

Order PROCELLARIIFORMES

A rather distinct group of some 80–100 species of pelagic seabirds, ranging in size from huge to tiny and in habits from aerial (feeding in flight) to aquatic (pursuit-diving for food), but otherwise with similar biology. About three-quarters of the species occur or have been recorded in our region. They are found throughout the oceans and most come ashore voluntarily only to breed. They are distinguished by their hooked bills, covered in horny plates with raised tubular nostrils (hence the name Tubinares). Their olfactory systems are unusually well developed (Bang 1966) and they have a distinctly musky odour, which suggest that they may locate one another and their breeding places by smell; they are attracted to biogenic oils at sea, also no doubt by smell. Probably they are most closely related to penguins and more remotely to other shorebirds and waterbirds such as Charadriiformes and Pelecaniiformes. Their diversity and abundance in the s. hemisphere suggest that the group originated there, though some important groups occurred in the northern hemisphere by middle Tertiary (Brodkorb 1963; Olson 1975).

Structurally, the wings may be long in aerial species and shorter in divers of the genera *Puffinus* and *Pelecanoides*, with 11 primaries, the outermost minute, and 10–40 secondaries in the Oceanitinae and great albatrosses respectively. The tail varies in length, being forked in *Oceanodroma*, forked to pointed in other forms, usually with 12 rectrices but up to 16 in fulmars. The tarsi are light and cylindrical in aerial forms; strong and laterally compressed with legs set far back in aquatic ones. The front toes are webbed; hind toe small or absent. The proventriculus is long and glandular; the gizzard small and twisted; and the small intestine often spiral in *Pterodroma*, presumably to aid absorption of the unusual lipids in their food. Chicks are helpless and covered in down, with two coats except in some Oceanitinae. Some larger species have a darker immature plumage, and the female is often darker than the male in the great albatrosses. The male is usually larger than the female, though smaller in the Oceanitinae and some other small species. Otherwise there is little difference in appearance with sex or age, except that young birds may have more pronounced pale or dark edges to the feathers. Many have simple counter-shaded markings that often appear to have given rise to uniformly dark or, less often, to pale derivatives; some species in most groups are dimorphic or polymorphic. The more complex groups have often developed distinctive markings of the extremities.

Breed more or less colonially on offshore islands, coastal cliffs, or on hills and deserts inland, where they perform complex vocal and aerial displays. The nest is a simple scrape or cup in a burrow or natural hole, sometimes under vegetation. The s. albatrosses build large cone-shaped nests in the open; may be lined with any debris available in the area. Smaller species visit it only at night, though larger ones and those breeding on remote islands may come to nests in the open by day. Parents incubate for spells of several days in turn and generally leave the chick alone soon after it hatches, only returning at long intervals to feed it by regurgitation. In consequence the chick is vulnerable to introduced predators and some species are now greatly reduced and at least two are now extinct. Some species also periodically liable to have unsuccessful breeding seasons. Many young or even old birds may be wrecked ashore and die when they meet bad weather or suffer shortage of food on migration or in the winter. Though it has been claimed that they are also vulnerable to all sorts of pollution, the evidence is weak (Bourne 1976). There is at present anxiety about the effect of some fishing methods, such as long-lining, which may be endangering species such as the great albatrosses.

All species feed at sea on a variety of fish, cephalopods and small marine invertebrates, either socially or alone; larger species may scavenge all sorts of offal or prey on other birds. Most, except perhaps *Pelecanoides*, can digest the complex lipids formed by some marine animals (Clarke & Prince 1976), and may eject them to soil the plumage of their enemies with lethal results (Swennen 1974). Some species can digest wax (Obst 1986). Many now take wastes from whaling and fishing operations (Fisher 1952). All have long life-cycles in proportion to their size; they disperse on fledging and then prospect for nest-sites for 2–12 years in their youth. They usually lay a single large white egg annually; though a successful breeding cycle may be completed in less than a year in at least one tropical species, *Puffinus lherminieri*, it may take 2 years in larger southern ones. Before laying, the birds court for weeks or months, then go to sea for feeding. Incubation lasts 6–8 weeks, and fledging 2–9 months. Once the fat chick fledges it fends for itself, even in species that immediately make a long migration, sometimes to the opposite hemisphere.

Tendency for failed breeders and non-breeders to begin moult before successful breeders. Five strategies of wing-moult in breeding adults: (1) In albatrosses, remiges replaced in staffelmauser interrupted while breeding; in nearly all other species, primaries moulted outwards; possibly simultaneously in some diving-petrels. (2) In most subantarctic and temperate species, moult begins soon after breeding and is completed shortly before next breeding season. (3) In most tropical species, moult aseasonal, between breeding attempts; resumption of breeding apparently depends on when moult completed. (4) In trans-equatorial migrants, wing-moult delayed until they reach non-breeding quarters, where it is completed; moult rapid but no satisfactory evidence for flightlessness. In

some species, body-moult also in winter quarters; in others, at breeding grounds. (5) In some species of high latitudes, rapid moult completed in summer when they breed; some begin moult long before breeding finished.

The history of the classification of the Order is very confused, as is seen by comparing Timmermann's (1965) discussion of their Mallophagan parasites with that by Klemm (1969) of their leg muscles and that by Harper (1978) of their proteins, but it is now widely agreed that the Order is best divided into four families: Diomedidae or large to huge aerial albatrosses; Procellariidae or medium-sized, mainly aerial but sometimes aquatic, petrels, shearwaters and prions; Hydrobatidae or small to tiny, aerial storm-petrels; and Pelecanoididae or small aquatic diving-petrels.

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Family DIOMEDEIDAE albatrosses

The albatrosses are a small group of some 13-16 large petrels with long wings adapted for gliding flight and with long powerful beaks adapted for seizing prey at the surface; nine species breed in our region and one other has been recorded as a vagrant. Because they are so large, they must breed in the open, where they walk well for petrels. Most s. species build substantial conical nests but n. ones, breeding in warm climates, make only scrapes. Young birds in some species have a drab plumage but adults of many species develop bolder markings with brightly coloured stripes on the bill, used in social displays when breeding. Three distinct groups occur in the Southern Ocean but the distinction between two is blurred by intermediate forms that occur in North Pacific:

(1) The great albatrosses are huge, long-winged, long- and pale-billed, short-tailed birds that glide round the world in Southern Ocean. Until recently, there were thought to be two species: the more pelagic Wandering Albatross *D. exulans* breeding on most of the subantarctic islands, which is dark with a white underwing when young, becoming more or less white with dark wing-tips when adult; and the more coastal Royal Albatross *D. epomophora*, breeding round NZ, which resembles the extreme white adult Wanderer throughout its life but has a dark cutting-edge to the upper mandible. A few birds breeding in extreme immature *exulans*-type of plumage on Ile Amsterdam in the Indian Ocean have recently been described as a third species *D. amsterdamensis* but there is continuing debate whether this is justified owing to the occurrence of similar populations in South Atlantic and round NZ (Bourne 1989).

(2) The medium-sized albatrosses *Diomedea* (*Thalassarche*), often called mollymawks, are a compact group of white-bodied, dark-backed species with brightly marked bills in adults, all five species being found in our region. They consist of two comparatively coastal species, the Black-browed Albatross *melanophrys* with main breeding colonies round South America, and the Shy *cauta* with 3-4 rather well-defined subspecies, sometimes treated as separate species, breeding in A'asia. There are also three pelagic species: Grey-headed *chrysostoma* to the south, Yellow-nosed *chlororhynchus* in subtropical South Atlantic and Indian Oceans, and Buller's *bulleri* in equivalent parts of South Pacific.

The differences between Groups (1) and (2) are rather marked and they would doubtless be treated as distinct genera if it were not that four other albatrosses with intermediate characters breed in North Pacific: Black-footed *nigripes* with plumage resembling that of sooty albatrosses, though shape differs; Laysan *immutabilis* with plumage like that of the medium-sized albatrosses (Group 2); Short-tailed *albatrus* with a sequence of plumages rather like those of Wanderer, though smaller; and the Waved *irrorata* with dark plumage except for pale head, neck and underwing. Because it is hard to make any clear distinction between these birds they are normally all included in an unusually wide genus *Diomedea*.

(3) The sooty albatrosses *Phoebastria*. Two extremely aerial, highly pelagic and rather aggressive or predatory species with fairly small bills with a groove along the lower mandible; long wings; long pointed tails; and dark plumage; nest on steep places and have vocal aerial displays.

General characters are: body, short and broad; head, large; neck, short. Wing, long and narrow, folded in three almost equal parts, 11 primaries, p10 longest, p11 minute; up to about 40 secondaries, diastataxic. Tail, short and square in *Diomedea*, longer and wedge-shaped in *Phoebetria*, 12 feathers. Bill, heavy and composed of several horny plates; hooked; nostrils in tubes on either side. Legs, strong; three front toes joined by web; hind toe absent or vestigial. Oil gland, feathered. Sexes similar; male larger on average. Plumage mainly white except in *Phoebetria*, in which it is dark grey. Juveniles and immatures generally separable but mostly not very different from adults except in *D. exulans* and *D. albatrus*; fully adult plumage attained only after several years. Stance upright and able to walk much better than most other Procellariiformes. Swim and rest on sea buoyantly with head held high. Feed mostly on fish and squid by surface-seizing or shallow diving, but sooty albatrosses also take birds. Follow ships for scavenging.

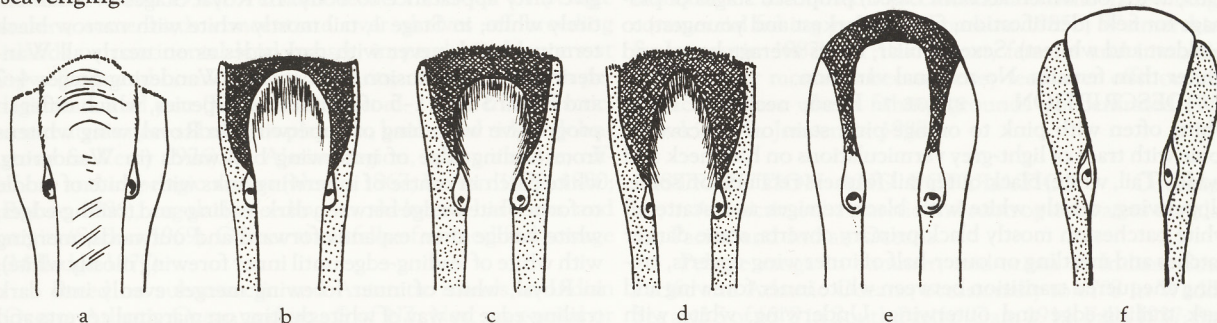


Fig. 1 Dorsal view of base of bill of small *Diomedea*

Fig. 1a Black-browed Albatross *D. melanoprys*

Fig. 1b Grey-headed Albatross *D. chrysostoma*

Fig. 1c Yellow-nosed Albatross, *D. chlorohynchos*, subspecies *chlorohynchos*

Fig. 1d Yellow-nosed Albatross, *D. chlorohynchos*, subspecies *bassi*

Fig. 1e Shy Albatross *D. cauta*

Fig. 1f Buller's Albatross *D. bulleri*

Long-lasting monogamous pair-bond. Breed colonially, pairs often returning to same site. Defend small nest-territories. Perform spectacular agonistic and sexual displays at nest in *Diomedea*; vocal aerial displays in *Phoebetria*. Eggs, white, minutely spotted reddish. Clutch-size; one; no replacement laying. Incubation by both sexes in long alternate spells. Incubation period, 2 or more months. Nestling, semi-altricial, nidicolous; hatched in down. Brooded for a short time after hatching; then left alone in nest, parents returning only to feed chick by incomplete regurgitation. Nestling period long, up to 12 months, and so in some species successful adults cannot breed annually. Young independent on fledging. Maturity reached only after several years. Some populations were reduced in the past, notably by egg-collecting, but there appear to be few threats now except that some great albatrosses are caught by long-line fishing.

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Diomedea chlororhynchos Gmelin, 1789, *Syst. Nat.* 1: 568; based on 'Yellow-nosed Albatross' of Latham, 1785, *Gen. Syn. Birds* 3: 309, Pl. 94 — Cape of Good Hope.

The scientific name refers to the colour (χλωρός pale green) of the bill (ρύγχος) — not very accurately.

OTHER ENGLISH NAME Carter's Albatross (Mollymawk).

POLYTYPIC Nominate *chlororhynchos* breeds South Atlantic at Gough I. and Tristan da Cunha; *bassi* Mathews, 1912, breeds Indian Ocean at Prince Edward Is, and Iles Crozet, Kerguelen, Amsterdam and St Paul.

FIELD IDENTIFICATION Length 75 cm; wingspan 200 cm; weight 2.5 kg. Smallest mollymawk of s. oceans; small head, slender neck and body, and long slender bill combine to give noticeably slender jizz. Two distinctive subspecies: adult *D.c. bassi* have mostly white head and neck with light grey wash across cheeks and ear-coverts and small dusky patch before eye; bill, black with bold yellow culminicorn stripe merging into orange of bill-tip. Atlantic *D.c. chlororhynchos* differ by light grey head and neck forming grey hood, topped with pale forecap, and pronounced black triangular patch before eye. Both forms have diagnostic underwing pattern: mostly white with narrow black margins, sharply demarcated from white lining; leading margin, straight, slightly broader than trailing margin; wing-tip, inky black; pattern of underwing recalls that of Buller's Albatross *D. bulleri* but leading margin narrower. Sexes alike. No seasonal plumage differences. Juveniles and immatures separable.

DESCRIPTION **ADULT.** *D.c. bassi.* Head and neck, white with small dusky patch before eye, narrow white line bordering rear of eye and extending beneath eye; light-grey wash across cheeks and ear-coverts; lost through wear. Mantle and back, blackish with frosty bloom, contrasting slightly with darker blackish upperwings; becoming darker and uniform with upperwing with wear. Scapulars and upperwings, uniform blackish, wearing browner; white bases of

outer primary shafts. Rump and upper tail-coverts, white. Tail, grey becoming darker with wear. Underbody, white; underside of tail, greyish-black. Underwing, mostly white with inky-black wing-tip and narrow black margins, sharply demarcated from white lining; leading margin, straight, slightly broader than trailing margin. Bill, glossy black with narrow bright-yellow culminicorn stripe becoming orange on ridge of maxillary unguis; extreme tip of maxillary unguis, yellowish. Culminicorn stripe tapers to fine point at base. Strip of black skin round base of culminicorn and forward between culminicorn and latericorn to nostrils; broadly separates yellow stripe from feathering of forehead. Cheek stripe (visible during display) and thin vertical strip of skin at base of lower mandible, bright orange. Iris, dark brown. Legs and feet, bluish or pinkish blue. **JUVENILE.** Appearance retained during first year or more, during which bill-stripe begins to develop. Differs from adult by: (1) head and neck, wholly white except for short pale-grey collar extending from mantle onto upper-sides of neck; on some, collar more obvious, extending well down sides of neck (but still incomplete); some show grey collar on nape, coupled with hind-neck collar. Gradually lost through wear and fading; (2) eye-patch smaller, less obvious or absent; eye looks small and beady; (3) black leading-margin behind elbow slightly broader; occasionally, series of short dark streaks run off hind-edge of leading mar-

gin opposite elbow, forming subtle wedge; (4) bill, black; vertical strip of skin at base of bill and cheek-stripe, black; during first year or more at sea, culminicorn at first brownish, then paler dirty cream; tip of maxillary unguis gradually turns dull yellow. **IMMATURE.** Changes in plumage and colour of bill with age not understood. Plumage gradually becomes more like adult but differs by head and neck, wholly white in younger immatures; eventually develop dusky eye-patch and grey wash across cheeks and ear-coverts, as adult. Colour of bill gradually develops from that of juvenile: tip of bill and culminicorn continue to become paler and more pronounced. Full adult plumage attained before bill-colour definitive; thus older immatures often recognizable from adult only by slightly duller yellow bill-stripe and duller orange bill-tip with trace of black amid orange on basal ridge of maxillary unguis. **D.c. chlororhynchos.** Adult differs from adult *bassi* by: (1) head and neck, pearly grey, forming grey hood, with paler, whitish forecap, and sharply demarcated from white underbody; chin and throat paler whitish on some; (2) much larger darker patch before eye appearing as large downward-pointing triangle of black almost reaching base of culmen and extending back in diagonal line across lobe to end in small tear-drop immediately below eye; (3) white crescent behind eye broader and squarer, fading into grey of ear-coverts and not extending round bottom of eye; (4) base of yellow culminicorn-stripe rounded. Juvenile differs from juvenile *bassi* in large black triangular eye-patch, slightly smaller than on adult (Hagen 1952 *contra* Harrison 1983). Immature *chlororhynchos* undescribed but likely to show triangular eye-patch as on juveniles and adults.

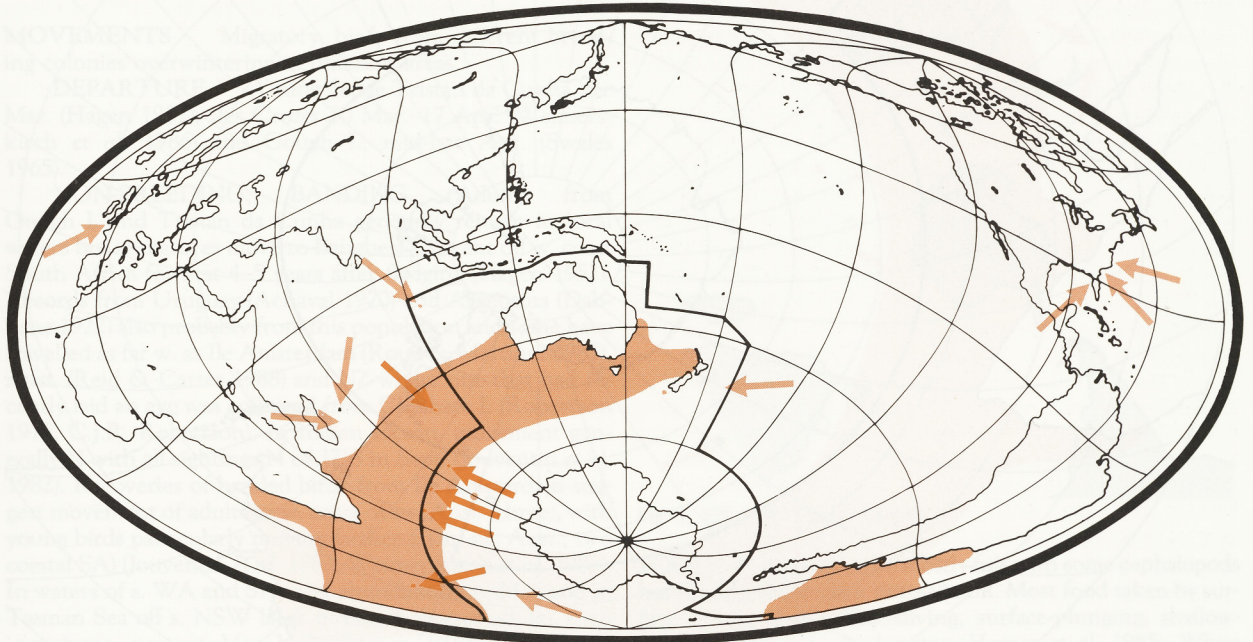
SIMILAR SPECIES Combination of small size, slender build, slender black bill with yellow stripe confined to culmen in adults (wholly black in juveniles), and narrow straight black margins on underwing, diagnostic. In adult *bassi*, these characters and white head, unmistakable; adult *chlororhynchos* has grey hood and could be confused with Grey-headed *D. chrysostoma* and Buller's *D. bulleri* Albatrosses (*q.v.* for distinctions).

Occur over wide range of marine habitats: pelagic, shelf

break and, commonly, inshore waters; often seen from land. Flight, effortless and graceful; in strong winds wheeling in broad arcs well above horizon and soaring on stiff almost motionless wings; flap more in light winds but in calms tend to settle on sea; patter along sea when taking flight, flapping wings vigorously till well clear of waves. Small size and slender build allow for somewhat greater manoeuvrability than larger mollymawks. Feed mainly by surface-seizing; also by dipping, surface-diving, surface-plunging, shallow-plunging and pursuit-plunging. Nest in dense colonies. Solitary or gregarious at sea; attend trawlers in large numbers for offal, often follow ships.

HABITAT Marine; in subtropical and warmer subantarctic waters. Observed over waters of surface-temperature 10–23 °C, but most abundant over warmer parts of subtropical zone, surface-temperature 18–23 °C (Bierman & Voous 1950; Cooke & Mills 1972; Brown *et al.* 1975; Grindley 1981; Dunlop *et al.* 1988). In breeding and non-breeding seasons, concentrate over productive waters of continental shelves, often at coastal upwellings and boundaries of currents (Cooke & Mills 1972; Brown *et al.* 1975; Weimerskirch *et al.* 1985); but birds breeding S of Subtropical Convergence may be pelagic and travel far to subtropical feeding grounds (e.g. Iles Crozet; Weimerskirch *et al.* 1986). In A'sian region, occupy inshore and offshore waters (Storr 1964; Barton 1979; Latham 1980; Swanson 1983), particularly where seas calm and winds light (Storr 1964; Cox 1973).

Breed on islands of s. Indian and Atlantic Oceans; s. limit of breeding may be determined by distance to subtropical waters used for feeding (Weimerskirch *et al.* 1986). Nest on tussock-covered coastal cliffs and slopes, often in rocky situations (Grindley 1981; Weimerskirch *et al.* 1986). Extraliminally, nest in various habitats. On Ile Amsterdam, confined to steeper slopes, nesting up to 800 m asl, on bare ground or among *Poa* or *Scirpus* (Jouventin *et al.* 1983); on Tristan da Cunha, avoid steep and exposed sites, and nest up to 800 m asl on slopes, plateaux, swampy flats or beaches, among tussock, ferns, bushes or trees (Hagen 1952). Fly low or at medium



heights over sea, using air currents rising off swells for lift.

DISTRIBUTION AND POPULATION South Atlantic, s. Indian Ocean and A'sian waters. Breed on s. subtropical, subantarctic and n. Antarctic islands of South Atlantic and s. Indian Oceans between 37–49°S. Nominate subspecies mostly South Atlantic, few records farther E: Iles Crozet (J-C. Stahl), Ile Amsterdam (Roux & Martinez 1987), NSW, Vic. (Reid & Carter 1988), Sisters I., Chatham Is (NMNZ). Subspecies *bassi*, Indian Ocean and A'asia; not recorded W of South Africa, but abundant off s. and e. coasts of S. Africa (Morant *et al.* 1983).

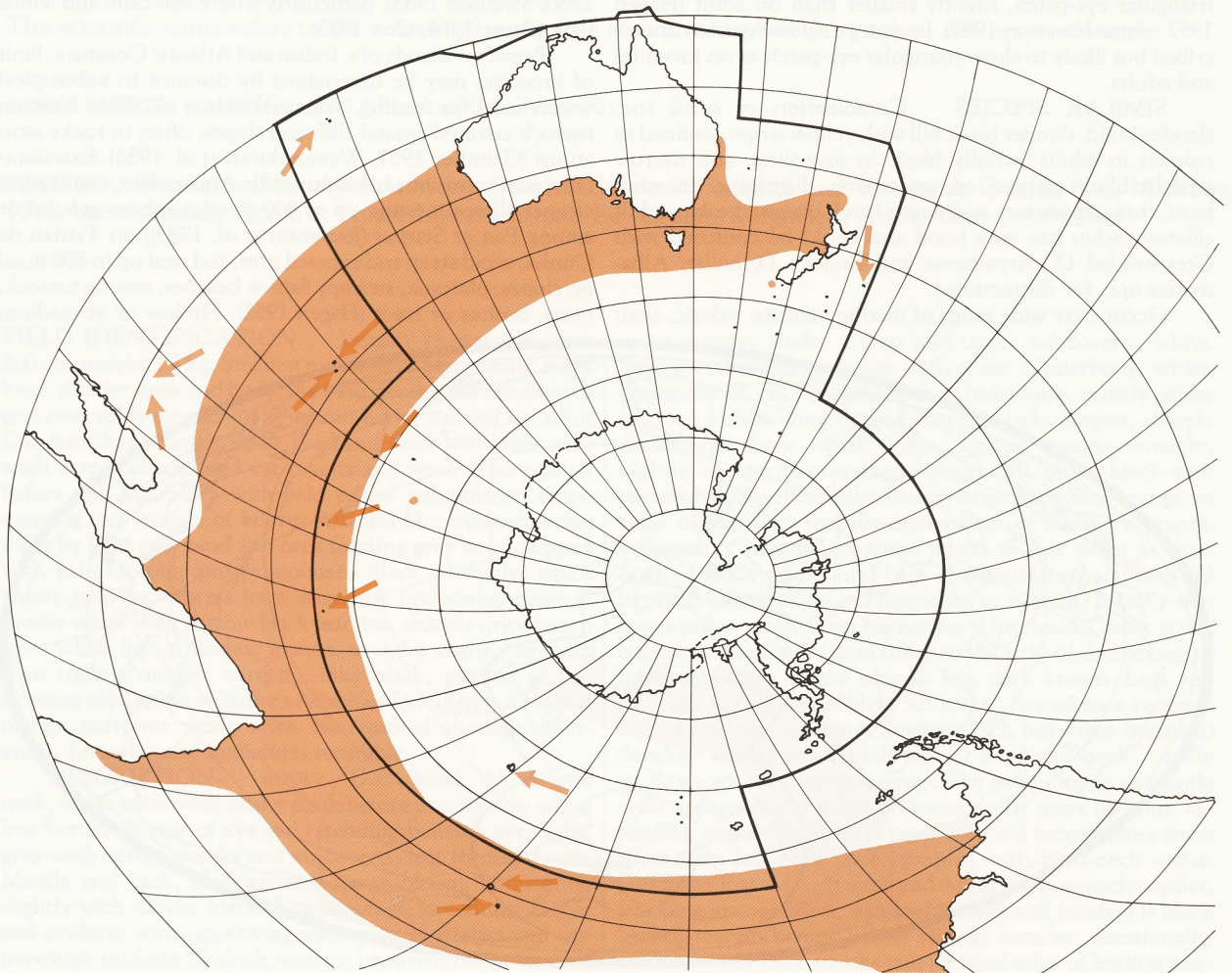
During summer: s. INDIAN OCEAN 34–48°S, most abundant in subtropical waters, occasionally to 56°S (Weimerskirch *et al.* 1986; Stahl 1987). AUST., NZ. Off s. Aust., fairly common Great Aust. Bight (Serventy 1935), S to 46°S, occasionally to 56°S (Mochizuki & Kasuga 1985). Easternmost records Chatham and Stewart Is, NZ (Robertson 1975; Wilson 1976). In s. ATLANTIC: , mainly in subtropical waters, 35–43°S (Thurston 1982), occasional S to Bouvetøya (Watkins 1981); off e. S. America between Rio Grande de Sul, Brazil (c. 30–33°S) and 39°S (Cooke & Mills 1972; Tickell & Woods 1972; Thurston 1982); in S. Africa, N to 15°S along w. coast (Hagen 1952).

Autumn to spring: ranges farther N; in s. INDIAN OCEAN,

26–37°S (Rand 1962; Jouventin *et al.* 1983; J-C. Stahl), occasional to Réunion and Mauritius (Staub 1976). AUST., NZ. On w. coast Aust. to 21°S; on e. coast to 24°S (Aust. Atlas); commonest Qld, May–Oct. (Amiett 1958); NSW, Apr.–Nov. although decrease in s. part in winter (Milledge 1977; Barton 1979); SA, May–Oct. (Cox 1973); WA, Apr.–Nov. (Serventy & Whittell 1976). Subtropical shelf waters off NI, NZ, N of 38°S, occasional off SI to 43°S (Robertson 1975). In s. ATLANTIC, 27–45°S, occasional to 52°S (Tickell & Woods 1972; Bourne & Curtis 1985); e. S. America, 24–30°S (Murphy; Tickell & Woods 1972), few S to 39°S (Rumboll & Jehl 1977); abundant w. coast of S. Africa, 15–26°S (Hagen 1952; Lambert 1971; Summerhayes *et al.* 1974), small numbers e. Cape (Liversidge & Le Gras 1981).

Immatures rare in oceanic waters of sw. Indian Ocean throughout year (J-C. Stahl); some se. Indian Ocean, but in much smaller numbers than in waters off w. Aust. (Falla 1930; Brown 1948). Most recorded continental shelves or slopes of e. S. America (Rumboll & Jehl 1977; Fraser *et al.* 1988), S. Africa (Hagen 1952; Sinclair 1979; Liversidge & Le Gras 1981), Aust. (HASB; Milledge 1977; Barton 1979) and NZ (Robertson 1975). Off WA, distributed farther N than adults (HASB).

Accidental to Cocos-Keeling Is, (Gibson-Hill 1950), Gulf of Mexico (Harrison 1983), Atlantic coast of North America



(13 records; BWP) and Britain (one record off Cornwall).

Breeding. Localities and population sizes below.

LOCALITY	YEAR	POPULATION (pairs)	REF
Tristan Grp			1
Tristan da Cunha	1972-74	16 000-30 000	1
Nightingale	1972-74	4 500	1
Middle I.	1972-74	100-200	1
Stoltenhoff I.	1972-74	1400	1
Gough I.	1972-74	5000-10 000	1
Prince Edward Is	1979	7000	2
Iles Crozet			
Ile des Pingouins	1986	3200	3
Ile des Apôtres	1981-82	1230	4
Iles Kerguelen			
Ile de Croy	1984-87	50	5
Ile Amsterdam	1981-82	37 000	6
Ile St Paul	1970	7	7

References: (1) Richardson (1984); (2) Berruti *et al.* (1981); (3) Jouventin (1990); (4) Jouventin *et al.* (1984); (5) Weimerskirch *et al.* (1989); (6) Jouventin *et al.* (1983); (7) Segonzac (1972).

Unrestricted harvesting of eggs and chicks occurred on Tristan da Cunha (Richardson 1984); started last century, but ended in 1930s, when population had been reduced drastically; increased from 3000 pairs in 1950-52 to 16 000-30 000 pairs in 1972-74. Harvesting shifted to Nightingale I. after collapse of Tristan population, with c. 3000-10 000 eggs and c. 2500 chicks taken yearly between 1928-50. Over-exploitation was repeated and population collapsed; harvesting restricted to c. 1700 eggs and c. 150 chicks in 1974 (Richardson 1984) but population unlikely to have recovered at this rate; no data on present situation. No reports of population changes on Gough I. or Indian Ocean breeding localities.

MOVEMENTS Migratory, birds from different breeding colonies overwintering in different areas.

DEPARTURE Young fledge Tristan da Cunha late Mar. (Hagen 1952), Iles Crozet 20 Mar.-17 Apr. (Weimerskirch *et al.* 1986) and Gough I., mid-late Apr. (Swales 1965).

NON-BREEDING, BANDING Adults from Gough I. and Tristan da Cunha generally remain in local waters but immatures move to Benguela Current off w. coast South Africa for first 4-5 years after fledging (Hagen 1952). Records from Uruguay (Achaval 1970) and Argentina (Dabene 1922) also probably from this population and some have travelled as far w. as Ile Amsterdam (Roux & Martinez 1987), Aust. (Reid & Carter 1988) and NZ where one that had recently laid an egg was collected from Chatham I. (Robertson 1975; C.J.R. Robertson). In Indian Ocean, movement generally N with all sightings N of 37°S in Sept. (Jouventin *et al.* 1982). Recoveries of banded birds from Ile Amsterdam suggest movement of adults to w. coast of sw. Aust. (three), with young birds particularly moving farther E (six sw. Aust., two coastal SA) (Jouventin *et al.* 1983; Weimerskirch *et al.* 1985). In waters of s. WA and SA most abundant Mar.-May and in Tasman Sea off s. NSW large numbers, first of adults, then immatures, present May-June (Barton 1979). Apparently

move N along coast, favouring inshore waters, immatures returning S, Sept.-Oct. (Barton 1979). Sightings off se. South Africa (Morant *et al.* 1983) possibly of birds from Marion I. or Iles Crozet (Weimerskirch *et al.* 1985).

RETURN Gough I., late Aug. (Swales 1965), Iles Crozet, 21 Aug., most arriving early Sept. Fidelity to nest site 92% with first immatures returning after 4 years (Jouventin *et al.* 1983).

BREEDING When breeding usually forage N of Iles Crozet and N of Subtropical Convergence (Weimerskirch *et al.* 1986) though most sightings S of 40°S (Jouventin *et al.* 1982).

BANDING Data from Ile Amsterdam (CRBPO) summarized Fig. 1 and Tristan da Cunha (SABRU) Fig. 2. Other records:

37S150E 07 1+ U 10 523 014 ABBBS
40S09W 10 1+ U 48 2471 078 SABRU



Fig. 1. 37S 77E 10X10 CRBPO

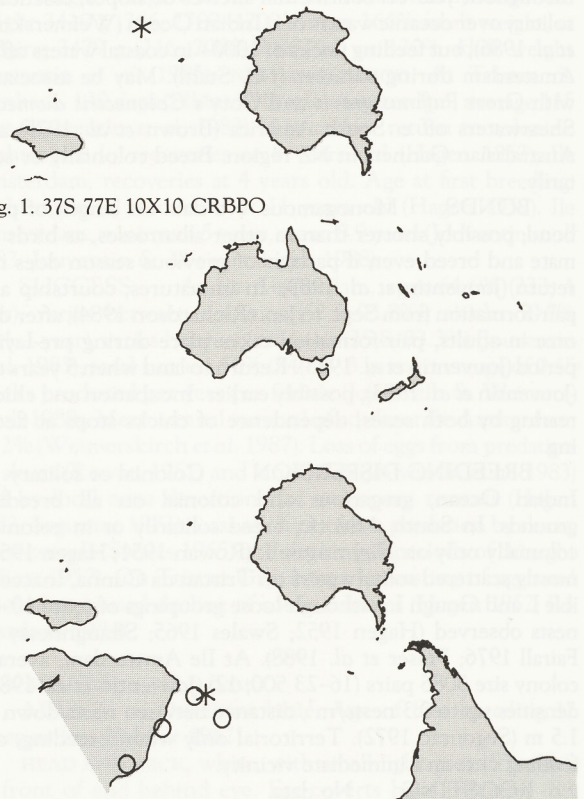


Fig. 2. 37S 12W 10X10 SABRU

FOOD Appears to be mostly fish with some cephalopods but no detailed studies. **BEHAVIOUR** Most food taken by surface-seizing, also surface-diving, surface-plunging, shallow-plunging and pursuit-plunging (Harper *et al.* 1985). When

pursuit-plunging use wings for propulsion (Voisin 1981). Fish, schooling near surface, taken while in flight; then eaten on wing or after alighting on water (Barton 1979). Near NZ, often feed in association with Australasian Gannets *Sula servator* (C.J.R. Robertson) and has been seen near whales and dolphins (Enticott 1986).

NON-BREEDING Off se. Aust. includes cephalopods *Sepioteuthis australis* and fish *Sardinops neopilchardus* and *Engraulis australis* (Barton 1979); adept at taking off from fishing boats (Milledge 1977).

BREEDING At **Iles Crozet** fish predominated in seven of nine regurgitated samples (actual freq. 100%), cephalopods dominating two samples (22.0, mostly Ommastrephidae) with crustaceans present in 55% but never predominant (Weimerskirch *et al.* 1986). At **Marion I.** (68 cephalopod beaks collected from ground; Brooke & Klages 1986) *Moroteuthis knipovitchi* 8.8% no., *M. roboni* 2.9, *Kondakovia longimana* 83.8, Cranchiidae 4.4. At **Tristan da Cunha** cephalopods 100% freq., small fish 10, 10–15 cm., *Scomberesox saurus* 10, 21 cm and amphipod crustaceans *Hyale grandicornis* & *Eurythenes gryllus* 40 (10 stomachs; Hagen 1952). At **Ile Amsterdam** stomach contents contained the fish *Cheilopogon furcatus* and *Thyrstites atun* (Segonzac 1972).

INTAKE At Iles Crozet gains 50 g/day (Mougin 1970).

SOCIAL ORGANIZATION At sea, gregarious throughout year on continental shelves or slopes; essentially solitary over oceanic waters of s. Indian Ocean (Weimerskirch *et al.* 1986), but feeding flocks of 1000+ in coastal waters off Ile Amsterdam during summer (J-C. Stahl). May be associated with Great Puffinus *gravis* and Cory's *Calonectris diomedea* Shearwaters off e. South America (Brown *et al.* 1975) and Australasian Gannets in NZ region. Breed colonially or solitarily.

BONDS Monogamous. No data on length of pair-bond; possibly shorter than in other albatrosses, as birds remate and breed even if partner of previous season does not return (Jouventin *et al.* 1983). In immatures, courtship and pair-formation from Sept. to Jan. (Richardson 1984); after divorce in adults, pair-formation takes place during pre-laying period (Jouventin *et al.* 1983). Return to land when 5 years old (Jouventin *et al.* 1983), possibly earlier. Incubation and chick-rearing by both sexes; dependence of chicks stops at fledging.

BREEDING DISPERSION Colonial or solitary. In Indian Ocean, gregarious and colonial on all breeding grounds. In South Atlantic, breed solitarily or in colonies: colonially only on Nightingale I. (Rowan 1951; Hagen 1952); mostly scattered solitary pairs on Tristan da Cunha, Inaccessible I. and Gough I., although loose groupings of up to 10–33 nests observed (Hagen 1952; Swales 1965; Shaughnessy & Fairall 1976; Fraser *et al.* 1988). At Ile Amsterdam, average colony size 3086 pairs (16–23 500; 12) (Jouventin *et al.* 1983), densities up to 0.3 nests/m², distance between nests down to 1.5 m (Segonzac 1972). Territorial only when breeding, defending nest and immediate vicinity.

ROOSTING No data.

SOCIAL BEHAVIOUR No detailed study. Most detailed descriptions by Rowan (1951), partially reinterpreted by Tickell (1984); also partial descriptions in Hagen (1952) and Richardson (1984). Information supplied by J-C. Stahl. Displays easy to observe, but sexing of birds in field difficult.

Social behaviour comparable to that of other albatrosses, although no equivalent to Gawky Look and Scapular Action described.

AGONISTIC BEHAVIOUR Territory holding signalled by **Croaking**: bird bows and stretches while uttering rattling Croak and exposing yellow stripe along cheek (Hagen 1952). When threatened, birds respond by **Snapping** and **Gulping**, or by **Wailing**, described as Braying or Gape (Rowan 1951; Richardson 1984).

SEXUAL BEHAVIOUR **Aerial activity** (Voisin 1979) similar to that of other albatrosses (Tickell 1984). **Aerial Display**. Displaying bird flies over incubating birds while arching back, raising head, fanning tail and uttering rattling cry (Shaughnessy & Fairall 1976); probably aerial variant of Croaking. **Croaking**. Performed either by single bird, mostly male (Hagen 1952), or in duo by both members of pair (Mutual Croaking); high-pitched rattling cry (Croak) emitted with upraised head (Rowan 1951); territorial display and possibly individual recognition (Hagen 1952). **Rapier Action**. Bird reaches forward and holds bill close to that of partner, motionless for moment; also described as Kissing (Richardson 1984); often follows Croaking and precedes Bill-clashing (Rowan 1951). **Bowing**. Performed in duo (Mutual Bowing), tail fanned (Rowan 1951). **Bill-clashing**. Birds click bill tips together, with abrupt sideways motion of head (Rowan 1951). **Scooping**. Display described as ponderous amble of male round female (Rowan 1951), interpreted as Scooping (Tickell 1984); several birds may shuffle round in circles, tail fanned, often raising and dipping heads (Richardson 1984). **Allopreening, Mutual Preening**. Usually directed at head, neck and bare skin at base of bill (Rowan 1951); not often seen among immatures and, if so, often interrupted by Bill Clashing (Richardson 1984); invariably precedes copulation (Rowan 1951). **Tattoo**. During copulation male rubs bill across that of female, nibbles feathers at base of her bill (Rowan 1951). Courtship of adults on or beside nest generally involves two birds; immatures frequent knolls rising above surrounding vegetation where they court in groups of up to six birds; courtship of immatures less complex and developed than that of adults, often with prolonging of single 'theme' (Richardson 1984).

RELATIONS WITHIN FAMILY GROUP Little known. Chick brooded, guarded and fed by both parents. Gradual response of chick to predator or intruder involves facing threat, sitting back in nest, bill snapping with gulping sound, oil ejection up to 1–2 m away, and finally but rarely ejection of stomach contents (Hagen 1952).

VOICE No studies. Descriptions in Rowan (1951), Hagen (1952), Elliott (1957) and Richardson (1984). Usually silent at sea, except when quarrelling over food; fairly noisy at colonies, with adults heard infrequently after Nov., but immatures noisy until Jan. (Richardson 1984). No individual, sexual or regional differences described. Repertoire of sounds presumably identical to those of other albatrosses.

ADULT **Wail**. Described as loud braying (Rowan 1951). **Croak**. Series of high-pitched and rapidly repeated notes transcribed as *he-e-e-ek-eg-gee-gee* (Hagen 1952); described as rasping cry (Elliott 1957) or high-pitched clattering cry (Rowan 1951), and compared to shrill laugh (Matthews 1932); emitted during Aerial Display and Croaking display; territory-holding and possibly identification signal (Hagen 1952); low-pitched croaking (Richardson 1984) may correspond to Throbbing of other albatrosses.

YOUNG Chicks emit gulping sound, described as *cop-cop* (Hagen 1952) while Bill-snapping when threatened. Food-begging call described as squawking (Elliott 1957) or low twittering call (Hagen 1952).

BREEDING Partial data from Tristan da Cunha Grp (Rowan 1951; Hagen 1952; Elliott 1957; Fraser *et al.* 1988) and Gough I. (Swales 1965); also studied at Ile Amsterdam (Jouventin *et al.* 1983). Information supplied by J-C. Stahl. Breed solitarily or in colonies of up to 23 000 pairs, on vegetated or rocky cliffs or plateaux of s. subtropical, subantarctic and n. Antarctic islands. Associated with Black-browed *D. melanophrys* and Grey-headed Albatrosses at Iles Kerguelen (Weimerskirch *et al.* 1989), slightly with Rockhopper Penguins *Eudyptes chrysocome* at Ile Amsterdam (Segonzac 1972).

SEASON Arrival at colonies: Tristan da Cunha Grp, mid-Aug. (Elliott 1957); Gough I. late Aug. (Swales 1965); Ile Amsterdam, 21 Aug. (Jouventin *et al.* 1983). At Ile Amsterdam, pre-breeding period of 15–20 days; copulation seen 13–21 Sept. (Jouventin *et al.* 1983). At Gough I., nest-building starts mid-Sept. (Swales 1965). Laying, Sept.–early Oct. Adults leave colonies at fledging of chicks; Tristan da Cunha Grp most chicks fledge mid-Apr., some seen until 6 May (Rowan 1951; Elliott 1957); Gough I. fledging mid-Apr., most adults have left by late Apr. (Swales 1965); Prince Edward I. most chicks fully fledged late Mar. (Van Zinderen Bakker 1971); Ile Amsterdam, 20 Mar.–16 Apr., peak of fledging late Mar.–early Apr. (Jouventin *et al.* 1983). At Tristan, immatures arrive with or slightly later than adults, and have left colonies by late Jan. (Richardson 1984).



(Tristan de Cunha)

SITE In Tristan Grp, nests in depressions, ravines or other sheltered areas among tussock or under *Phyllica* scrub or tree-ferns *Blechnum palmiforme*, usually near open space, path among vegetation, or pond; sometimes on tree-ferns (Hagen 1952; Swales 1965; Shaughnessy & Fairall 1976). At Iles Crozet, nests on ledges of unvegetated rocky cliffs on lee sides of islands (J-C. Stahl). At Ile Amsterdam, among thick *Poa novarae* or *Scirpus nodosus*, or on bare soil (Segonzac 1972).

EGGS Egg ovoid, elongated oval or ellipsoid; smooth with no or little gloss; white or dirty white with varying fine brown mottling round broad end, some with scattered larger brown blotchings (Hagen 1952).

MEASUREMENTS:

Tristan da Cunha: 95.3 (3.8; 89.3–101.2; 27) x 62.6 (2.2; 56.5–66.5) (Richardson 1984)

Gough I.: 96.1 (83.1–105.8; 75) x 60.0 (56.4–65.2) (Verrill 1895)

Ile Amsterdam: 96.4 (3.3; 91.4–105.0; 47) x 60.4 (2.0; 56.3–65.3) (Jouventin *et al.* 1983)

WEIGHTS:

Tristan da Cunha: 212 (14; 184–238; 22) (Richardson 1984)

Ile Amsterdam: 199.8 (13.5; 170–225; 47) (Jouventin *et al.* 1983)

CLUTCH-SIZE One; in Tristan Grp, nests observed with two eggs probably laid by different females (Fraser *et al.* 1988).

LAYING No replacement laying (Hagen 1952). Lay-

ing dates, synchronized: at Tristan da Cunha, peak of laying late Sept.–early Oct. (Hagen 1952); Inaccessible I., based on first hatching, starts 13 Sept. (Fraser *et al.* 1988); Nightingale I., first 3 weeks of Sept. (Rowan 1951), peak 10–20 Sept. (Elliott 1957); Gough I., 20 Sept.–2 Oct. (Verrill 1895; Swales 1965); Iles Kerguelen, based on hatching dates, 27 Sept.–2 Oct. (Weimerskirch *et al.* 1989); Ile Amsterdam, 18 Sept.–4 Oct., 50% laid 26 Sept. (Jouventin *et al.* 1983). At Ile Amsterdam, little variation annually in laying dates (Jouventin *et al.* 1983). At Ile Amsterdam, 93% of successful breeders and 88% of unsuccessful breeders nest again following year (Jouventin & Weimerskirch 1988).

INCUBATION Incubation by both sexes. No data on length of stints. **INCUBATION PERIOD:** Ile Amsterdam, 71.3 days (71–72; 3) (Jouventin *et al.* 1983).

NESTLING Hatchling covered with grey down with bluish tinge; short down of face nearly white, chin and throat almost naked (Hagen 1952). Brood- and guard-stage: Gough I. 21 days (Swales 1965); Ile Amsterdam mean 20 days (Jouventin *et al.* 1983). Chick fed by both parents until fledging, by incomplete regurgitation; chick places bill transversely into gape of adult (Hagen 1952). Feeding during middle of day at Tristan (Hagen 1952), mostly late afternoon at Ile Amsterdam (Segonzac 1972). Independent of parents at fledging.

GROWTH No data on weight at hatching. At Nightingale I., maximum weight 2643 g (2000–3350) or 136% adult weight after c. 56 days, weight at fledging 2380 g or 122% adult weight (Hagen 1952). At Ile Amsterdam, maximum weight 3410 g (366; 2700–4200; 32) or 166% adult weight, at fledging 2479 g (216; 2000–3000; 54) or 120% adult weight (Jouventin *et al.* 1983). **NESTLING PERIOD.** At Tristan da Cunha, c. 130 days (Elliott 1957); Ile Amsterdam, average 115 days (Jouventin *et al.* 1983). Age at first return to colonies: Nightingale I., recovers at 8 years old (Hagen 1952); Ile Amsterdam, recovers at 4 years old. Age at first breeding: Nightingale I., recovers at 11 years old (Hagen 1952). Ile Amsterdam, minimum 5 years, mean 8.9 years (Jouventin *et al.* 1983; Jouventin & Weimerskirch 1988).

SUCCESS At Ile Amsterdam, eggs 64.6% (223; 1 year), varies between colonies (52.5–93.8%); chicks 50.7% (144; 1 year), varies between colonies (25.8–93.3%) (Jouventin *et al.* 1983); total success 50% (34–67; 3 years), average of 0.45 chicks produced per year per female (Jouventin & Weimerskirch 1988). Mean annual survival of adults at Ile Amsterdam, 91.2% (Weimerskirch *et al.* 1987). Loss of eggs from predation by skuas (Rowan 1951) and landslides (Jouventin *et al.* 1983) and by local mass desertions for unknown reasons (Hagen 1952; Segonzac 1972). Loss of chicks from predation by skuas, giant-petrels (Swales 1965) and prolonged periods of drought (Elliott 1957). On Tristan Grp, heavy harvesting of eggs and chicks has caused decline of some colonies (Hagen 1952; Richardson 1984).

PLUMAGES *D.c. bassi*.

ADULT Definitive basic. Age of first breeding 12 years or less (Palmer 1962).

HEAD AND NECK, white, with small light-grey (85) patch in front of and behind eye. Ear-coverts have pale-grey (86) wash, restricted to feather tips and lost with wear. **UPPER PARTS.** Mantle, back and scapulars, grey-black (c82). Rump and upper tail-coverts, white. **TAIL**, grey-black (c82). **UPPERWING**, grey-black (c82), becoming dark slaty brown (c121) when worn. Has slight bronze-green gloss in strong direct light. **UNDERPARTS**, white. **UNDERWING**. Boldly defined lead-

ing-edge, about twice width of trailing-edge, formed by blackish marginal coverts and first row of lesser coverts, which grey-black (82) when fresh, slaty brown (121) when worn. Second row of lesser underwing coverts, and inner feathers in third row, light grey (85) with blackish shafts.

DOWNY YOUNG At hatching, grey, whiter on face with chin and throat almost naked (Hagen 1952). Down becomes paler later; unknown if two generations of down, or whether colour changes caused by fading.

JUVENILE Differs from adult in white head with smaller eye-patch; in subspecies *chlororhynchos*, back of neck pale grey (Rowan 1951). Not known when these characters lost.

BARE PARTS

ADULT Iris, black-brown. Latericorn, ramicorn and sides of culmicorn, black (89). Centre of culmicorn, yellow (55) to yellow-orange (c18). Maxillary unguis, peach-red (94), with cream (54-92) tip and black (89) sides. Mandibular unguis, black (89) with cream (54-92) tip. Strip of skin at base of ramicorn, and ridge of skin running from gape to ear-coverts, orange-buff (c18); latter ridge of skin has also been described as yellow (Reid & Carter 1988), usually obscured by feathers; exposed when courting or irritated (Rowan 1951). Tarsus, feet and claws, whitish suffused with grey-mauve (77) or with light bluish grey; webs sometimes slightly more pink.

DOWNY YOUNG Bill, and ridge of skin from gape to below eye, black (82-89). As in adult, ridge of skin only exposed when excited or alarmed (Rowan 1951). Feet, pale blue or mauve, darkening with age (Elliott 1957).

JUVENILE Bill, black (82-89). Skin at base of bill and in ridge below eye, 'chalky-cobalt', developing pink or purple tinge just before going to sea (Rowan 1951). Distinctive yellow culmicorn stripe develops slowly, passing through stages of brown and brownish yellow; time taken to attain adult bill-colour unknown. Juvenile or immature photographed in flight (Lindsey 1986) has light-pink (c7) tarsus.

MOULTS Based on Furness (1988) on Gough I. except where stated.

ADULT POST-BREEDING Primaries replaced in stafflemauser, which interrupted during breeding season. At start of breeding season, 16% of birds that bred successfully in preceding season had incompletely grown primary at laying, significantly higher frequency than in birds that did not breed successfully in preceding season. While at sea, birds that bred successfully in preceding season replace 8.34 (2.24; 4-14; 64) of their 20 primaries, significantly fewer than failed breeders, non-breeders, and breeding birds not found at colony in preceding season. Number of primaries renewed not correlated with length of bill or wing, or with sex. Only 7.2% of primaries retained through two moults, which suggests no replacement of new primaries at sea. Adult primary wear at colonies implies there can be 1-4 (usually two) moult-foci in primaries of each wing. Pattern of primary wear symmetrical in 41.4% of birds; asymmetrical in 58.6%, in many of which one wing had more new feathers than other.

Moult-waves probably move outwards (Brooke 1981); beachcast specimen (subspecies *bassi*; MV) had primary moult $N^1O^33^14^2O^3$ (left wing), $O^42^14^2O^3$ (right wing), which implies waves may sometimes move inwards. Wear of secondaries suggests they are also replaced in stafflemauser interrupted during breeding season; no information for other tracts.

POST-JUVENILE MOULT No direct information. By analogy with other albatrosses, primaries probably outwards. No information on moult of immatures.

MEASUREMENTS Subspecies *bassi*: (1) Prince Edward I., live birds; methods unknown (Brooke *et al.* 1980). (2) Iles Kerguelen, live birds; methods unknown (Weimerskirch *et al.* 1989). (3) Skins, MV; all unsexed. Other measurements in Segonzac (1972).

UNSEXED		
WING	(1)	488 (9.7; 465-499; 14)
	(2)	476 (11.6; 462-495; 13)
8TH P	(3)	279
TAIL	(1)	197 (7.0; 185-210; 15)
BILL	(1)	118.7 (4.5; 111.2-124.2; 15)
	(2)	116.1 (3.8; 110.5-120; 14)
TARSUS	(1)	82.1 (2.5; 78.7-86.6; 15)
	(2)	76.5 (3.9; 72-82; 14)

Nominate *chlororhynchos*: (1) Gough I., live unsexed birds; methods unknown (Brooke *et al.* 1980). Females slightly smaller than males; in mated pair, female has smaller bill (Furness 1988).

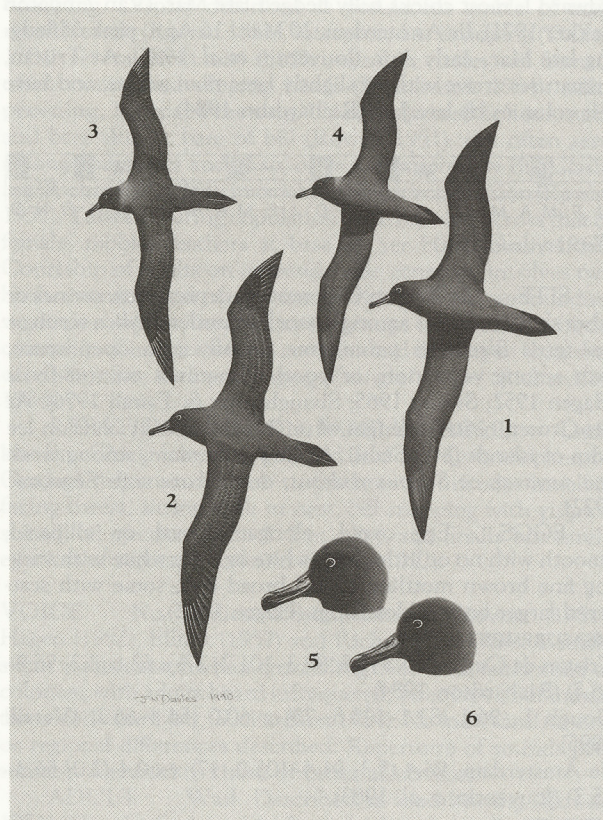


Plate 23

Sooty Albatross *Phoebastria fusca*

1. Adult, ventral, fresh
2. Adult, dorsal, fresh
3. Adult, dorsal, worn
4. Adult, ventral, worn
5. Adult, head
6. Juvenile, head

UNSEXED

WING	(1)	501 (10.9; 483-520; 27)
TAIL	(1)	195 (8.4; 118-214; 27)
BILL	(1)	114.6 (3.9; 107.6-121.8; 27)

WEIGHTS At Prince Edward I., Sept., 2640 (130.0; 2490-2930; 15) (Brooke *et al.* 1980). At Iles Kerguelen, 2460 (240; 2130-2800; 16) (Weimerskirch *et al.* 1989). At Gough I. in Nov., 2199 (227.9; 1780-2840; 26) (Brooke *et al.* 1980).

STRUCTURE Wing, long and narrow. Eleven primaries; p10 longest, p9 12-19, p8 40-52, p7 68-89, p6 109-137, p5 152-177, p4 192-208, p3 251, p2 279, p11 minute. Twenty-six secondaries, five humerals. Tail strongly rounded. Bill, long, slender, laterally compressed; deep at base. Culminicorn slightly concave; upper mandible hooked at tip, lower mandible decurved. Nares in front of broad naricorn, below culminicorn. Culminicorn of Indian Ocean birds tapers behind nares, and pointed at base; naricorn has straight sides. In s. Atlantic birds, culminicorn broadens behind nares, and has rounded base; naricorn has convex sides.

GEOGRAPHICAL VARIATION Two subspecies:

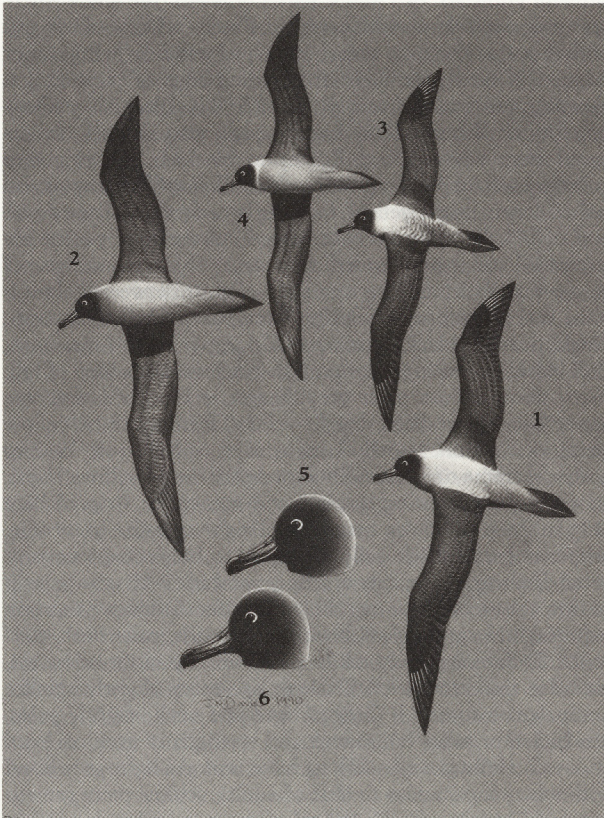


Plate 24

Light-mantled Sooty Albatross *Phoebastria palpebrata*

1. Adult, dorsal, fresh
2. Adult, ventral, fresh
3. Adult, dorsal, worn
4. Adult, ventral, worn
5. Adult, head
6. Juvenile, head

chlororhynchos and *bassi*, following Brooke *et al.* (1980); sometimes considered monotypic (e.g. Peters; Aust. CL). Subspecies *bassi* described above; *chlororhynchos* differs by shape of culminicorn (see Structure); bluish-grey head with white forehead; and larger blackish triangular patch in front of and round eye.

DIR

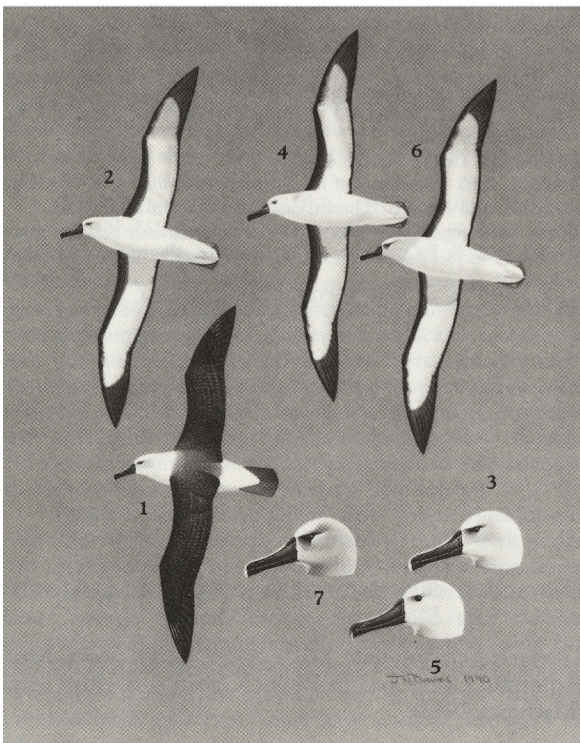
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J.N. Davies 1990



Volume 1 (Part A), Plate 21

Yellow-nosed Albatross *Diomedea chlororhynchos*

- 1. Adult, subspecies *bassi*, dorsal
- 2. Adult, subspecies *bassi*, ventral
- 3. Adult, subspecies *bassi*, head
- 4. Juvenile, subspecies *bassi*, ventral
- 5. Juvenile, subspecies *bassi*, head
- 6. Adult, subspecies *chlororhynchos*, ventral
- 7. Adult, subspecies *chlororhynchos*, head

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