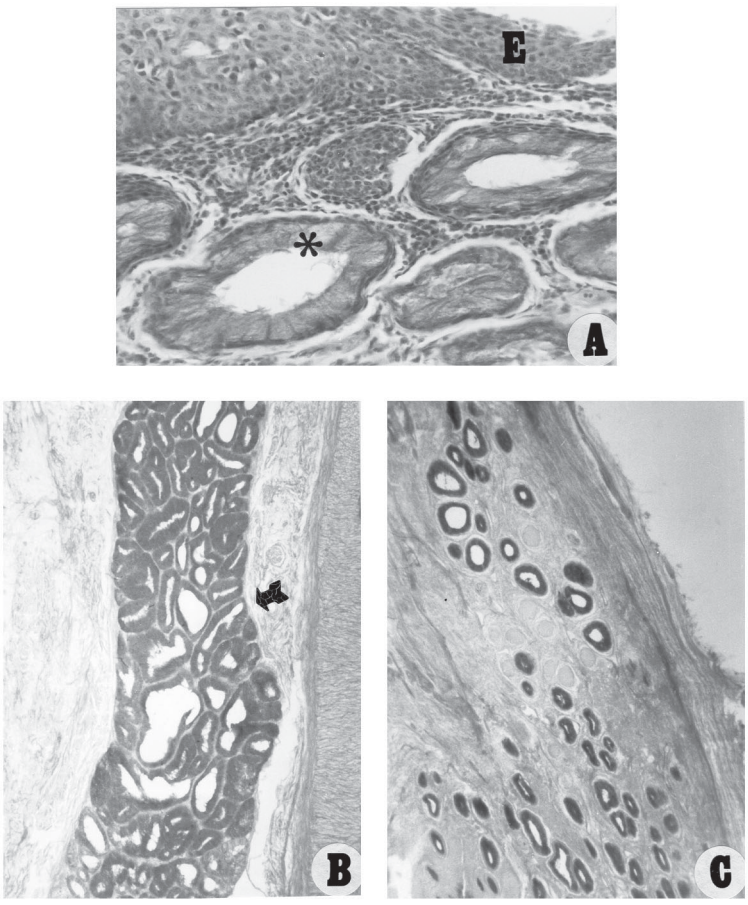

Figure 1. *Magellanic Penguin* Spheniscus magellanicus:

a: Palate alveolar salivary glands. The secretory epithelium consists exclusively of mucous cells (asterisk). Superficial epithelium (E). Hematoxylin and Eosin stain. 400X.
b: Alveolar salivary glands reveal a strong PAS reaction which is resistent to α-amylase digestion (arrow). PAS stain. 250X.
c: Alveolar salivary glands. The cells present an intense metachromasia at the floor of the mouth cavity. Toluidine blue pH 3.8 stain. 250X.

sulphate groups, which are lost to the medium. Demethylation made after methylation at 37°C unblocks carboxylic groups, and alcianophilia is reestablished. Demethylation after methylation at 60°C restores alcianophilia of carboxylic groups but not of sulphate groups, which are hydrolysed and lost to the medium.

Digestion with neuraminidase (sialidase): Selective enzymatic remotion of sialic acid with neuraminidase is used to identify sialic acid residues of glycoconjugates sialoglycoproteins and sialoglycans. The difference in staining between control and neuraminidase-treated samples after staining with PAS and Alcian blue at pH 2.5 indicates the existence of accessible sialic acid.

Salivary gland development distributed in the wall of the

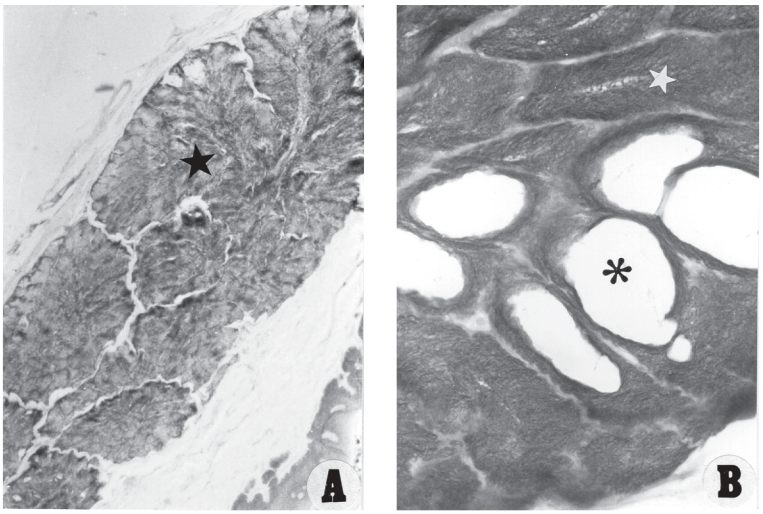

Figure 2. *Kelp Gull* Larus dominicanus:

a: Gland lobes composed by PAS reactive acini (star). PAS stain. 250X.
b: Acini (star) and alveoli (asterisk) glands with PAS positive glycoproteins. PAS stain. 400X.

mouth cavity was observed in both species. In the Magellanic Penguin the mouth cavity salivary glands were mucous with alveoli having a large lumen. In the floor of the mouth cavity some glands were located within the epithelium, but others were in the subepithelial layer. Palate areas showed abundant glands surrounded by mononuclear cells (Fig. 1a–c). Lingual glands appeared in the ventral region and were predominantly mucous and alveolar. In comparison, glands of the Kelp Gull showed an acinar structure, but they had a mucous appearance like that of the Magellanic Penguin (Fig. 2a–c). In both species, PAS-positive, alcianophilic and metachromatic mucosubstances were located in the mucous cells of glands and in the lumen of acini and alveoli. The cells were strongly reactive with PAS and their cytoplasm was filled with numerous amylase-resistant, bright purple granules. The lumen of acini and alveoli was also filled with PAS-positive material. Alcianophilia, as revealed by a deep blue coloration with Alcian blue at pH 2.5 and 1.0, indicated a strong reaction in the mucous-secreting units and in the lumen. When Toluidine blue stain was carried out at pH 3.8 an intense alcohol-resistant metachromasia could be observed.

Neuraminidase produced a decrease of PAS and Alcian blue at pH 2.5 reactions, but the α-amylase did not exert any effect on PAS positive substances in glands of both birds, indicating the presence of glycoproteins. Blocking reactions showed that the sulphated glycosamineglycans were increased in relation to the nonsulphated molecules in the glands of the two species.

The comparative morphology of salivary glands has been studied by many investigators for more than a century (e.g. Reichel 1883, Greschik 1913, Bock 1961, Foelix 1970) and the adaptation of these glands according to feeding habits, has been thoroughly described by Antony 1920 (cited by Ziswiller & Farner 1972).

It is generally agreed that, in fish-eating birds, whose intake is composed of wet food, salivary glands are poorly developed (Grasee 1950, Pisano & Barbieri 1967, Farner & Ziswiller 1972). However, from the results of the present work, it is evident that salivary gland development is important and that glycoprotein and glycosamineglycan secretions are abundant in the two seabirds studied, despite the fact that both seabirds feed on moist food (Yofre *et al* 1983, Ward 1991). We

can not offer a ready explanation to account for this apparent discrepancy. Moreover, penguins have long, pointed tongues, the upper surface being covered by numerous conical sharp, horny papillae pointing backwards to manipulate and direct slippery food towards the the esophagus. By comparison, gulls have tongues which do not appear to be specially adapted either for collection, manipulation or swallowing of food (McLelland 1979). In any event, it has to be kept in mind that the feeding habits of the Kelp Gull differ markedly from those of the Magellanic Penguin.

The oldest known function of salivary glands is to supply lubricatory molecules (Heidrich 1908, Chodnik 1948, McCaillon & Aitken 1953). These molecules not only coat the food, but the oral soft tissues as well, thus exerting a protective action on the mucosal surface (Young & Van Lennep 1978, Mandel 1987). Furthermore, salivary mucins possess properties (low solubility, high viscosity, adhesiveness), which enable them to concentrate on buccal mucosal surfaces, where they provide an effective barrier against dessication, while glycoproteins may exert a protective role against enzymatic acidic elements in contact with the mucosa. Additionally, sulphated glycosamineglicans may inhibit pathogens in the buccal cavity. It has been demonstrated that the sialic acid glycoconjugates conditions the hydrophilic environment to maintain the hydration of the mucosal surface, providing an effective barrier against bacterial activity (Farner 1978, Tabak *et al* 1982, Supraset *et al.* 1986).

It is possible that glycoconjugates secreted by the epithelium of buccal glands are necessary not only to protect mucous membrane integrity, but also to perform other functions, especially coating and softening food, facilating transit towards the stomach (Sharon 1981, Bee de Speroni & Chikilian 1983).

Further biochemical and histochemical studies of mucosubstances in the salivary glands of the Magellanic Penguin and Kelp Gull species are required to understand the relationship between ingested food and gland secretion.

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FIRST RECORD OF THE AUSTRALASIAN GANNET *MORUS SERRATOR* FOR NAMIBIA

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Ichaboe Island (26°17'S, 14°56'E) is situated about 30 km north of Lüderitz, Namibia. The 6.5-ha island was ceded to Namibia by South Africa on 28 February 1994. It supports a large number of breeding seabirds, including the largest Cape Gannet *Morus capensis* colony in Namibia (Crawford *et al.* 1983).

During a seabird census on 23 November 1993, I heard the distinctive higher-pitched call of an Australasian Gannet *M. serrator* (Berruti 1988, Dyer 1990) at one of the colonies of Cape Gannets near the island's summit. After a brief search an Australasian Gannet was located and identified by its much darker eye, very short gular stripe and white outer tail feathers (Berruti 1988, Dyer 1990). The bird was photographed, captured and banded (9–87201). Repeated bowing and calling by the Australasian Gannet and a quick return to its site of capture after release suggested it was a male (Nelson 1978, Dyer 1990).

The call of an Australasian Gannet was apparently heard at Ichaboe Island by the conservation officer there in 1990 (Y. Chesselet pers. comm.) but its significance was not then recognized.

This record extends the previous most northerly record of the Australasian Gannet for Africa at Lambert's Bay, Western Cape Province, South Africa (Cassidy 1983, Dyer 1990) by 642 km. It also exceeds the previous most northerly record of the species at Moleques do Sul Islands (27°51'S, 48°26'W) in southern Brazil (Bege & Pauli 1990).

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ANTARCTIC TERNS *STERNA VITTATA* FEEDING ON STRANDED KRILL AT KING GEORGE ISLAND, SOUTH SHETLAND ISLANDS, ANTARCTICA

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Sterna terns feed mainly in marine habitats by surface plunging or dipping into water (Ashmole 1971, Harper *et al*. 1985), but there are a few observations of this genus taking prey from terrestrial habitats, such as Kerguelen Terns *S. virgata* (Berruti & Harris 1976, Weimerskirch & Stahl 1988) and Common Terns *S. hirundo* (Dunn 1984, Fraser & McMahon 1990a, 1990b, 1990c). Antarctic Terns *S. vittata* have been previously reported feeding on the ground in open pastures at Tristan da Cunha (Ryan 1985) and on low sand dunes near the Cape of Good Hope, South Africa (Fraser & McMahon 1990c). This is the first report of Antarctic Terns taking prey from the ground in Antarctica.

On 16 December 1993, four Antarctic Terns were seen foraging actively on the shore on the west coast of Potter Cove (62°14'S, 58°38'W), King George Island, South Shetland Islands, close to a breeding site of *c*. 30 pairs. All were flying over the shore 2–3 m up, looking for euphausiid crustaceans stranded on the beach by the ebbing tide. Two birds were seen on three occasions taking euphausiids from the shore by means of low and uninterrupted flight ("ground dipping") as reported for Common Terns (Fraser & McMahon 1990b). At the South Shetland Islands, krill (mainly *Euphausia superba* and *E. crystallorophias* during the observations) often accumulates on the shore due to strong winds, and usually Antarctic Terns feed on this resource in shallow waters, but rarely on land.

Ryan (1985) cites birds walking and feeding through 30–50 mm high pastures at Tristan da Cunha, and mentions as unlikely that terns could have employed this feeding method before the advent of human settlement and the creation of short pastures. This note reports terns feeding from the ground but in a natural and unmodified environment. At the time of the observations stranded krill was scattered and scarce. On other occasions, when krill was stranded in large aggregations due to the combination of the ebbing tide and strong winds, the main scavengers were Kelp Gulls *Larus dominicanus*, with smaller numbers of Subantarctic Skuas *Catharacta antarctica* and South Polar Skuas *C. maccormicki*, but terns were absent. The highest densities of birds observed during the 1993/94 summer season were recorded form 22 to 24 December at Potter Cove after several days of strong southwesterly winds. At this time 123 Kelp Gulls (34 juveniles), 10 Subantarctic Skuas and 20 South Polar Skuas were observed. Both skua species and the majority of the gulls were feeding on the ground while walked slowly. A few Kelp Gulls and 5 to 10 Pintado or Cape Petrels *Daption capense* were foraging in shallow waters by surface seizing, together with 20 to 30 Antarctic Terns which were foraging by means of surface plunging or dipping.

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AN ADDITIONAL RECORD OF BULWER'S PETREL *BULWERIA BULWERII* OFF THE SOUTHEASTERN UNITED STATES OF AMERICA

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Although there are only two previously published reports (Taylor 1972, Haney & Wainright 1985) of Bulwer's Petrel *Bulweria bulwerii* for North America, there are a growing number of reports and records from the western North Atlantic. Taylor (1972) reported a Bulwer's Petrel between Key West and the Dry Tortugas, Florida, USA, on 14 May 1969. Haney & Wainright (1985) observed an individual off the north-eastern coast of Florida on 1 May 1984. As reported in Haney & Wainright (1985), D. S. Lee also briefly observed a bird fitting the description of Bulwer's Petrel off North Carolina (6 June 1979; North Carolina State Museum of Natural History records). In the eastern Caribbean the species' occurrence has been documented by a specimen (American Museum of Natural History 763839) from Saldado Rock off the southwestern tip of Trinidad, West Indies, on 23 January 1961 (ffrench 1963). Voous (1983) reported a sighting on 13 May 1970, four nautical miles northeast of Klein Curaçao, and another was seen off French Guyana on 9 July 1986 (Tostain 1987). Excluding the January Trinidad record, the reports from the western North Atlantic range from early May through July, a seasonal period when other eastern Atlantic species are regularly encountered off the southeastern United States of America.

On 1 July 1992, I saw a small, all-dark petrel while counting seabirds about 75 km east–northeast of Cape Hatteras, North Carolina, at 35°29'N, 74°47'W. At approximately 15h25 EDT, an all-dark procellariid seabird crossed the bow of the r.v. *Edwin Link*, at a distance of about 60 m (one ship-length). I watched it continuously for approximately 90 s until it disappeared from view at a distance of over 300 m.

My field notes taken immediately after the observation noted that both the upperparts and underparts of the bird were uniformly sooty or blackish brown. The head of the bird appeared small and the dark bill was proportionately longer and stouter than the bill of a Wilson's Storm Petrel *Oceanites oceanicus*. The wings were long, narrow, angled forward and bent sharply at the wrist. No pale carpal bar was visible. The bird appeared to be slightly smaller than Audubon's Shearwaters *Puffinus lherminieri* seen immediately before and after the petrel. The wings of the petrel appeared 50% longer than those of a Wilson's Storm Petrel seen in the same field of view at 60 m. The tail was long for a procellariid seabird and tapered to a moderate point. The legs and feet were not seen.

The distinctive flight of the petrel was apparent before I raised my binoculars. The bird flew northwest in a 24-knot southwesterly wind, whereas almost all other seabirds were flying with the prevailing wind to the northeast. The bird flew in long, shallow arcs, between one and three metres above the surface of the water. At the peaks of these banks the wings were nearly vertical. I did not see the bird flap, although it is possible that it could have during a few of the low passes it made through wave troughs. The bird maintained its cross-wind course with ease.

The nearest breeding colonies of Bulwer's Petrels to North America are in the eastern North Atlantic. The species breeds in the Azores (islets off Santa Maria and Graciosa, and the main islands of Graciosa and Santa Maria), Madeira (Desertas), the Salvages Islands (Selvagen Grande, Selvagen Pequena and Fora), the Canary Islands (Montana Clara and Tenerife) and the Cape Verde Islands (Razo and Cime) (Le Grand *et al*. 1984). Except for the Salvages Islands and Desertas, where the species is reported to be "very common" (Jouanin *et al*. 1979, Le Grand *et al*. 1984), the population sizes are generally unknown but are thought to be small. For example, although Bannerman (1914) stated that these petrels breed commonly in the Canary Islands, only small, isolated colonies are now known, with the stronghold on Montana Clara where there are only about 100 pairs (Lovegrove 1971). In the Cape Verde Islands, De

Naurois (1969) estimated the total population to be about 10 pairs. Owing to its largely nocturnal habits, however, it is possible that the population estimates from the eastern Atlantic are unreliable. It is likely, though, that the entire Atlantic population is less than several thousand pairs.

In the Canary Islands the breeding season extends from May to September (Bannerman 1914). The summer occurrence of Bulwer's Petrels off the southeastern United States of America corresponds with the regular appearance of other seabirds that breed on various eastern Atlantic islands (North Atlantic Softplumaged Petrels, *Pterodroma mollis* complex, of which most are believed to belong to the Cape Verde or Salvages populations; Cory's Shearwaters, *Calonectris diomedea*; Little Shearwaters, *Puffinus assimilis*; Bandrumped Storm Petrels, *Oceanodroma castro*; and Whitefaced Storm Petrels *Pelagodroma marina* (Haney *et al.* 1993, NCSM specimen records, Lee 1984, Lee 1988, Watson *et al*. 1986). The relative abundance of these eastern North Atlantic species in the western North Atlantic closely parallels their documented population sizes in the eastern Atlantic. Cory's Shearwaters are present off the southeastern United States during the species' breeding period (Lee 1986). In a series of specimens collected off North Carolina, all individuals are young nonbreeding birds (D. S. Lee pers. comm.). This same pattern may also hold for the other eastern Atlantic seabirds visiting the western North Atlantic during the northern summer.

The recent sightings in the western North Atlantic and Caribbean make D.S. Lee and J.V. Remsen's prediction (in Roberson 1989) of this species' eventual documentation by photograph or specimen in North America more promising than ever.

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STOMACH CONTENTS OF A GREYBACKED STORM PETREL *GARRODIA NEREIS* FROM SUBANTARCTIC MARION ISLAND

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Greybacked Storm Petrels *Garrodia nereis* are small seabirds with a circumpolar breeding distribution in the Subantarctic (Warham 1990). These birds are not often seen, and even fewer have been collected, at Marion Island (46°54'S, 37°45'E), where less than 100 pairs are believed to occur but breeding has not been proven (Williams *et al.* 1979, Cooper & Brown 1990). On 9 February 1994 in foggy conditions a Greybacked Storm Petrel flew against a building of the meteorological station in Transvaal Bay and broke its neck. The bird had a body mass of 36 g, wing and culmen lengths were measured as 122 mm and 13 mm, respectively. The stomach of the bird was filled to capacity with 2.7 g of food (equivalent to 8.1% of body mass), consisting almost entirely of cypris larvae of the stalked barnacle *Lepas australis*. The only other item found was one very damaged specimen of a euphausiid crustacean, tentatively assigned to the genus *Euphausia* because of its spherical (not bilobed) eyes. The sizes (greatest length) of the cypris larvae ranged from 2.05–2.70 mm (n=24), with a mean of 2.34 mm (SD=0.18 mm) (Fig. 1). A subsample of 211 cypris larvae was weighed on an analytical scale and gave a wet mass of 0.4184 g, SD=0.0012 g (mean of four weighings). Given that the total stomach mass was 2.7 g and subtracting 0.05 g (an estimate) for the mass of the euphausiid, the bird consumed a minimum of 211 (2.7–0.05)/0.4184 = 1336 cypris larvae during its final foraging trip.

Ridoux (1994) has recently shown that *Lepas australis* larvae also formed the bulk of the diet of the Greybacked Storm Petrel at all other localities where it has been sampled, including the only four food samples that have been collected previously at Marion Island (Grindley & Lane 1979, Imber 1981). Cypris sizes reported by Ridoux (1994) from three stomach contents were identical to the measurements obtained from our sample. Ridoux (1994) identified the euphausiid *Euphausia vallentini* and the hyperiid amphipods *Themisto gaudichaudii* and *Cyllopus lucasii* in the Crozet diet.

The Greybacked Storm Petrel obtains its food from the surface of the ocean, employing the feeding methods of pattering and dipping without alighting (Warham 1990). The species is thought to forage preferentially over drifting kelp rafts and other floating debris, where dense elongated swarms of the free-living cyprid larvae of *Lepas australis* find shelter before metamorphosis into sessile stalked thoracic crustaceans (Ridoux 1994). The new data presented here support this concept since the storm petrel would have to find a cypris larva almost every 30 seconds during the 12 hours of daylight prevailing at that time to collect this number of prey.

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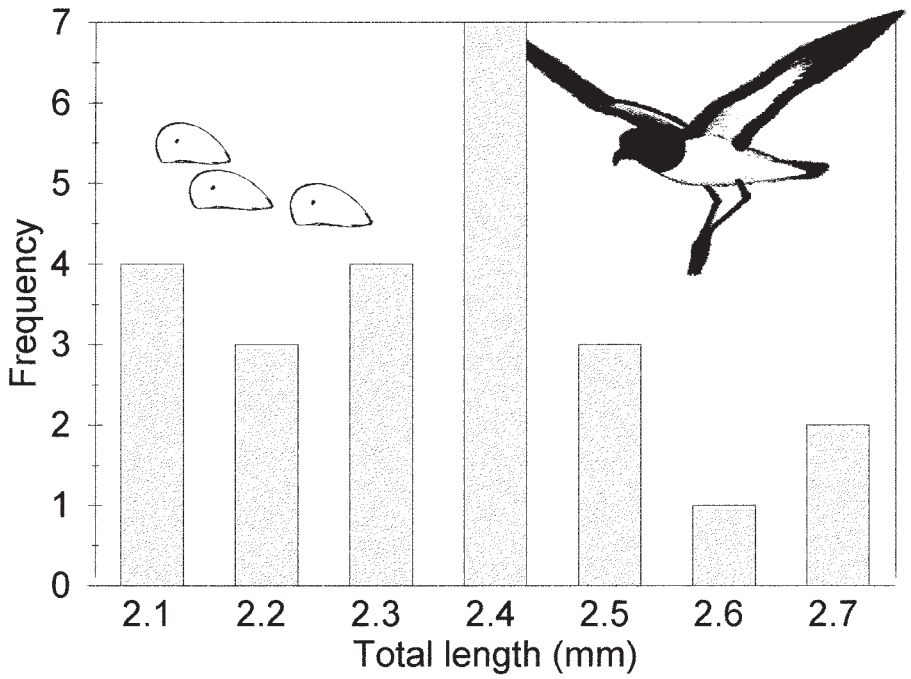

Figure 1. *Size distribution of cypris larvae of* Lepas australis *consumed by a Greybacked Storm Petrel from Marion Island.*

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KLEPTOPARASITISM OF IMPERIAL CORMORANTS *PHALACROCORAX ATRICEPS* BY GREATER SHEATHBILLS *CHIONIS ALBA* IN ANTARCTICA

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On 3 February 1995, while carrying out a study on the foraging behaviour of the Imperial Cormorant *Phalacrocorax atriceps* at Duthoit Point, Nelson Island, South Shetland Islands, Antarctica, I observed Greater Sheathbills *Chionis alba* kleptoparasitizing breeding cormorants which were feeding their chicks. The robbing behaviour consisted, as described for Greater and Lesser Sheathbills *C. minor* on penguins (Jones 1963, Burger 1979, 1981), in attacks running or flying against the cormorant just as a bolus of food was passed from the adult to the chick, producing an interruption of regurgitation and the spilling of some food, which was seized by the sheathbill. During the study six breeding pairs of cormorants were followed for 24 hours, observing a total of 42 chick feedings (M. Favero *et al.* unpubl. data), from which three (7%) were kleptoparasitized, involving one, two and four attacks, respectively. Success was observed only in the second case mentioned.

Greater Sheathbills have been cited robbing penguins (see Brockmann & Barnard 1979, Furness 1987, Marchant & Higgins 1993 for review) but never Imperial Cormorants, despite the fact that the association between sheathbill and cormorant colonies has often been noted (e.g. Watson 1975, Olrog 1984).

During the observations the mass of the cormorant chicks averaged 2820 g (SD=210 g, n=11) which means they were 38–50 days old. Two additional 24-h observations were made at the same colony in early December (during the cormorant incubating period) and late January (brooding period). No robbing behaviour was observed, although individual sheathbills were seen walking, looking and occasionally taking dropped food among the cormorant nests.

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PREDATION BY SOUTHERN GIANT PETRELS *MACRONECTES GIGANTEUS* ON ADULT IMPERIAL CORMORANTS *PHALACROCORAX ATRICEPS*

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The diet of the Southern Giant Petrel *Macronectes giganteus* has been studied at a number of Antarctic and Subantarctic colonies (e.g. Conroy 1972, Bonner & Hunter 1982, Hunter 1983, Voisin 1991) and found to consist of penguins, burrowing petrels, seal carrion, cephalopods, crustaceans and fish. However, observations of predation by giant petrels on adult Imperial Cormorants *Phalacrocorax atriceps* at their colonies has not been previously published.

During 17, 18, 20 and 22 November 1991, we observed predation by a Southern Giant Petrel on breeding Imperial Cormorants at Isla Isabel (45°07'S, 66°30'W), Chubut, Argentina. Observations were made during early egg-laying by the cormorants. The cormorant colony had 182 active nests, 22 of which were under study. On all days, the giant petrel involved had a similar colouration pattern, with the head and neck almost completely white, suggesting that the attacks were made by the same individual.

Predation attempts occurred between 15h00 and 19h00 on all days and in all cases they elicited a similar behavioural response from the cormorants. We noted the start of each attack by sudden nest abandonment by some cormorants and their regrouping at the centre of the colony. This was followed by the immediate appearence of the giant petrel, which flew over the colony at a height of approximately 0.5 m. The giant petrel always approached the island flying into the wind and never landed at the colony. As a result, approximately 40–50 cormorants took flight. Once the cormorants were flying over the water, the giant petrel chased them and usually approached a cormorant that had become separated from the group. These flights and chases, or attacks, were repeated several times and consisted of a mean of 21±13 attacks (range 4–34) daily. The duration of each attack lasted between three and five minutes.

During the chases, the giant petrel sometimes hit the cormorant several times with its beak or body while still flying. On occasions, when the giant petrel was close, the cormorant dived below the water surface and was then followed by the giant petrel. On two of the four days when we observed attacks, the giant petrel landed on the sea surface, captured a cormorant and continued hitting it with its beak. Two out of 85 observed attacks resulted in a cormorant being killed and eaten. The Southern Giant Petrel ate only part of the cormorant's viscera, starting from the cloaca.

During all predation attempts, Kelp Gulls *Larus dominicanus*, Dolphin Gulls *L. scoresbii* and Greater or Palefaced Sheathbills *Chionis alba* took advantage of the predator's disturbance of the cormorant colony by preying almost immediately on exposed cormorant eggs. Except for groups of between 10 and 15 individuals, cormorants did not return immediately to their nests after being attacked. Most disturbed cormorants remained at sea, approximately 50 m from the coast, until some time after the giant petrel had stopped attacks and many did not return to the colony until evening. Cormorants lowered their probability of being preyed upon with this behaviour, but increased the probability of loosing their clutches to gulls and sheathbills. It is possible, however, that due to the timing of predation events most cormorants that did not return to the colony after attacks had not yet laid their eggs.

Thirteen of the nests under study had eggs (15 in total) at the time of the attacks. Four eggs (27%) from four nests (30.8%) were taken by predators. We confirmed later that two (15.4%) of the depredated nests were permanently abandoned. Additionally, another eight eggs were lost between 22 November and our next visit to the colony on 26 November, suggesting that other attacks had occurred. In addition to egg loss to gulls and sheathbills, several eggs rolled out of the nests when cormorants fled at the approach of the giant petrel. This egg mortality was not quantified.

Predation by giant petrels on adult seabirds is apparently frequent at Subantarctic localities (Hunter 1983, 1990, Voisin 1991), where penguins and, to a lesser degree, small petrels are captured. Along the Patagonian coast, Southern Giant Petrels prey on Magellanic Penguins *Spheniscus magellanicus*, Kelp Gulls and Imperial Cormorants (Harris 1986, A. Bos & P.M. Yorio pers. comm.). In the Chubut Province, Southern Giant Petrels have also been observed attacking adult Imperial Cormorants at their colonies at Isla Lobos during the 1991/92 breeding season (F. Fauring pers. comm.) and at Isla Vernaci Oeste during the 1993/94 breeding season (G. Herrera pers. obs.).

Egg mortality and nest abandonment as a consequence of Southern Giant Petrel predation at the colony at Isla Isabel during the 1991/92 season were significant. However, it is possible that the predation impact was underestimated, because daily predation observations were not made throughout the breeding cycle. Our data suggest that giant petrel predation, although apparently uncommon, may significantly affect not only the adult population but also breeding success. It is possible that giant petrels may affect other breeding variables, such as settlement and pair formation. Given that apparently only one Southern Giant Petrel was involved, more information is needed to know how common this type of predatory behaviour is or whether this was an isolated occurrence.

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Review

HANDBOOK OF AUSTRALIAN, NEW ZEALAND & ANTARCTIC BIRDS (HANZAB). VOLUME 1, PART A, RATITES TO PETRELS; PART B, PELICANS TO DUCKS

Marchant, S. & Higgins, P.J. (Coordinators) 1990. Melbourne: Royal Australasian Ornithologists Union & Oxford University Press. 1400 pp. Numerous figures, sonograms, tables, maps and colour plates. Price $AUD 395.00. ISBN 0-19-553068-3.

To all those interested in marine ornithology, publication of HANZAB is a very significant project. The completed work will cover almost 50% of the world's seabirds in great detail. Many of these species have a tropical distribution in both hemispheres and many others are migrants either to or from the northern hemisphere so the publication should attract attention throughout the world. For those whose ornithological interests lie in Australasia or in the higher latitudes of the southern hemisphere, the work is an essential reference.

Since HANZAB comes from the same publishing house as the 'Birds of the Western Palearctic' it is not surprising that the format of HANZAB is very similar. Thankfully, the birds are listed in the familiar Wetmore order so everything is where you might expect to find it. In 'The taxonomy & species of birds of Australia & its Territories' by Christidis & Boles, published by the RAOU in December 1994, the new *de facto* official Australian 'Checklist', the more modern sequence, proposed by Sibley & Ahlquist (1990) in their 'Phylogeny and classification of birds: a study in molecular evolution', has been adopted in part. Not so for HANZAB which was commenced well before the new order was generally accepted. Seabird groups included in Volume 1 are the penguins (Spheniscidae), albatrosses (Diomedeidae), petrels and shearwaters (Procellariidae), storm petrels (Hydrobatidae, the synonym Oceanitidae is also used), diving petrels (Pelecanoididae), pelicans (Pelecanidae), gannets and boobies (Sulidae), darter (Anhingidae), cormorants (Phalacrocoracidae), frigatebirds (Fregatidae) and tropicbirds (Phaethonidae). A map on the endpaper indicates the area embraced by the work, which is about 18.5% of the whole world. All of the Antarctic region below 60°S, 225° of arc below 45°S, as well as New Zealand, the whole of Australia (i.e. to 10°S), its territories and surrounding seas, are included: this area is home to about 10% of all avian species. Volume 2 of this seven-volume HANZAB project has already been published but includes no seabirds unless sheathbills are considered to be marine animals. Volume 3, which includes the phalaropes (Scolopacidae), and the skuas, gulls and terns (Laridae), is due for publication in early 1996.

Comprehension of the precise region covered by HANZAB is made easier if one labels the latitudinal and longitudinal lines on the maps, as this is not done for you. This is one of a few features of HANZAB which is not immediately user-friendly. I suggest that when you buy these books, your first task should be to make them more friendly just by making a few simple additions. Firstly, using a thick, permanent, instant-drying pen, label the spine and face of the dust cover with a bold **A** or **B** as appropriate to avoid picking up the wrong 'Part' of this two-book volume on every second occasion. This will save much time and obscene language if, like me, you often refer to them. Unfortunately, the publishers chose a small and obscure 'print' to distinguish the two parts. Next, use a similar pen but with a fine point, to label properly the plates. Otherwise you will forever be jumping between the plate, the numbered monochrome reproduction of the plate and the caption, to identify the image of your desire. Thank goodness this strategy of plate numbering was dropped for the second volume (third book). This task is made even more necessary because the numbering on the plate is random and the caption is sometimes located in reverse position, e.g. Gould's and Stejneger's Petrels *Pterodroma leucoptera* and *P. longirostris*. This is in contrast to the text which does read conventionally from left to right and from top to bottom! Another problem is that the plate captions do not give page numbers for the relevant text.

The 'Introduction' for the whole work is in Part A. This is a users' guide, giving general background information, glossaries of terms and definitions, and a summary of the sort of information one may expect to obtain from major headings in the species texts. There are a few short-comings with this section. Unfortunately the print size used for some subheadings is the same as for the major headings making quick reference difficult. I suggest that you qualify repeated subheadings yourself. For

instance, after 'GLOSSARY' add 'Habitat' or 'Plumage' as relevant to save time when you flick back in search of a definition. Not that you will always satisfactorily find your definition anyway. For instance the 'glossary' for 'Plumage and Related Matters' defines 'ramus' only as part of a feather as shown in Fig. 21, omitting the other definition as one half of the lower mandible where it is divided at its base as shown in Fig. 13. Incidentally, some abbreviations are also undefined. Luckily I know that NZDOC means New Zealand Department of Conservation and I guess OED (under Emu e.g.), means Oxford English Dictionary but we are not told. Having once had a boss who enjoyed talking in abbreviations just to imply superior familiarity with his subject, I am not fond of this practice.

I found difficulty with Table 1, which ostensibly defines the nomenclature for plumages and moult, when trying to reconcile it with the terms used in the text. The terms defined here seem to have been largely abandoned. Moreover this table doesn't seem to admit two plumages within one year. That is, there may be a first-immature non-breeding-(season)-plumage as well as a first-immature breeding-(season)-plumage and so on (I am informed that the section defining plumages and moult will be revised and clarified in Volume 3). Here too, in the table, many of us will be introduced to an unfamiliar feather tract: the humerals and their associated coverts. This is an important innovation because birds like albatrosses gain extra length in the wings by having a long humerus which therefore supports more feathers. What I'm not clear about is how a bird can have subhumerals without having humerals, as indicated in Fig. 5 for the Fluttering Shearwater *Puffinus gavia* (which looks more like a Hutton's Shearwater *P. huttoni*)? Maybe the figure is incomplete? Certainly Fig. 3, which shows feather tracts on the dorsal surface of a Latham's Snipe *Gallinago hardwickii* is incomplete. This figure shows in great detail the primaries and secondaries but completely omits the tertials which are very important feathers in this species, as in most Charadriiformes.

There are occasional taxonomic departures from previous publications and some of these are without explanation or justification. For instance, the Whitetailed Tropicbird *Phaethon lepturus* is regarded as monotypic whereas Peters' Checklist of the birds of the world, and other authorities, properly consider the golden form on Christmas Island to be of the race *fulvus*. Some flippancy in taxonomic opinion is also demonstrated by the recognition of Macaroni and Royal Penguins *Eudyptes chrysolophus* and *E. schlegeli* as separate species. Just four years on, the new Australian 'Checklist' has lumped them. This is just as well as there is now no need to resolve the contradictions of the identity of vagrants. We are told identification must be based on locality, not morphology, Royals occurring only at Macquarie Island. Yet vagrant records of Royal Penguins are given for several other localities! Another change of thought since HANZAB has been the lumping of several island forms of cormorants and, for some, even a change of genera. Macquarie and Heard Cormorants *Phalacrocorax purpurascens* and *P. nivalis* are now, elsewhere, considered to be part of the Imperial Cormorant *Leucocarbo atriceps* complex.

The species texts are normally subdivided into the following major subjects. Field Identification, Habitat, Distribution and Population, Movements, Food, Social Organization, Social Behaviour, Voice, Breeding, Plumages, Moults, Measurements, Weight, Structure, Geographical Variation and References. A section headed Recognition is added where identification may be a problem. General data on the Family are given under that title preceding the species texts. The quantity of information presented is immense. We are told what is known about a bird, what may be known and what is not known. Only a few things are incorrectly stated. There are, however, just a few subjects, such as longevity, diseases, causes of death, etc., which are hardly mentioned – perhaps indicating the real lack of such data.

Some subject matter is provided under unsuitable headings. Notes on general behaviour are tucked away in the final paragraph of the sub-heading 'Similar Species' under 'Field Identification' and descriptions of mechanically-produced sounds, such as bill claps, are given under 'Voice'. Occasionally one finds subject matter apparently transposed. For example, under 'Habitat' one reads that Cook's Petrel *Pterodroma cookii* is 'endangered', information I expected to find under 'Population'. Some sections of text have even been transported from another species. For instance, under Pycroft's Petrel *P. pycrofti* we read that its behaviour at sea is assumed to be similar to '. . . Pycroft's Petrel'!

We can be very thankful that the senior co-ordinator did not get his published wish and 'let us get our art-work elsewhere'. Sanity prevailed, so every species is illustrated with at least two images. Where necessary, multiple images are provided. Jeff Davies' plates are original in style, extremely informative, generally accurate as well as pleasing. They are an essential part of the project complementing the 'Field Identification' and 'Plumage' elements of the text. All are portrayed in the most reveal-

ing postures to aid field identification. Thus the Procellariiformes are shown in flight and in most plumage phases. Many are the best representations presently available but there are inaccuracies. For instance subtle, and not-so-subtle, differences which enable Short-tailed and Sooty Shearwaters *Puffinus tenuirostris* and *P. griseus* to be identified and separated at sea are not properly depicted. The necks of both species are drawn fractionally too long, the wings too broad and the tails much too tapered. The Sooty Shearwater is illustrated with equal projections of the body fore and aft of the wings instead of about 3/8 before and 5/8 after. It has less of a cruciform shape than Short-tailed Shearwater. In flight, the Short-tailed Shearwater has more like half the length of the toes trailing behind the tail rather than just the claws as drawn. The Sooty Shearwater has a more attenuated wing point which is neither portrayed nor mentioned under 'Field Identification'.

Text writers and the artist usually co-operate well and share material so there should not be a dichotomy of opinion. However, as mentioned above, both the Short-tailed and Sooty Shearwaters are illustrated with a wedge-shaped tail whereas in both 'Field Identification' and 'Structure', their tails are described as rounded. This may be true, but at sea they do usually appear slightly cuneate. Another instance is in differences in the underwing pattern of Stejneger's and Gould's Petrels. The text states that the mainly white underwing of Stejneger's distinguishes it from Gould's, but the plate shows it with only marginally less black.

The authors of the various sections have incorporated the results of many of their own previously unpublished work and have been bold, and in my opinion, generally very sensible, in accepting unreviewed and unpublished information provided pers. comm. and *in litt*. This was necessary due to the rapid accumulation of radically new information, especially about seabirds, over the period immediately before publication. Thus HANZAB is more than a collation of published literature. Much original work and information gleaned from photographs is included in addition to the traditional museum studies of skins and literature review although there is some contradiction in the acceptance of some data. For instance, under Softplumaged Petrel *Pterodroma mollis*, data taken from some of my photographs of birds off the Victorian and New South Wales coasts are presented as fact under Plumages and Moults, whereas under Distribution and Population the occurrences are claimed to be 'unconfirmed'! The information provided on that great seabird phenomenon, the 'Wreck', receives only scant mention and I could find no mention at all of the occurrence of such disasters for the Common Diving Petrel *Pelecanoides urinatrix*, in spite of published data from New Zealand and Australia.

My one great personal disappointment is with the HANZAB treatment of prion *Pachyptila* spp. morphology and distinguishing features. Both the plates and text are at fault and are not consistent. All prions are drawn with a **T**-shaped undertail pattern which may be nearly correct only for some Antarctic Prions *P. desolata*. Typical Slenderbilled Prions *P. belcheri*, at least those occurring in Australia, have a very long central streak, longer than drawn, with no cross bar at the tip. Fairy Prions *P. turtur* have no central streak at all (only the tips of the longest coverts are black), but the black across the tip is broader and darker. Salvin's Prions *P. salvini* typically have a black triangle at the centre of the tip of the undertail and are often barred on the lateral undertail coverts. Strong barring is indicative, possibly diagnostic, of this species. Antarctic Prions are rather variable but typically the tail pattern is like a **T** with the stem narrowest at its base and broadest at the cross-bar which extends almost to the outer tail feathers. The head and neck patterns are also improperly drawn, thus masking actual distinctions. The illustration of the Slenderbilled Prion does not show the half collar which differentiates it from Fairy Prion shown on the same plate. Some of these errors could have been avoided if Carter, M.J. (1981) Undertail patterns of prions, *Australasian Seabird Group Newsletter* 15:9–10 had been consulted. The paper was written in 1978 and distributed among my friends and colleagues. Since then I have seen thousands of prions at sea, taken many photographs of live and dead birds, and I stand by the statements in that paper. The distinctive long central streak up the undertail of the Slenderbilled Prion, first described therein, has found expression in HANZAB, if only in the text, but no credit is accorded to the source.

At last we have a publication where we can find detailed information on measurements, mass and structure. Until HANZAB, data on these subjects for many exclusively southern seabirds was very hard to obtain. I no longer retain some beach-cast specimens in my freezer for the purpose of obtaining this previously scarce material. The references provide an extremely useful bibliography for one's own research and are testimony to the exhaustive literature search performed. There are nearly 150 citations for the Wandering Albatross *Diomedea exulans* alone.

My appreciation of HANZAB was enhanced recently when at sea with a group of seabird enthusiasts we

encountered two non-typical *Fregetta* storm petrels in an extralimital location. The local field guides and other seabird identification books were inadequate to solve the problem of identification but reference to HANZAB resolved the matter immediately.

This publication is expensive but its purchase will eliminate the need for other books as most accumulated knowledge is synthesised herein. Members of the RAOU in Australia can purchase this volume (two books) for A$335.00 plus $7.50 for postage, and since the current subscription rate is only $40.00, buying this way is an overall saving and you also enjoy the other benefits of membership which includes the excellent quarterly magazine *Wingspan*. Elsewhere, potential purchasers should inquire locally because postage from Australia can be exorbitant.

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Review

PENGUINS OF THE WORLD

Reilly, P. 1994. Melbourne: Oxford University Press. 164 pp. 57 figures of colour and black & white photographs and drawings, eight colour plates. ISBN 0-19-553547-2 (paper). Price UK£ 12.95, AUD$ 19.95, USD$ 16.95.

Pauline Reilly began working with Little Penguins *Eudyptula minor* at Phillip Island, Australia in 1967, and continued in this pioneering study for 13 years. In the late 1970s, she visited Macquarie Island twice, once to review penguin research there, and again the following summer to study Gentoo Penguins *Pygoscelis papua*. She has published 11 papers on Little Penguins, and one on Gentoo Penguins, in addition to many papers and two books on other Australian birds. With one children's book on penguins, a general introductory book on Little Penguins (*Fairy Penguins and earthy people*, Lothian 1983), and as co-editor of the forthcoming *Penguin biology – advances in management* (Dann, P., Norman, F.I. & Reilly, P.N., Surrey Beatty), Pauline has successfully and eloquently introduced Australian seabirds to readers, ages five and up, for two decades. Her newest book, *Penguins of the World*, now introduces the non-specialist reader to the most recent developments in penguin biology and conservation for all species of penguins in the world.

The book is comprised of eight chapters. The first chapter is an introduction to the diversity of penguins, and covers material common to all species under such topics as plumage, fossil penguins, taxonomy, population sizes, morphology, navigation, locomotion, foods and prey consumption, behaviour and breeding. Out of necessity, many topics covered in this chapter are dealt with in one or two paragraphs, but more space is given to aspects of behaviour and breeding. The information on the newest technologies such as satellite telemetry, automatic weighbridges and stomach temperature sensors is lucidly described.

Chapters 2 to 7 are devoted to each of the six genera of penguins, and each chapter begins with a brief introduction to the genus. Material for each species is then presented under the following headings: i) description, ii) distribution, dispersal and population, iii) at sea and on land, iv) behaviour, v) breeding and vi) threats and conservation. Information under description includes masses, body lengths and colouration, and accounts of each species' breeding distributions, diving behaviour, postures and breeding regimes are provided under their respective headings. Typically one species per genus is described in greater detail than the others as representative of all species in that genus. The colour identification plates are those used in the *Handbook of Australian, New Zealand and Antarctic birds*, published in 1990 by Oxford University Press, with the exception of the plate illustrating the *Spheniscus* penguins.

Chapter 8 deals with current and future conservation issues. While species-specific threats are given in the species' accounts, this chapter stresses the wide variety of anthropogenic factors involved in the decreases of most penguin species, including direct interference, introduction of exotic predators and pollution. Competition with commercial fisheries, mentioned only in passing in species' accounts, is conspicuously absent from this final review, despite several recent studies in Africa and the Subantarctic.

Throughout the book, technical jargon has been kept to a minimum – any technical word or phrase not immediately explained in the text is included in the brief glossary of 67 words and phrases. The inclusion of some words and terms in the Glossary is puzzling: 'pre-egg' and 'synchronous' are probably unnecessary. The bibliography is up to date, including many citations from *Penguin biology: advances in management* (1995), but perhaps surprisingly, none of John Warham's work on *Eudyptes* penguins is cited.

My main criticism of the book is the maps. The intended audience of non-specialists will not be helped at all by the maps in the book: 17 tiny maps are squeezed onto two pages, with no islands, continents or oceans named. A single, large map, providing all place names and oceanographic features used in the text would have been far more useful for readers attempting to locate the islands or coastlines indicated by arrows on these species' maps. While the maps do provide an overview of where the breeding localities of a species are found, the lack of detail is frustrating.

Despite the small maps, the book is an excellent introductory text for its intended audience. The breadth of information, including as-yet unpublished data, the clarity of the writing and the overall presentation make for an enjoyable book.

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