

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.

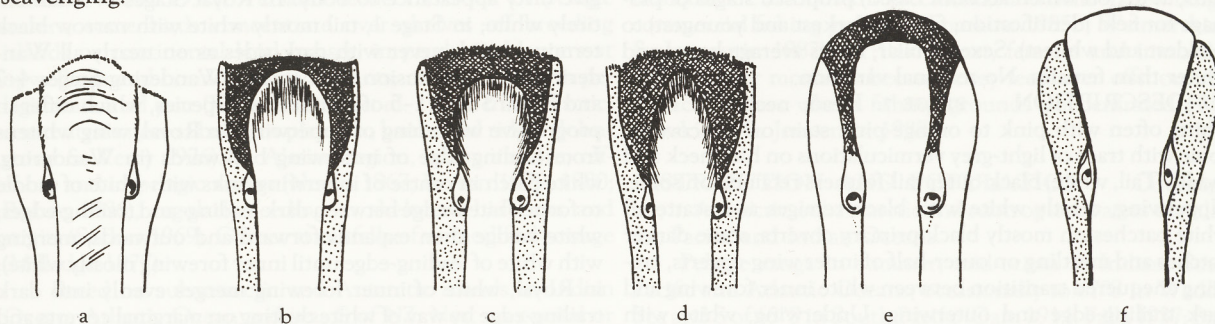


Fig. 1 Dorsal view of base of bill of small *Diomedea*

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 fusca Hilsenberg, 1822, in Froriep, *Notiz.* 3: Col. 74 — Mozambique Channel.

The generic name is derived from the Greek god Phoebus (Apollo) or goddess Phoebe (Diana), meaning the Bright One and, as φοῖβειος *prophetic, inspired*; hence, perhaps φοῖβερτρία one after the sort of Phoebe or prophetess; *fusca* alludes to the dark colour of the birds.

There is a temptation to join the two species of *Phoebetria* in the English group-name, **sooty-albatross**. To do so would mean qualifying this species (*fusca*) and thereby creating two clumsy names instead of one.

MONOTYPIC

FIELD IDENTIFICATION Length: 84–89 cm; wing-span: 203 cm; weight: males 2.7 kg, females 2.4 kg. Slender-bodied, all dark-brown albatross with very long, narrow wings and long pointed tail, appearing wedge-shaped when spread. Sexes similar; male slightly larger. No seasonal differences in plumages, except by wear. Immatures differ from adults.

DESCRIPTION **ADULT.** In fresh plumage, entirely dark greyish brown to blackish, except for white crescent almost encircling eye (broken at lores and visible only at close range) and white or pale shafts on primaries and rectrices. In good light, back, mantle and abdomen show *slightly* lighter than rest of plumage. Bill, slender and dark with marked creamy to creamy yellow or orange stripe (sulcus) along lower mandible. Iris, brown. Legs and feet, mauve or greyish flesh. As breeding progresses, plumage becomes worn, browner and paler with tips of individual feathers buffish, creamish or even whitish, particularly on nape and sides of neck; outer primary tips usually broken. **JUVENILE.** Differ in having grey sulcus, grey crescent round eye and shafts on all remiges dark (Murphy; Berruti 1979b). Fledgelings at Iles Crozet have shafts of remiges pale as in adults (Jouventin & Weimerskirch 1984). **IMMATURE.** Older immatures have mottled buff or creamy collar, extending down to sides of neck (sometimes to upper mantle) and whitish nape. In Indian Ocean, pale collar recorded in birds with dark and yellow sulci, which suggests that this plumage pattern is common to immatures and adults in worn plumage; birds with yellow sulci account for only a small proportion in Jan.-Mar. but half in June-Oct. (Ferguson 1921; Alexander 1922; Falla 1937; J-C. Stahl).

SIMILAR SPECIES Can be confused only with

Light-mantled Sooty Albatross *Phoebetria palpebrata*. Adult Light-mantled Sooty Albatross has diagnostic contrast on upperparts between light-grey neck, mantle and back and dark head, upperwings and tail. Immature Light-mantled Sooty Albatross has pale areas of plumage whitish rather than buffy or creamy, not restricted to collar but extending from nape to lower back and down to underparts, isolating dark mask. Some Sooty Albatrosses have markings and colours that render them, as yet, inseparable from Light-mantled Sooty Albatross (Harrison 1983). In hand, Sooty Albatross also identified by heavier bill, and culminicorn far less concave in profile and slightly longer than in Light-mantled Sooty Albatross; eye-ring more complete but narrower. Both sooty albatrosses fairly easily distinguished from other albatrosses by dark plumage, long slender wings, long pointed tails and effortless gliding flight. Juvenile **Wandering Albatross** *Diomedea exulans* much larger with white underwings and mask; **Black-footed Albatross** *D. nigripes* has whitish area at base of bill at all ages and, when adult, whitish base of tail and under tail-coverts. **Giant-petrels** *Macronectes* spp are almost as large but fly with flap-and-glide action, have heavy pale-coloured bills, thickset head and body; head more prominent and larger relative to body-size; wings broader and shorter; rounded tail.

Pelagic, solitary or in small groups. Fly swiftly and apparently effortlessly, seldom flapping actively; wings always slightly flexed; in windy conditions, unusually slender build and exceptional gliding and soaring ability very evident. Supreme ability in flight without flapping, flying higher and stooping more rapidly than other albatrosses, stressed by

Murphy; appear to fly higher above water than other albatrosses except Light-mantled Sooty Albatross, partly because undulations while soaring smoother. Swim with upright erect posture typical of albatrosses. Feed by surface-seizing; possibly mostly during twilight and at night. Regularly follow ships but usually only for short periods. Mostly silent at sea, trumpet-like calls at colonies. Gait on land, awkward, deliberate with hunched body and bobbing head; less agile than other albatrosses but can take off from level surfaces. Nest in loose colonies or small groups on ledges of cliffs, not so densely as other albatrosses.

HABITAT Marine; pelagic. In summer, mainly S of 35°S in subtropical and subantarctic waters, but most abundant near Subtropical Convergence (Falla 1937; Tickell & Woods 1972; Weimerskirch *et al.* 1986); range S of Antarctic Convergence in sw. Indian Ocean but rarely elsewhere (Bierman & Voous 1950; Johnstone & Kerry 1976; Naito *et al.* 1979; Jouventin *et al.* 1982; Weimerskirch *et al.* 1986). In late autumn and winter, mainly in Subtropical Zone (Rand 1963; Tickell & Woods 1972; Jouventin *et al.* 1982; J-C. Stahl). Immatures restricted to Subtropical Zone throughout year (Stahl 1987). Tolerate wide range of sea surface-temperatures and salinities (Bierman & Voous 1950; Jouventin & Weimerskirch 1984). In breeding and non-breeding seasons, occur

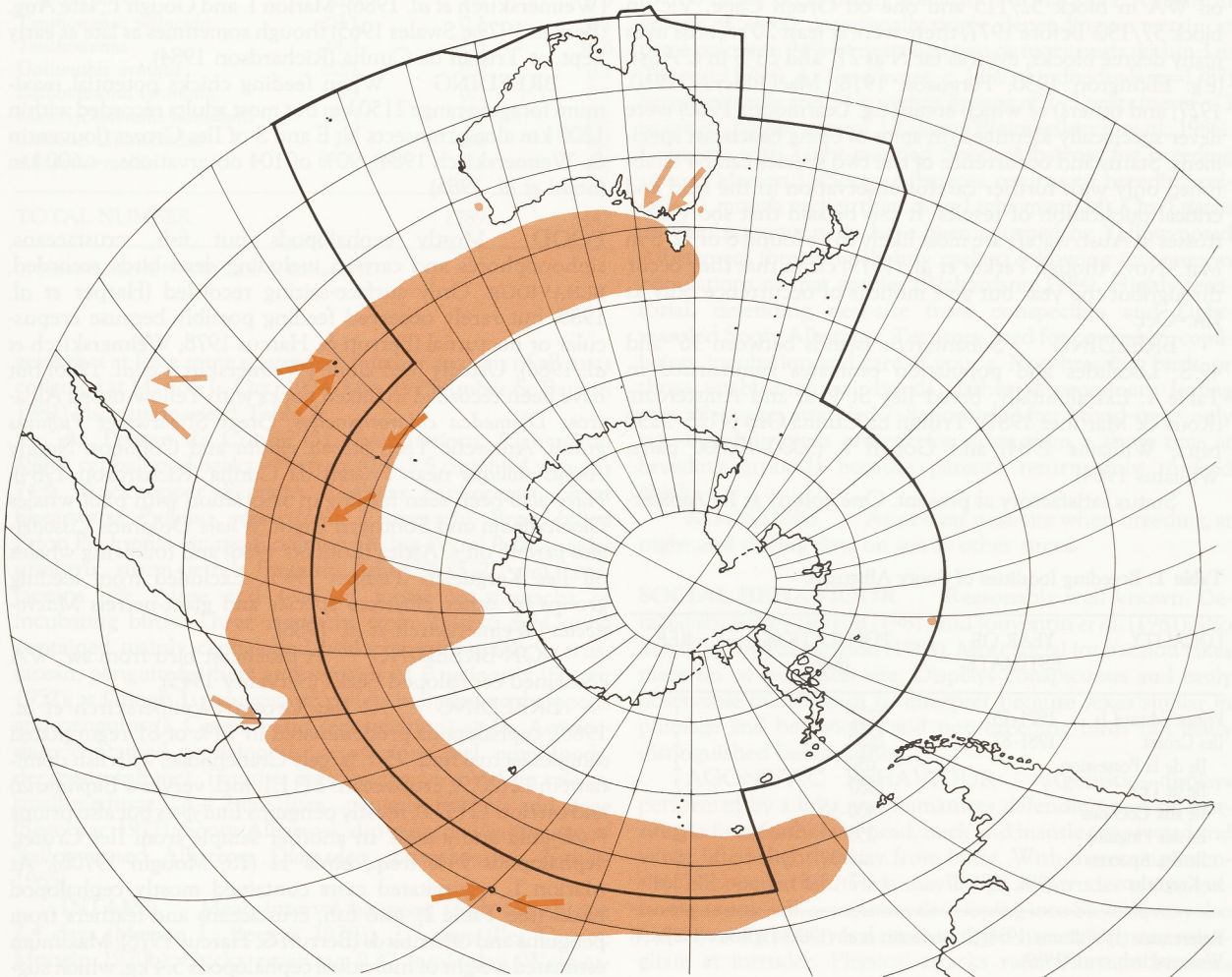
widely over pelagic waters, exploiting dispersed sources of food (Weimerskirch *et al.* 1986); but observed over inshore waters in Aust. on occasions (Thiele 1977) and forage over coastal kelp beds off Tristan da Cunha (Richardson 1984).

Breed on subtropical and subantarctic islands in Indian and Atlantic Oceans; on vegetated cliffs and steep slopes sheltered from prevailing winds, often among tussock grass (Bertruti 1979a; Weimerskirch *et al.* 1986; Roux 1987). On Marion, Prince Edward Is, Iles Kerguelen and Crozet, breeding confined to coastal sites, but nest inland on Ile Amsterdam, Gough I. and Tristan da Cunha Grp, on ridges, cliffs, high slopes and plateaux (Hagen 1952; Segonzac 1972; Shaughnessy & Fairall 1976).

Fly within 10–15 m of sea surface, using updrafts off wave fronts for lift; food taken at surface.

Repeated fires at Iles St Paul and Amsterdam may have caused decrease in vegetation cover at breeding sites; material for nest construction now scarce (Segonzac 1972; Jouventin *et al.* 1984). Predation by introduced rats most likely cause of breeding failure at Ile St Paul (Segonzac 1972).

DISTRIBUTION AND POPULATION Usual pelagic range South Atlantic and s. Indian Oceans, in summer between 35° and 50°S, to 64°S in sw. Indian Ocean; in winter, 30°S and 40°S. Reaches Aust. but not normally NZ or Pacific



Ocean. Breed on subantarctic islands in Atlantic and Indian Oceans between 36°S and 49°S.

At sea, over much of South Atlantic and s. Indian Oceans. In South Atlantic Ocean, w. limit of range c. 40°W (Tickell & Woods 1972; Thurston 1982); accidental to C. Horn, Chile; specimen in Mus. natn., Santiago ('capturado hace años en los alrededores del Capo de Hornos'; Goodall *et al.* 1951); occasional in Antarctic waters in summer, southernmost record 61°S (Novatti 1960); northernmost record in winter 25°S (Tickell & Woods 1972). Rare visitor to s. Africa (Clancy 1980; Ryan & Rose 1989); type-specimen from Mozambique Channel. In Indian Ocean, accidental to Mauritius (Meinertzhagen 1912) and Réunion Is (Gruchet in Rowlands 1987); extends E to Tas. and e. coast of Aust. No records NZ, Macquarie I. Only records Pacific Ocean in SE: two individuals at 61°37'S 98°58'W in Dec. (Holgersen 1957).

AUST. Clearly sooty albatrosses are fairly regular in small numbers off s. Aust., mostly beyond continental shelf, but identification and description of sightings has generally been inadequate so that it is not possible to say whether Sooty or Light-mantled Sooty was seen. In Aust. Field Atlas (1977–81), Sooty was claimed 15 times in eight 1° blocks between 32° and 43°S and 115° and 151°E, mostly from Mar. to Nov. None was supported by field description of modern standard and only two can be accepted as being truly Sooty Albatross: one, off WA in block 32/115 and one off Green Cape, Vic. in block 37/150. Before 1977, there were at least 20 records in as many degree blocks, even as far N as 27° and 23°S in e. Aust. (e.g. Elkington 1930; Ferguson 1916; MacGillivray 1920, 1927; and others) of which some (e.g. Learmonth 1960) were never specifically identified, in spite of being beachcast specimens. Status and occurrence of the two species can be established only with further careful observation in the field and critical publication of results. It can be said that sooty albatrosses in Aust. waters are most likely to be found S of 32°S in Mar.–Nov., though Parker *et al.* (1979) claim that they occur throughout the year but give months of occurrence only as Jan.–Oct.

BREEDING Subantarctic islands between 36° and 49°S. Localities and population estimates summarized in Table 1. Extraliminally, breed Iles St Paul and Amsterdam (Roux & Martinez 1987), Tristan da Cunha Grp (4125–5250 pairs; Williams 1984) and Gough I. (5000–10,000 pairs; Williams 1984).

Status satisfactory at present. One colony at Ile Amster-

dam declined from several tens of chicks in 1956 to 15 in 1970; at Ile St Paul, one colony reported last century now deserted (Segonzac 1972). Tristan da Cunha population increased by two-thirds between 1952 and 1972–74 despite harvest of 100–325 chicks and 5–10 adults each year by Tristan islanders (Richardson 1984). No changes reported from other localities.

MOVEMENTS Dispersive, possibly migratory, from nesting islands but little known of movements at sea.

DEPARTURE Young fledge Tristan da Cunha and Gough I., mid-May (Elliott 1957; Swales 1965; Richardson 1984); Marion I., Apr.–late May (Rand 1954; Berruti 1979a); Iles Crozet, May–early June (Mougin 1970b; Weimerskirch *et al.* 1986).

NON-BREEDING Disperse N in winter, deserting subantarctic and Antarctic waters and N limit shifts to 30–35°S (Jouventin *et al.* 1982); most records South Africa, winter (Liversidge 1959). E. movement in Indian Ocean suggested by rarity in sw. Indian Ocean, May–Aug. (Rand 1962, 1963; Grindley 1981; J-C. Stahl), increase in abundance E of 74°E (Macgillivray 1920; Hansen 1978) and observations of up to 20 individuals together in the Great Australian Bight (Ferguson 1921).

RETURN Arrive breeding colonies: Tristan da Cunha, mid-July (Elliott 1957); Iles Crozet, mid-Aug. (Weimerskirch *et al.* 1986); Marion I. and Gough I., late Aug. (Berruti 1979a; Swales 1965) though sometimes as late as early Sept. at Tristan da Cunha (Richardson 1984).

BREEDING When feeding chicks potential maximum foraging range 2150 km but most adults recorded within 1200 km along transects N, E and S of Iles Crozet (Jouventin & Weimerskirch 1984); 90% of 104 observations, <600 km (Stahl *et al.* 1985).

FOOD Mostly cephalopods but fish, crustaceans, siphonophores and carrion including dead birds recorded. **BEHAVIOUR.** Only surface-seizing recorded (Harper *et al.* 1985) but rarely observed feeding possibly because crepuscular or nocturnal (Berruti & Harcus 1978; Weimerskirch *et al.* 1986). Usually feed alone (Weimerskirch *et al.* 1986) but have been recorded in mixed flocks with Yellow-nosed Albatross *Diomedea chlororhynchos*, Great Shearwater *Puffinus gravis*, Antarctic Tern *Sterna vittata* and Common Noddy *Anous stolidus* near Tristan da Cunha (Richardson 1984). Have also been seen feeding in association with pilot whales *Globicephala* and Southern Right Whale Dolphins *Lissodelphis peronii* off s. Africa (Enticott 1986) and following whales off Iles Kerguelen (Paulian 1953). Excluded from feeding groups by other albatross species and giant-petrels *Macronectes* (Weimerskirch *et al.* 1986).

NON-BREEDING A beachcast bird from sw. WA contained cephalopod beaks (Serventy 1945).

BREEDING At Iles Crozet (Weimerskirch *et al.* 1986), cephalopods predominated in 74% of 81 regurgitated samples (actual freq. 95.1, largely Cranchiidae) with fish dominant in 12 (20.9), crustaceans 2 (11.1, incl. very few *Euphausia*) and carrion 12 (32.0, mostly penguins *Eudyptes* but also prions *Pachyptila* and a seal). In another sample from Iles Crozet, cephalopods 94% freq., birds 11 (18; Mougin 1970b). At Marion I. regurgitated casts contained mostly cephalopod beaks (see Table 2), also fish, crustaceans and feathers from penguins and other birds (Berruti & Harcus 1978). Maximum estimated weight of individual cephalopods 5.4 kg, which sug-

Table 1. Breeding localities of Sooty Albatross.

LOCALITY	YEAR OF ESTIMATE	POPULATION (pairs)	REF.
Prince Edward Is	1974–75	2732	1
Iles Crozet	1981–82	2620	2
Ile de la Possession		650	2
Ile de l'Est		1300	2
Ile aux Cochons		400–500	
Ile des Pinguins		250	2
Ile des Apotres		20–30	2
Iles Kerguelen	1984, 1984–87	7+, 3–5	3, 4

References: (1) Williams (1984) (2) Jouventin *et al.* (1984); (3) Roux (1987); (4) Weimerskirch *et al.* (1989).

Table 2. Cephalopods in the diet of the Sooty Albatross at Marion I.

	%wt. ¹	%no. ¹	% no. ²
<i>Ancistrocheirus lesueurii</i>	<0.1	0.1	0.1
<i>Octopoteuthis</i>	0.2	0.1	0.1
<i>Kondakovia longimana</i>	47.4	5.6	9.4
<i>Moroteuthis ingens</i>	2.4	0.3	0.6
<i>Moroteuthis knipovitchi</i>	19.2	8.6	7.4
<i>Moroteuthis rosoni</i>	0.7	0.2	0.2
unident. Onychoteuthidae			0.1
<i>Cycloteuthis sirventyi</i>	0.7	0.1	0.1
<i>Discoteuthis</i>	0.9	0.1	0.1
<i>Gonatus antarcticus</i>	0.6	1.3	1.9
<i>Gonatus</i>	0.1	0.1	
<i>Psychroteuthis glacialis</i>	0.4	0.3	0.3
<i>Psychroteuthis</i>	<0.1	0.1	0.1
<i>Histioteuthis</i>	7.3	29.1	27.0
<i>Alluroteuthis antarcticus</i>	0.1	0.1	
<i>Notodarus</i>	0.2	0.1	0.1
<i>Chiroteuthis macrosoma</i>	0.9	0.8	0.9
<i>Chiroteuthis picteti</i>	0.3	0.8	0.9
<i>Chiroteuthis veranyi</i>	<0.1	0.1	0.1
<i>Chiroteuthis</i>	0.7	1.8	4.6
<i>Mastigoteuthis</i>		0.1	0.1
<i>Taonius belone</i>	<0.1	0.1	0.1
<i>Taonius cymoptypus</i>	1.2	0.8	0.9
<i>Taonius pavo</i>	0.6	1.1	0.9
<i>Teuthowenia pellucida</i>	<0.1	0.1	0.1
<i>Teuthowenia</i>	14.4	42.5	38.6
<i>Galiteuthis armata</i>	<0.1	0.1	0.1
<i>Bathothauma lyromma</i>	0.3	0.1	0.1
<i>Mesonychoteuthis hamiltoni</i>	0.3	0.1	0.1
unident. Cranchiidae	2.6	5.6	5.3
<i>Alloposus mollis</i>		0.1	0.1
TOTAL NUMBER		2789	3442

(1) Berruti & Marcus 1978. (2) Imber & Berruti 1981.

gests that at least some scavenged. Further analysis of all casts collected at Marion I., Oct. 1974–May 1975 (Imber & Berruti 1981) also summarized Table 2.

At **Tristan da Cunha** (31 regurgitations; Richardson 1984), cephalopod beaks 97% freq. (0.5–3.5 cm), bird remains 74% (Rockhopper Penguin *Eudyptes chrysocome*, Great Shearwater *Puffinus gravis* (2 in 1 stomach), Broad-billed Prion *Pachyptila vittata*, Common Diving-Petrel *Pelecanoides urinatrix*, storm-petrels *Fregatta*), fish 32% (5–20 cm), crustaceans 3%. Algae and seaweed found in stomachs of incubating birds. Three stomachs from Tristan da Cunha contained mainly cephalopod beaks as well as fish, a crustacean, penguin feathers and remains of *P. urinatrix* (Hagen 1952); at **Gough I.** regurgitated pellets included cephalopods and penguins (J. Cooper) and regurgitations at **Ile Amsterdam** contained cephalopods, crustaceans incl. amphipods, decapods, fish incl. *Thryxites atun*, hydrozoans *Velevella velevella*, small medusae 0.8–1.2 cm diam., penguin feathers and algae (Segonzac 1972). Sooty Albatross also recorded eating egg of Yellow-nosed Albatross *Diomedea chlororhynchus* (Swales 1965).

INTAKE Mean interval between feeds for chicks: 2.4 days (Marion I.; Berruti 1979a), 2.7 days (Iles Crozet; Mougin 1970b); chicks receiving 0.37 meals/day (Weimer-

kirch *et al.* 1986) and 500 g (146; 100–630; 4) (Jouventin & Weimerskirch 1984).

SOCIAL ORGANIZATION Based on Berruti (1981) and Jouventin *et al.* (1981). Usually solitary, or in twos and threes at sea throughout the year. Gregarious in breeding season, forming small colonies, occasionally solitary. Non-breeding period spent at sea, but some non-breeding birds return to breeding colonies during breeding season. No detailed knowledge of behaviour at sea; while foraging, occasionally associated with other seabirds and cetaceans (see Food).

BONDS Monogamous. Pair-bonds life-long, divorces very rare. At Iles Crozet, 99.2% of individuals with same partner in following breeding season (n=254); only divorces observed caused by late arrival of partner (Jouventin & Weimerskirch 1984). Bonds renewed each season at nest site; no evidence that pairs associate at sea. Sex ratio apparently balanced. At Iles Crozet, age of first return to land 8.4 years (2.3; 5–14; 67). Establishment of pair-bond occurs over 3.4 years (2.0; max. 7; 17) in immatures and 1.7 years (0.9; 7) in adults after loss of partner. Breeding adults re-establish pair-bond in Sept.–early Oct. Immatures present at colonies: Dec.–June in third year before laying; Aug.–May, second year before; and Sept.–Dec. year before laying (Jouventin & Weimerskirch 1984).

BREEDING DISPERSION Breed in groups of up to 100 nests; occasionally solitary. At Marion I., usually in groups of 50–60; occasionally singly, depending on terrain; at three colonies, 94% of nests had two or more nests within 3 m (Berruti 1979a). At Iles Crozet, c. 12% of individuals (n=1787) breed solitary and 54% within groups of 2–5 nests (nests ≤ 3 m apart); largest groups 18 nests (Weimerskirch *et al.* 1986). Compete with Light-mantled Sooty Albatross for breeding sites at Marion I. (Sooty Albatross returns to breeding colonies 1 month earlier than does Light-mantled). On Tristan da Cunha, some nests have been usurped by Yellow-nosed Albatrosses (breeding slightly earlier) following increases in populations of that species (Richardson 1984). Highly territorial, defending nest-site from conspecifics and Light-mantled Sooty Albatross. Territory used for courtship, copulation, incubation and care of young. Non-breeding birds, or those establishing pair-bonds, gather at prominent loafing sites. Nest-sites attended 7–8 months. After brood-stage, only non-breeding birds present for more than a short time at breeding grounds because parents return only to feed chick.

ROOSTING At or near nest-site when breeding, at night and during day; on sea at other times.

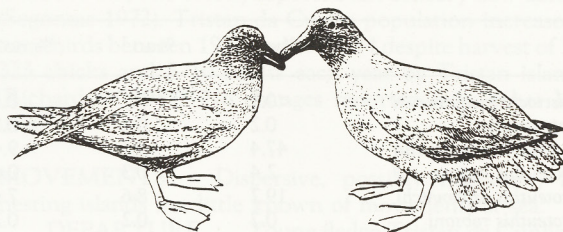
SOCIAL BEHAVIOUR Reasonably well known. Detailed studies by Berruti (1981) and Jouventin *et al.* (1981); also described by Richardson (1984). Most social interaction takes place on or near nest-site. Displays conspicuous and easily observable but difficult to interpret because sexes similar in plumage and behaviour, and non-breeding birds not easily distinguished before laying.

AGONISTIC BEHAVIOUR Agonistic displays performed by adults and immatures defending nest or nest-site. At first, feathers of head, neck and mantle are erected and wings lifted slightly away from body. With increasing intensity, bill opened and birds may lunge at intruder giving guttural *gaaaau* call, sometimes developing into Skycall; may also Gape or snap bill several times in rapid succession; may regurgitate at intruder. Physical attacks rare. Plumage becomes

sleeked when bird shows increased tendency to flee. Displays performed in aggressive circumstances between partners are described below (see Berruti 1981).

SEXUAL BEHAVIOUR Descriptions based on computer analysis by Jouventin *et al.* (1981). Most active behaviour and complex displays found in immature birds establishing pair-bonds. Sexual behaviour consists of many different actions (Skycall, Scapular Action, Glances, Bill-pointing, Scooping, Gape, Head-shaking, Bowing Head-up, Bill-clashing, Preening and Mutual Preening, Fanned Tail, Synchronized Flight) used in several different levels of displaying (see below). Displays between partners are identical to those of Light-mantled Sooty Albatross, except that Bill-clashing replaces Bill-thrusting. **Skycall:** birds utter a loud expiratory syllable with head and slightly open bill pointed vertically then a softer and shorter inspiratory syllable as head and bill quickly lowered; may be performed in standing or sitting position, most often by male. Main functions are ADVERTISING ownership of territory and INDIVIDUAL RECOGNITION; often followed by Foot-looking. **Scapular Action:** bill placed at junction of wing and body, generally on side opposite to partner and tail fanned; given mainly by male. Used as APPEASEMENT attitude and invitation to contact. **Glances:** bird glances at partner, alternately with right and left eye; mainly by female. Used for establishment of visual contact and as response to Scapular Action. **Bill-pointing:** bird reaches forward with closed bill pointed to head or upperparts of partner; slight biting movement may be made but contact rare and gentle; performed standing but occasionally by sitting birds, mainly by female. Display not easily distinguished and grades into Bill-clashing and Mutual Preening. Female uses display as another response to Scapular Action; used by male when attempting to preen partner. **Gape:** similar to Bill-pointing but bill opened when neck extended; mainly by female; aggressive version of Bill-pointing. **Scooping:** like Gape, but head bowed and bill pointed downwards; given mainly by female. Less aggressive than Gape, as aggression apparently re-directed towards ground instead of partner. **Head-shaking:** a series of accentuated sideways movements of head; given mainly by male. Advertises Scapular Movement which follows immediately. **Bowing-head-up:** head slowly bowed then rapidly tossed upwards and backwards; given mainly by male. Fulfills same function as Head-shaking but less aggressive. **Bill-clashing** (Fig. 1): mutual sideways movements of heads; one bird reaches forward with closed bill pointed at head of partner who jerks head sideways, fencing bills lightly with clicking sounds; up to 15 contacts made in rapid succession. Bill-clashing is ritualized combat aimed at easing aggression between partners. At high-intensity, tail may be fanned. Bill-clashing usually first mutual display; may be followed by Mutual Preening. **Preening and Mutual Preening:** one bird preens partner, or mutual preening between partners; round head region, especially round eye and base of bill; performed by both sexes, either standing or sitting, birds tending to sit as Preening continues. Functions in maintenance of pair-bond. **Fanned Tail:** tail fanned and skewed to one side at 45° angle to ground; performed by both sexes. An excitement attitude that can last several minutes, in conjunction with most other attitudes. **Synchronized Flight:** both partners fly close together over colony, with movements closely synchronized. Caused by departure of female and male attempting to keep contact with female and bring her back to display site. Displacement attitudes also observed during displays: **Paddle-walk:** consists of quick, exaggerated up-and-

Fig. 1 Bill-clashing



down movements when walking; **Belly-looking, Foot-looking:** head bowed and bill placed between legs; bill may touch belly or one leg and biting movement may be performed; lasts 2–3 s and may be repeated two or three times; and **Autopreening, Wing-fluffing** or collection of nest material (briefly).

Establishment of pair-bond takes place through four distinct levels of displays. Displays performed in sessions of up to 20 min duration and carried out over several months at colony and over several seasons of courtship before breeding; sequence of displays evolves during this time. Session comprises a series of bouts, during which birds establish or strengthen bonds by a sequence of the displays described above. **Level 1.** Specific to second or earlier years before breeding (Jouventin & Weimerskirch 1984). Characterized by small variety of displays, performed independently of partner and without sexual differentiation. Displays brief, occurring only between landing of female, attracted by **Skycall** of male on display site, and her departure at slightest incident. In **Level 2**, male twice as active as female; birds start to display towards one another; male takes initiative through **Head-shaking, Bowing-head-up** and **Scapular Action**. All forms of display used, except **Preening**. Female still very mobile, but, when she departs, followed by male in synchronized flight. In **Level 3**, displays are always mutual, with all forms being used as in Level 2; more pronounced, centred round **Gape** and **Bill-clashing**, because female tends not to fly away. Female three times as active as male. In female, conflict between attraction to mate and fear generally resolved by **Bill-clashing**. Female still sometimes departs, followed by male in synchronized flight. **Level 4** displays less complex and consist only of **Bill-clashing** and **Skycalls** (given alternately or overlapping), and **Preening** and **Mutual Preening**. Pair-bond established. In new partners, Level 4 not observed earlier than year preceding breeding (Jouventin & Weimerskirch 1984). Level 4 also only level observed between partners of established breeding pairs. Displays during establishment of pair-bond do not progress linearly from Level 1 to Level 4, but rather in loops during sessions with frequent returns to lower levels. **COPULATION** occurs 14.0 days before laying (5.9; 1–30; 63) (Jouventin & Weimerskirch 1984).

RELATIONS WITHIN FAMILY GROUP During pre-breeding period, male spends nearly ten times as long at nest-site as female. Incubation, brooding and feeding of chicks shared equally by both sexes. Chicks independent of parents after fledging.

VOICE No detailed studies; descriptions from Marion I. (Berruti 1981) and Iles Crozet (Jouventin & Weimerskirch 1984). Silent at sea (A. Berruti) except Threat Call while feed-

ing which is rare as birds mainly feed alone (J-C. Stahl). Calling restricted to breeding periods and mainly to nest-site; usually only during day (A. Berruti). Calls similar to those of Light-mantled Sooty Albatross. Sexual differences: **Skycall** of male longer than that of female; also individual differences in form and number of harmonics (Jouventin & Weimerskirch 1984). No geographical variation reported. Non-vocal sounds: click-ing sounds when bills make contact during Bill-clashing.

ADULT Skycall. A characteristic two-syllable call given during Skycall Display. A loud long expiratory syllable, initially shrill but becoming more trumpet-like, given with head and bill pointed vertically; bird then utters quiet nasal inspiratory syllable as head and bill are lowered; first syllable louder and longer than second. At Iles Crozet, duration of expiratory syllable 1.30 s (0.12; 1.10–1.47; 9) for males, 1.03 s (0.13; 0.85–1.20; 9) for females (Jouventin & Weimerskirch 1984). Calls given by sitting birds noticeably softer. Sound of call reflected in common names Piew, Pee-arr, Pio. Members of a pair often duet with alternate or overlapping calls (Berruti 1981; Jouventin *et al.* 1981). Skycall is an integral part of the display (see Social Behaviour); used in mate attraction, individual recognition and sometimes in agonistic actions. **Threat Call.** Harsh, throaty *gaaaaau*, similar to that of Light-mantled Sooty Albatross.

YOUNG Begging Call and gulping noise when threatened similar to that of Light-mantled Sooty Albatross.

BREEDING Fairly well known. Detailed studies on Marion I. (Berruti 1979a) and Iles Crozet (Jouventin & Weimerskirch 1984; Weimerskirch *et al.* 1986); extraliminally and partially on Tristan da Cunha, Gough I. and Ile Amsterdam (Elliott 1957; Hagen 1952; Swales 1965; Richardson 1984; Segonzac 1972). Information supplied by A. Berruti, J-C. Stahl. Breeds colonially on steep slopes of coastal cliffs and inland cliffs, in association with Light-mantled Sooty Albatross on Price Edward Is and Iles Kerguelen, to some extent with Sooty, Grey-headed *Diomedea chrysostoma* and Black-browed *D. melanophrys* Albatrosses on Iles Crozet, and with Yellow-nosed Albatross *D. chlororhynchos* on Tristan da Cunha.

SEASON Broadly from mid-July to early Sept. through to May to mid-June according to locality. At Marion I. and Iles Crozet, first arrivals mid-Aug. At Iles Crozet, breeding males arrive first (mean 16 Sept. [5 days; 3–26 Sept.; 37]), breeding females later (mean 21 Sept. [6 days; 10 Sept.–2 Oct.; 34]); immatures (<7 years old) in Dec. onwards (Jouventin & Weimerskirch 1984). No pre-laying exodus. At Iles Crozet, male at nest-site for 15.5 days (5.7; 2–24; 39) pre-laying, female only 1.8 days (1.1; 0–5; 38); laying, 7 Oct. (30 Sept.–16 Oct.; 109) (Jouventin & Weimerskirch 1984). At Marion I., laying finished by 14 Oct. (Berruti 1979a). At Tristan da Cunha, most eggs laid 2–4 Oct. (Richardson 1984). Fledging, with immediate departure of successful breeders: at Marion I., Apr. (Rand 1954) to late May (Berruti 1979a); at Iles Crozet, 31 May (9 days; 11 May–15 June; 31) (Jouventin & Weimerskirch 1984). Failed breeders leave at once; latest non-breeders (mostly immatures) leave in June (Berruti 1979a; Jouventin & Weimerskirch 1984).

SITE On vegetated ledge on cliff or steep slope, with drop of ≥ 3 m in front; often on areas of grey lava at Marion I.; a few to 100s m asl. Coastally at Marion I., Iles St Paul and Crozet; also inland at Tristan da Cunha and Gough I; and only inland at Ile Amsterdam. Usually in groups of up to 50–60, occasionally singly, density depending on terrain; at three colonies on Marion I., 94% of nests had two or more nests within 3 m. At Iles Crozet, 74% of previous nests (n=142) re-used next season but 94.3% of breeding pairs (n=145) returned to same locality. Site selected by male (Jouventin & Weimerskirch 1984).

NEST, MATERIALS Low mound of mud mixed with plant material; cup lined mostly with grass; 35–40 cm wide at base, 10–20 cm high, with inner cup 6–8 cm deep (Hagen 1952). Both sexes build by sitting on nest, collecting earth, vegetation within reach, adding to sides of mound; by shifting round, mound is formed on all sides. Old nests, even overgrown with short vegetation, may be renovated at start of season.

EGGS Oval, broader at one end; coarse-shelled, not glossy; white with reddish brown specks at broad end.

MEASUREMENTS:

Marion I.: 103.1 (3.1; 96.0–110.7; 67) x 65.1 (1.8; 59.3–68.7)

Iles Crozet: 101.8 (3.2; 95–108; 74) x 65.3 (2.1; 59–69.5)

Tristan da Cunha: 101.7 (2.9; 93.6–196.2; 40) x 65.2 (2.1; 58.9–69.7)

Gough I.: 102.2 (4.6; 91.7–110.8; 26) x 64.8 (2.6; 60.0–71.4)

WEIGHTS:

Marion I.: 243 (14.1; 204–270; 31) or c. 9.6% ad. mass

Iles Crozet: 227 (17.7; 185–265; 74)

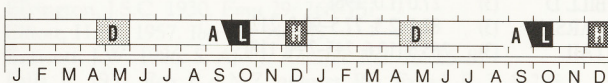
Tristan da Cunha: 240 (16; 216–274; 40).

CLUTCH-SIZE One. No replacement laying.

LAYING Synchronized (for dates, see above). At Iles Crozet, no significant difference in three seasons (Jouventin & Weimerskirch 1984). Breed once in 2 years. At Iles Crozet, successful breeders (n=72) all laid again in second year after success; of failed breeders (n=176), 89.2% laid again next year, 9.7% in second year after failure and 1.1% in third year (Weimerskirch 1982).

INCUBATION By both sexes in alternate shifts. At Marion I., female took first shift; total number of shifts, 6–9; male's share 47% in 3–4 shifts, each 2–17 days long; female's, 53% in 3–5 shifts, each 3–17 days long; female's third shift longest on average but second and fifth almost equally long; shifts shorter as hatching approached. Eggs that failed to hatch incubated for 10–12 shifts. At Iles Crozet, 6–10 shifts, lasting 1–21 days; male's share 49.2%; female's, 50.8%; female's third shift longest, 12.6 days (3.9; 6–21; 13) (Jouventin & Weimerskirch 1984; Weimerskirch *et al.* 1986). **INCUBATION PERIOD:** at Marion I., 70.1 (1.8; 69–73; 15); at Iles Crozet, 70.7 (1.5; 65–75; 40) days.

YOUNG Semi-altricial, nidicolous. Pipping of egg to emergence, 4.2 days (3–6). At Marion I., brooded continuously by both parents in alternate shifts; total number of shifts, 6–11, each 1–4 days long. Brood-stage lasts 21 days (2.1; 17–28; 23), almost equally shared by sexes. At Iles Crozet, mean length of brood-stage 21.3 days (2.4; 16–28; 42), equally shared by sexes; mean length of shifts 2.3 (1.0; 1–6; 181) (Weimerskirch *et al.* 1986). **NESTLING PERIOD:** Marion I., 149–163 days (n=6); at Iles Crozet, 164 d (9; 145–178; 28). Chick fed by both parents at an average interval of 2.3 days, apparently only during daytime, at least after brood-stage; fed by incomplete regurgitation. If threatened, chick regurgitates oil at intruder. Fed less often as fledging approaches but not aban-



doned in nest.

GROWTH Weight of one chick at hatching, 240 g (Richardson 1984). At Marion I., peak weight, c. 112% of adult mass at 100 days old, declining to fledging at 2274 (148.7; 2050-2420; 5) (Berruti 1979a). At Iles Crozet, maximum weight 115% of adult mass; mean daily gain from 8-68 days old (or between 10 and 90% of maximum weight), 37g/day (Weimerskirch *et al.* 1986).

FLEDGING TO MATURITY Independent of parents on fledging. First return to land at 8.4 years old (2.3; 5-14; 63). Pair-bond established after 3.4 years old (2.0; 17) (Jouventin & Weimerskirch 1984). First breeding at 11.9 years old (1.5; 9-15; 22). At Iles Crozet, survival of immatures from fledging to first breeding attempt at 9 years old, 51%; mean annual survival of adults, 1975-82, 95% (n=185) with no significant variation annually (Weimerskirch *et al.* 1987).

SUCCESS At Marion I., for one season 13% (61 eggs laid, 35 hatched, 8 chicks fledged); for next, 25%; determined from three colonies only in both seasons but, in first, success probably better (possibly 35%) for all colonies on Island. In first season, losses: of eggs: six (9.8%) infertile, 20 (32.7%) lost, probably after desertion; of nestlings: five (14.3%) starved or diseased, 18 (15.4%) lost, probably to giant-petrels *Macronectes* spp, two (5.7%) destroyed by collapse of nest, two deserted. At Iles Crozet, for seven seasons, mean total success 42.1% (12.3-60.2; 928 eggs); for five seasons, 70.1% (44.3-83.6) eggs hatched, 50.1% (31.7-70.2) chicks fledged. Total breeding success increased with age: for birds <15 years old, 28.1% (n=32); >15 years old, 42.4% (n=171) (Jouventin & Weimerskirch 1984). Average chicks fledged/pair/year, 0.26 (Weimerskirch *et al.* 1987). Chief losses caused by local mass desertions in parts of colonies for unknown reasons, occurring throughout incubation and brood-stage, followed by predation of chicks by skuas and sheathbills (Jouventin & Weimerskirch 1984).

PLUMAGES ADULT Age of first breeding, 10 years (Weimerskirch 1982). In fresh plumage: **HEAD AND NECK.** Crown, dark-brown (119A). Lores and side of head, black brown (119). Incomplete semi-circular eye-ring of short dull-white feathers; lacking in front of eye. Rest of head and neck, dark brown (119A). **UPPERPARTS,** excluding mantle, dark brown (119A). Mantle, brown (119B), broadly fringed light grey-brown (119C); when worn, fringes light grey-brown (119D). **TAIL.** Dark brown (219); rachis buff (123D). **UPPERWING.** All humerals, tertials, secondaries, coverts and alula, dark brown (121). Median, lesser and marginal coverts broadly fringed light grey-brown (119C); when worn, fringes light grey-brown (119D). Primaries, dark brown (219); rachis buff (123D) and broad on p10. Wide glossy tegmen on inner web of all primaries, and most obvious on p10; tegmen narrow on outer webs. **UNDERPARTS,** dark-brown (119A). Axillaries, dark-brown (121). Concealed bases of body-feathers, light grey-brown (119D); when worn, feather bases exposed. **UNDERWING.** All coverts, dark brown (121). In worn plumage, concealed bases of feathers more evident. Worn feathers also noted on forehead, crown and breast; abrasion of remiges, with distal tip of p10 often broken (up to 30 mm) (Berruti 1979b).

DOWNY YOUNG Protopile, short and light grey. Mesoptile, longer and thicker, grey (84), with pale-grey (86) tips; shorter grey (84) down on crown, sides of head and chin;

pale-grey (86) tips absent. Down on lores, including eye-ring, very short and dull white.

JUVENILE Similar to adult, but wear of head and neck feathers exposes bases of feathers, producing light grey-brown (119D) nape and lower neck. Rachis of tail and primaries, dark brown (Watson 1975; Berruti 1979b).

BARE PARTS Based, except where stated, on photos in Lindsey (1986).

ADULT Iris, dark brown (219A). Bill, black (89); sulcus, buff (53). Legs and feet, light grey (85) with dull-pink (5) shade. Webs, dull pink (5).

DOWNY YOUNG Iris, black-brown (119). Bill, grey-black (82); sulcus, partly developed and similar in colour. Legs and feet, grey (87); dull mauve-blue (HASB).

JUVENILE Similar to adult except bill not so shiny; sulcus varying, flesh-grey, dull yellow or violet (HASB; Watson 1975); dark grey (Berruti 1979b); colour lightens with age.

MOULTS Largely undescribed.

ADULT In 234 breeding and non-breeding birds, during Oct.-June, one replacement of a 'wing feather' and tail feather (see Berruti 1979a for full details). Wing and tail moult occurs at sea; moult may start late in breeding cycle and reach completion early in following breeding cycle (Berruti 1979a). Primaries probably moulted in staffelmauser. Moult strategy presumably similar to that of Yellow-nosed Albatross (see Furness 1988 for details).

POST-JUVENILE Undescribed.

MEASUREMENTS Live birds: (1) Marion I., adults; methods unknown: **BILL D** = bill depth at gonys (Berruti 1979a); (2) Iles Crozet; methods unknown (Jouventin & Weimerskirch 1984).

	MALES	FEMALES
WING	(1) 526.5 (-; 522-531; 2) (2) 523.6 (12.02; 490-540; 19)	508.5 (-; 508-509; 2) 501.2 (5.95; 490-510; 12) *
BILL	(1) 114.9 (1.8; 112.4-116.5; 5) (2) 113.3 (2.72; 109-117; 20)	109.9 (1.0; 108.5-110.5; 4) * 107.2 (2.90; 101-112; 13) *
BILL D	(1) 28.4 (0.4; 28.1-29.0; 5)	26.2 (0.8; 25.3-26.9; 4) *
TARSUS	(1) 83.0 (2.0; 81.2-86.0; 5)	81.3 (2.2; 79.1-83.7; 4)
TAIL	(1) 275.0 (4.5; 269-280; 5)	256.3 (9.1; 245-267; 4) *

Unsexed birds: (3) Marion I., adults; sexes combined (Berruti 1979a);

	UNSEXED
WING	(3) 516.5 (12.9; 490-551; 101)
BILL	(3) 112.1 (3.5; 99.9-120.2; 212)
BILL D	(3) 27.0 (1.0; 198)
TARSUS	(3) 82.7 (2.3; 77.5-90.0; 212)
TAIL	(3) 265.5 (10.6; 245-294; 118)

methods unknown: BILL D = bill depth at gonys (Berruti 1979a); (2) Marion I., adults; sexes combined (Berruti 1979a); (3) Iles Crozet; methods unknown (Jouventin & Weimerskirch 1984).

Additional measurements given in Murphy. For measurements from Iles Amsterdam and St Paul, and Tristan da Cunha see Hagen (1952) and (Mougin 1970b). For details of growth rates of chicks, see Berruti (1979a).

WEIGHTS (1) Marion I., adults, Oct.–June (Berruti 1979a); (2) Iles Crozet (Jouventin & Weimerskirch 1984).

MALES	FEMALES
(1) 2600 (200; 2300–2700; 5)	2400 (200; 2300–2600; 4)
(1) Sexes combined: 2500 (200; 2100–3400; 176)	
(2) 2730 (330; 2200–3250; 18)	2440 (250; 2100–2800; 12)

At Marion I., breeding birds significantly heavier than non-breeding birds (Berruti 1979a; A. Berruti).

BREEDING	NON-BREEDING
2623 (245; 31)	2484 (220; 148)
2720 (220; 2450–3250; 31)	2300 (210; 2050–2550; 8)

At Iles Crozet, breeding birds heavier than non-breeding (Jouventin & Weimerskirch 1984). Further details of weights from Iles Crozet and Tristan da Cunha in Mougin (1970b). Details of weight changes in chicks in Berruti (1979a) and Weimerskirch *et al.* (1986).

STRUCTURE Based on two skins at MV. Wing, long and narrow. Eleven primaries: p10 longest, p9 17–18 mm shorter, p8 43–49, p7 76–87, p6 120–131, p5 166–175, p4 209–224, p3 249–265, p2 286–297, p1 311–331. No emarginations. Tail, wedge-shaped. Twelve rectrices, t1 longest, t6 c. 85–90 mm shorter. Bill, slender and laterally compressed; deep at base. Culminicorn, almost straight (see Fig. ; bill profile in Murphy). Nares, rounded, directed forwards, situated near base of upper mandible, between groove of culminicorn and latericorn. Feet, webbed. Middle and outer toes, approximately equal, inner c. 83% of middle; hind absent.

SEXING, AGEING Discriminant function analysis of 203 unsexed and nine sexed birds was unable to separate sexes (Berruti 1979a). RMO

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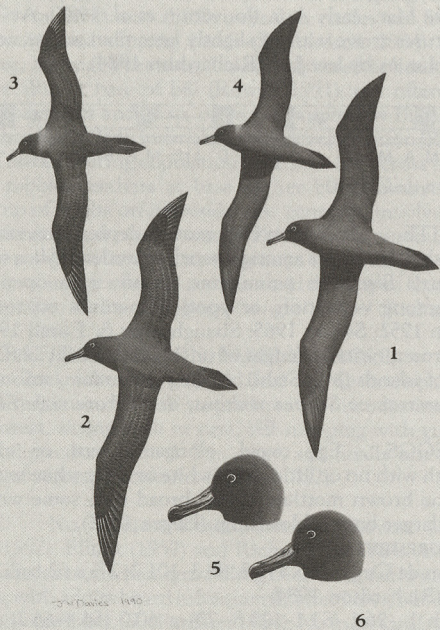
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Volume 1 (Part A), Plate 23

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

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