AGEING IMMATURE ATLANTIC YELLOW-NOSED *THALASSARCHE CHLORORHYNCHOS* AND BLACK-BROWED *T. MELANOPHRIS* ALBATROSSES IN WINTERING GROUNDS USING BILL COLOUR AND MOULT

LEANDRO BUGONI[1,2] & ROBERT W. FURNESS[1]

[1]*Faculty of Biomedical and Life Sciences, Graham Kerr Building, University of Glasgow, Glasgow, G12 8QQ, UK*
[2]*Current address: UFPel, Instituto de Biologia, Campus Universitário Capão do Leão, CP 354, 96010-900, Pelotas, RS, Brazil (lbugoni@yahoo.com.br)*

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SUMMARY

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Atlantic Yellow-nosed *Thalassarche chlororhynchos* and Black-browed *T. melanophris* Albatrosses were captured at sea off the Brazilian coast and aged based on bill colour and moult of wing, tail and contour feathers. First-year Atlantic Yellow-nosed Albatrosses have a black bill and show no moult. One-year-olds have some yellow at the culminicorn and show tail and contour feather moult, but not primary moult. Two-year-olds show more yellow on the bill, progressing through to full orange culminicorn and reddish nail at age 3, but three-year-olds differ from adults by having only a pale vertical bar at the base of ramicorn and flight feather moult during the breeding period. Adults have a more pronounced vertical bar at the base of the ramicorn and do not moult flight feathers while breeding. Comparison with previous descriptions for ageing Black-browed Albatross shows that birds off Brazil (originating mainly from the Falkland Islands/Malvinas) differ considerably from birds from South Georgia Island. First-year birds wintering off southern Brazil show paler bills, with colour changing quickly after fledging. However, Black-browed Albatrosses two years old with fully black bills, as those described from South Georgia, were also sampled, suggesting a variety of origins of Black-browed Albatrosses wintering in the area and inter-colony differences in bill colour maturation.

Key words: Age determination, albatrosses, origin, Diomedeidae, *Thalassarche chlororhynchos, Thalassarche melanophris*

INTRODUCTION

Albatrosses are known to have slow plumage maturation, going through a recognizable ongoing transition until 20 years of age in the large Wandering Albatross *Diomedea exulans* (Prince *et al.* 1997), and even longer in females of the Tristan Albatross *D. dabbenena,* of which some breeding birds are known to have chocolate-brown plumage similar to that of the chicks they are rearing (Cuthbert *et al.* 2003). In the group of small albatrosses ("mollymawks"), plumage maturation produces an increase in the amount of white in the surface of the underwing and a change in bill colour, usually to pale or colourful bill plates from an originally dark shade.

Plumage maturation in mollymawks lasts up to six years, can make age assignment difficult, and is not fully described in most species. For example, the Black-browed Albatross *Thalassarche melanophris* changes bill colour with age, which, combined with examination of the state of flight feather moult, allows for age determination up to six years of age, because the pattern and timing of flight feather moult change with age up to breeding age (Prince & Rodwell 1994). In a similar way, bill colour maturation and development of moult patterns were described for Grey-headed Albatross *T. chrysostoma* (Prince & Rodwell 1994), which change from having a wholly dark bill to orange at the culminicorn, ramicorn and ungues (Prince & Rodwell 1994).

The present study aimed to provide a tool for age determination of immature Black-browed and Atlantic Yellow-nosed *T. chlororhynchos* albatrosses. Ageing of the Atlantic Yellow-nosed Albatross has not previously been described, but because this bird's bill colour is similar to that of the Grey-headed Albatross and also changes from wholly black to orange according to age, we used this characteristic, coupled with moult data, to describe the characteristics of birds of various ages, from fledging plumage up to adult plumage, from studies of birds captured at sea. The resulting description is expected to facilitate studies describing the age composition of birds through observations at sea and to assist with ageing of birds incidentally captured in fisheries and of birds washed ashore. It could also be useful for ageing the sister species, the Indian Yellow-nosed Albatross *T. carteri* (Onley & Scofield 2007).

For ageing Black-browed Albatross, we tried to use the description provided by Prince & Rodwell (1994), which was based on known-age birds captured on breeding grounds, but because we found divergences between our data and the description they provided, we report here a detailed description of bill characteristics and moult that we found, and we discuss potential reasons for the differences between their observations and ours.

METHODS

Study area and seabird capture

Birds were captured over the continental shelf and offshore waters in southern Brazil in the region under the influence of the Subtropical Convergence, formed by the meeting of the warm tropical Brazilian Current flowing southward and the cold Malvinas/Falkland Current flowing northward (Garcia 1998). Work was conducted on fishing vessels targeting tuna *Thunnus* spp., sharks (mainly blue shark *Prionace glauca*) and swordfish *Xiphias gladius* using a range of hook-and-line and pelagic longline fishing methods as previously described by Bugoni *et al.* (2008a). Birds were captured by a cast net after attracting they had been attracted close to the vessel with baits and shark liver (Bugoni *et al.* 2008b). During six cruises and 58 trapping days from February to June 2006 and from July to September 2007, 66 albatrosses (33 of each species) were captured in the area 25–35°S, 41–52°W. A few birds (about 10) incidentally captured on long-line hooks, dead or alive, were also sampled.

Plumage moult and ageing

Moult scores for each of the 10 primary feathers of the right wing (from the inner P1 to the outer P10) and all tail feathers were recorded according to age and stage of development (Ginn & Melville 1983). For every feather, a score was given as follows:

- 0—old feather remaining
- 1—old feather missing or new feather in pin
- 2—feather emerging from the sheath up to one third grown
- 3—new feather between one and two thirds grown
- 4—new feather more than two thirds grown and with remains of waxy sheath at its base
- 5—new feather fully developed, with no waxy sheaths remaining at the base.

The vestigial 11th primary feather present in Procellariiformes (Marchant & Higgins 1990) was not scored. Distinguishing old from fully grown new feathers is sometimes difficult, but is assisted by the colour and brightness of the feather, which is generally paler and has a ragged worn tip in old feathers. Moult of contour feathers on head, dorsum and ventral parts was recorded as occurring or not, as was the presence or absence of a brood patch. It was assumed that wing moult is symmetrical, which is generally the case in albatrosses (Furness 1988, Prince *et al.* 1993) and so moult scores were recorded only for the right wing. Pictures of the bill in lateral and upper view were taken for every bird. Age classes of birds follow Prince & Rodwell (1994), which is based on birds of known age.

RESULTS

Ageing and moult of Atlantic Yellow-nosed Albatrosses

The stages from fledging to adult plumage at five years old, when they recruit (Cuthbert *et al.* 2003), based on moult timing and bill colour can be described as follows:

- *First year* (from fledging until May of the following year): Bill wholly black, except for a slight pale dirty patch at the tip of upper unguis and at the base of the culminicorn. Vertical bar at the base of ramicorn (lower mandible) hard to notice and very pale (Fig. 1). No moult occurs.
- *Age 1*: Pale yellow patch at the ungues tips and at the base of culminicorn (sometimes striped black and yellow), visible at distance (e.g. when birds attend the vessel for discards) and spreading toward the nail. Extension of yellow is variable, but still with black usually halfway along the bill toward the top of the unguis. No primary or secondary feather moult occurs, but some tail and contour feather moult may be present (seven birds, with birds fledged in the previous year—i.e. Age 1 + 1 month sampled in May, included in this category).
- *Age 2*: Yellow spread along the whole culminicorn, except at the top of the maxillary unguis, but yellow still "dirty". First primary moult takes place during austral summer; tail and contour moult take place again. Primary moult occurs in two waves according to the age and size of feathers (seven birds).

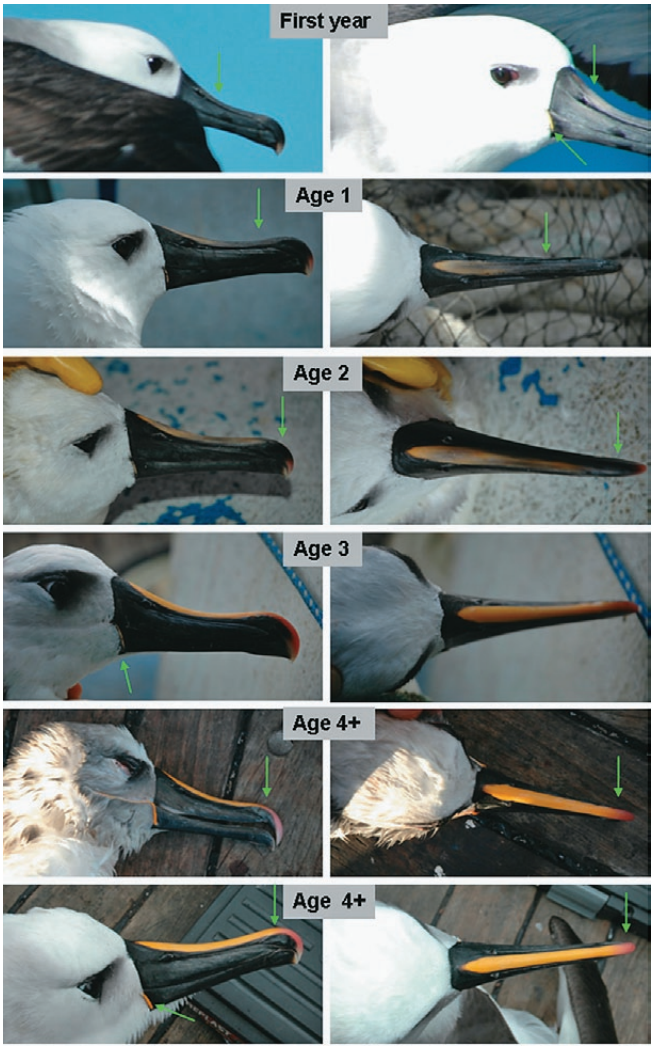

Fig. 1. Changes in bill colour of the Atlantic Yellow-nosed Albatross *Thalassarche chlororhynchos* captured in 2006 and 2007 in the southwestern Atlantic Ocean. Across the two columns, each pair of pictures shows the same individual. Arrows indicate diagnostic characteristics for each age. First year (recently fledged): early June; no wing or tail moult. Age 1: April; no wing moult, but some tail, head, dorsum, and ventral moult. Age 2: February; final wing moult and tail and contour moult occur. Age 3: early June; finishing wing, tail, and contour moult (breeders are in the middle of moult); apart from moult, differs from adult breeder by the pale vertical bar at the lower mandible. Age 4+ (adult): February; no moult; enlarged testis and brood patch of this bird was in regression.

- *Age 3* (prebreeding): Bill colour much as adult. Yellow parts of the culminicorn turn orange, as in adults, except for vertical bar at the ramicorn, which could remain pale or yellowish. Moult differs from that of adults by occurring during late summer and finishing during autumn, which is when only breeders start to moult (two birds: one in February with bill as adult and moulting primaries, tail and contour feathers; another in June with culminicorn as adult, but vertical bar still pale, moulting primary, tail and contour feathers).
- *Age 4+* (adult): Culminicorn and vertical bar at the base of ramicorn fully orange, borders well delimited and without sign of black. Maxillary unguis is red with pale tip, mandibular unguis pale. No moult during the austral summer when they breed, but moult could start in autumn at the end of breeding period (approximately April/May). Some moult of contour feathers could take place during breeding (16 breeding birds sampled from February to May, and one post-breeding adult sampled in August).

Ageing and moult of Black-browed Albatrosses

In April, May and August, 27 first-year Black-browed Albatrosses with no primary, tail or contour moult were captured. Bill colour in May, when they were recently fledged, was dark grey (horny) with blackish ungues, but in August, they already had a very pale bill with black only at the base of culminicorn and ungues, suggesting a rapid change in bill colour (Fig. 2). During the same period, age 1 birds were captured and differed from first years by having moulting rectrices and contour feathers in May, but only contour feathers in August. Primary feathers were all of the same age; birds did not appear to moult P8–P10 and some inner primaries during the second winter as suggested previously (Prince *et al.* 1993, Tickell 2000), but show moult similar to the pattern described earlier for Atlantic Yellow-nosed Albatrosses. Age 1 birds have a pale beige bill with some grey patches, ungues still black, but with pale tips. First-year (from August onward) and age 1 birds were both not predominantly dark billed ("bronzy brown") as postulated by Prince & Rodwell (1994). However, one bird captured in April with new rectrices and moulting contour feathers (thus age 1) had a black bill, even darker than first-year birds trapped in May/early June (Fig. 2). This bill colour pattern is out of the expected range of birds of this age found off the Brazilian coast and could suggest that this individual was from South Georgia because of the similar pattern (Prince & Rodwell 1994) or elsewhere. Two other age 1 (based on moult patterns) birds captured in the same week with typical bill colour and the small size for a male of this unusually coloured bird confirm that this was an atypical bird.

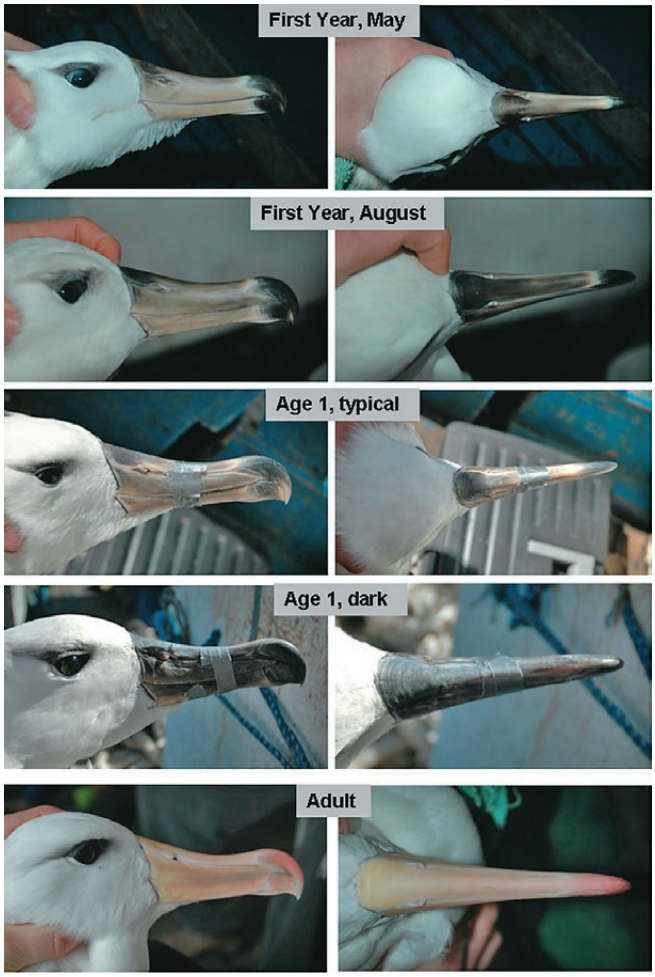

Fig. 2. Variation in bill colour in Black-browed Albatross *Thalassarche melanophris* of various ages captured in the southwestern Atlantic Ocean. Note the pale bill in recently fledged birds captured in May and August. "Age 1" birds with typical bill and one bird with wholly black bill are suspected to originate from different colonies.

Two adults captured in late July had the typical reddish unguis and no grey on the bill (Fig. 2). All rectrices had grown recently and the primaries had blocks of old and new feathers, with active moulting recorded only in contour feathers. These birds were probably finishing moult in preparation for breeding which starts in September. Only six birds of intermediate ages (immatures) were captured.

DISCUSSION

Bill colour was useful for ageing Atlantic Yellow-nosed and Black-browed Albatrosses, but because of individual variation, it should be used carefully and in association with moult data, which provide a clear indication of status as prebreeding birds. The ageing guide based on bill colour and moult proposed here and by Prince & Rodwell (1994) is valid as an approximation for age determination, although it remains to be confirmed in birds of known-age and in populations of different origin. This study conducted of birds at sea benefited from birds being in active moult, which is not usually observed in colonies. Although somewhat counterintuitive, age determination is easier for birds at sea than at colonies for this reason. We could determine breeding status and age based on moult and detection of new and old feathers, rather than by ageing feathers from first to fifth generation, which is not always possible. By trapping birds at sea in wintering grounds, we probably sampled Black-browed Albatrosses from various populations (Falkland Islands/Malvinas and South Georgia breeding colonies). Because bill colour consistently matched moult patterns for each age category assigned in both species, the method proposed here is potentially useful for age determination and age composition of birds incidentally captured in fisheries and of beach-stranded birds. It is also potentially applicable to the Indian Yellow-nosed Albatross wintering in Australian waters, but further validation of that application is required.

It is remarkable that 59% of Atlantic Yellow-nosed Albatrosses captured during the breeding season in Brazilian waters were adults and that 48% had no primary or rectrix moult (i.e. were breeding

birds), which means that breeding birds make long foraging trips to the southwest Atlantic Ocean during breeding. In this area, breeding birds meet a range of hook-and-line and longline fishing vessels that provide discards, but they also are at risk of being drowned on hooks (Bugoni *et al.* 2008a, 2008c). The population is in decline, mainly because of incidental capture in fisheries (Cuthbert *et al.* 2003).

First-year Black-browed Albatrosses composed two thirds of our captures at sea, with minor numbers of immatures and juveniles. These proportions in captures reflect the abundances of the various ages observed at sea (Neves *et al.* 2006) and the age composition of birds captured on pelagic longlines (Neves & Olmos 1997) and stranded on the southern Brazilian coast (Colabuono & Vooren 2006). Many are known to originate from the Falkland Islands/Malvinas, as demonstrated by records of chest-painted fledglings (Sullivan *et al.* 2003). Thus, the odd age 1 Black-browed Albatross that we caught with a distinct darker bill could possibly originate from South Georgia, where immatures have darker bills (Prince & Rodwell 1994) or from elsewhere. This supposition implies differences in bill colour between colonies and is in line with significant genetic differences between the Falkland and South Georgia birds (Burg & Croxall 2001). Furthermore, some adults from South Georgia are known to winter in the southwest Atlantic rather than the more common migration to the Benguela system off South Africa (Phillips *et al.* 2005). A South Georgia origin for one of our 33 captured Black-browed Albatrosses accords with the 6% of ring recoveries of young birds from that island occurring in the southwest Atlantic Ocean (Prince *et al.* 1997). The suggestion that birds with distinct origins have different bill colour at maturation requires further study, particularly with regard to the applicability of the description of age classes across Black-browed Albatross populations.

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