

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.

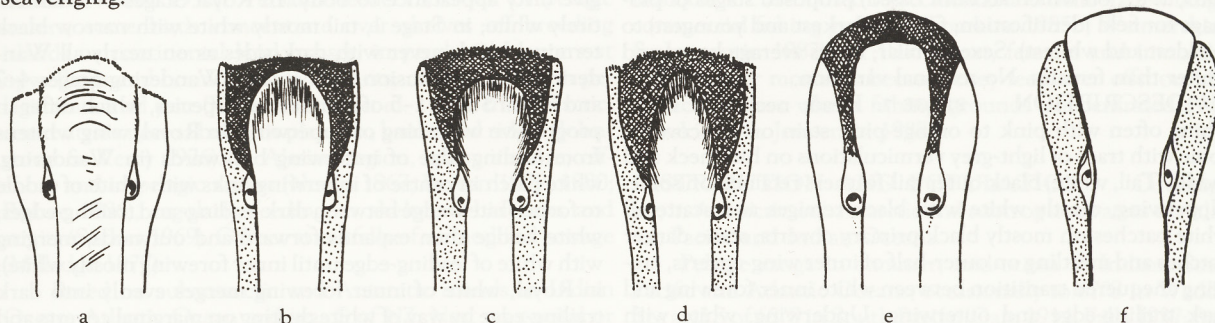


Fig. 1 Dorsal view of base of bill of small *Diomedea*

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 cauta Gould, 1841, *Proc. zool. Soc. Lond.* (1840): 177 — Bass Strait.

The specific name (Latin *cautus*, wary or cautious) refers to the species' reputed shyness at sea, which is not really justified.

OTHER ENGLISH NAMES White-capped, Salvin's, Chatham Island Albatross (Mollymawk).

Because the qualifier **White-capped** applies to only one subspecies, the simple succinct **Shy** is preferred.

POLYTYPIC Nominate *cauta* breeds on Tas. islands and Auckland Is, NZ; *salvini* (Rothschild, 1893) breeds on Snares and Bounty Is, NZ, and Iles Crozet; *eremita* (Murphy, 1930) breeds on Chatham Is, NZ.

FIELD IDENTIFICATION Length 90–100; wingspan 212–256; weight: male 4.0–4.4 kg, female 3.4–3.8 kg. Largest black-backed albatross; proportionately longer-winged than others of Southern Ocean, with slightly fuller body, stouter bill and less manoeuvrable flight, giving slightly heavier, longer-winged jizz. Underwing pattern distinctive: mostly white, with very narrow black margins and diagnostic black pre-axillary notch at base of leading-edge. Adult *salvini* has light grey head and neck with pronounced whitish cap; bill, slightly darker grey, with contrasting ivory-horn stripes top and bottom, and black mandibular spot. Subspecies *eremita* slightly smaller, with proportionately shorter bill; adult has dark grey head and neck with faintly paler cap; bill, bright yellow with black mandibular spot. At all ages, amount of dark on undersurface of primaries helpful in separation of subspecies. Juveniles and immatures separable. Sexes alike. No seasonal variation.

DESCRIPTION Nominate *cauta*. **ADULT.** Forehead and crown, white, forming pronounced white cap sharply bordered by narrow greyish-black brow (tapering across upper lores, nearly to base of upper mandible) and by varying light grey wash across sides of head: most have pronounced wash on sides of nape, ear-coverts, cheeks and sides of throat, merging into white round base of bill, on chin and mid-throat; on many, wash encircles nape, further emphasizing cap; on others, wash paler and mostly on ear-coverts and rear of cheeks; rarely, appears white-headed, with little capped effect. Cheeks and throat become paler with wear. Hindneck, sides of neck and upper mantle, white, forming broad white collar. Thin white crescent encircles rear and bottom of eye. Lower mantle and back, blackish with pronounced silvery bloom, forming frosty-grey saddle contrasting with darker, uniform blackish scapulars and upperwings; with wear, saddle

and upperwings darken to uniform brownish black; white bases of outer primary shafts visible. Rump and upper tail-coverts, white. Tail, light grey; darker brown with wear. Underbody, white; underside of tail, greyish black. Underwing, white except for very narrow black margins and diagnostic black pre-axillary notch at base of leading edge; on most, black leading-edge ends before reaching pre-axillary notch, isolating notch. Varying black wing-tip: most have narrow black border round wing-tip, sharply demarcated from extensive white wedge covering basal three-quarters of primaries; on some, extensive black tip with shorter, duller silvery-white wedge covering bases of primaries; intermediates occur. Bill, uniform greyish-horn, with maxillary unguis and distal half of mandibular unguis, straw-yellow, forming contrasting yellow tip; some have wholly black mandibular unguis or smaller dusky mandibular spot; often straw-yellow wash across base of culminicorn; narrow strip of black skin round base of culminicorn, extending forward between culminicorn and latericorn to base of nostrils; thin strip of skin bordering base of upper mandible, black; cheek stripe (exposed only during display) and narrow vertical strip of skin bordering base of lower mandible, orange. Iris, dark brown. Legs and feet, bluish-flesh. **JUVENILE.** Differs from adult: (1) grey of head, darker medium-grey; neck, grey (not white), merging into grey of mantle and not extending onto flanks. Amount of grey on head varies; darkest have full grey hood (sharply demarcated from white breast and flanks) with slightly paler greyish-white cap; palest have mostly white head and pronounced grey collar tapering from hindneck to mid-line of foreneck. Intermediates have collar and varying grey wash extending from collar across ear-coverts, cheeks and rear of crown, forming partial hood with white cap. Collared types and those with intermediate head patterns appear to predomi-

nate. During first 2 years at sea, amount of grey on head and neck much reduced by wear, initially to narrow but complete hindneck collar (though darkest birds may retain hood for much of first year, hood developing brownish tinge before whitening with wear); when fully worn, all mostly white-headed, with grey on hindneck reduced to partial, somewhat patchy collar of varying extent, often separated from mantle by paler grey or whitish posterior hindneck. (2) When fresh, saddle and upperwings slightly paler, greyer (darker, matching adult, when worn). (3) On most, leading-edge of underwing extends inward to join pre-axillary notch; many have small, varying dusky patch (on lesser primary coverts) jutting off inner edge of black leading-margin, mid-way between carpal and base of outermost primary (on some, very faint or lacking). Area of dark on wing-tip varies: many have narrow dark border enclosing extensive white wedge, like typical adult; others have extensive blackish wing-tip with much shorter, duller, diffuse silvery-white wedge covering basal third or less of primaries, which can be hard to see and wing-tip may appear wholly blackish. (4) Bill, darker; medium-grey with black unguis forming contrasting black tip; all bare skin, black; at fledging, show black saddle over base of culminicorn, extending onto base of latericorn (fades to dusky wash, or lost completely, during first few months). Bill remains unchanged till some time in second year when tip of maxillary unguis turns dull yellow or yellowish-horn. IMMATURE. Changes in plumage and colour of bill with age not fully known. Appearance and plumage like adult, with broad pale hindneck collar and identical underwing pattern. Colour and pattern of bill and amount and darkness of grey on head and neck differs: many have darker, more pronounced grey wash across sides of head and round nape, and broad pale hindneck collar lightly washed with pale grey (but white on some, matching adult); on others, grey wash on head, nape and hindneck much reduced or head and neck can be wholly white. Adult plumage attained some time during fourth or fifth year at sea, before bill colour definitive. Gradually develop adult bill colour: side-plates and culminicorn become paler greyish-horn as tip and sides of maxillary unguis turn yellowish and become brighter and more extensive, and black on ridge of unguis, duller and less extensive; vertical strip of bare skin turns dull orange then brightens; mandibular unguis remains as black or paler greyish-black spot until after rest of bill and plumage, fully adult.

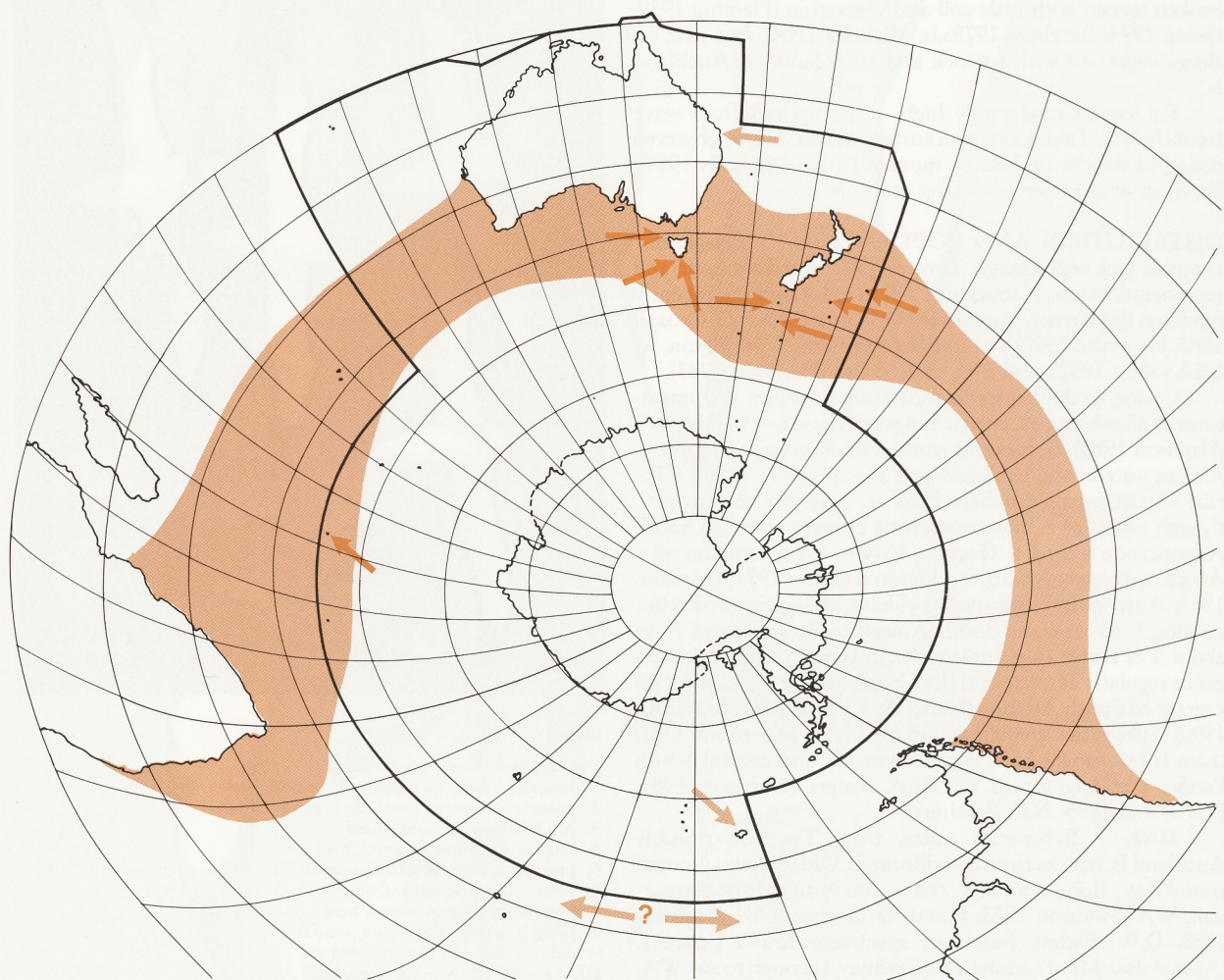
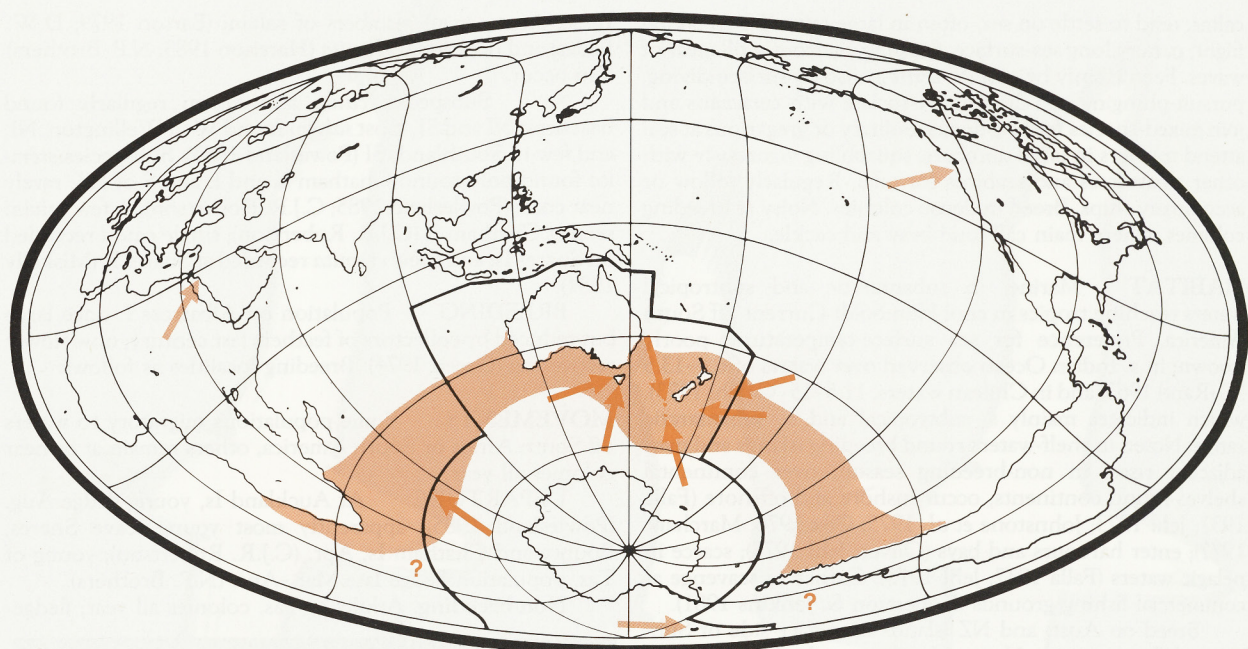
Subspecies *salvini*. ADULT. Like nominate except: (1) head and neck mostly uniform light grey, forming hood (sharply demarcated from white underbody) with white or greyish white cap (emphasized by narrow greyish-black brow between eye and base of culminicorn). Grey of hindneck merges into light grey of mantle and back which form conspicuous grey saddle contrasting with darker blackish upperwings. Tone of hood and saddle varies with light: light grey in full sunlight, darker medium-grey under cloud or at distance. In worn plumage, hood appears brownish grey, chin and upper throat become faintly paler; saddle darkens, contrasting less with upperwings. (2) Some have small dusky patch on lesser primary coverts, jutting off inner edge of black leading margin, mid-way between carpal and base of outermost primary (as on juvenile); undersurface of primaries wholly black, forming larger dark wing-tip sharply demarcated from white lining; basal half of primaries can appear faintly paler steely-grey but never show pale wedge pattern of nominate. (3) Side-plates of bill slightly darker grey with olive tinge; culminicorn, maxillary unguis and narrow stripe along

bottom edge of lower mandible, ivory-horn, appearing as contrasting pale stripes top and bottom; mandibular unguis, black; many have blackish patch on basal sides of maxillary unguis; in strong light or at distance, side-plates often look brownish (bill then appearing decidedly darker and browner than nominate). JUVENILE. Poorly known. Like nominate, with overlap in head pattern: most have full grey hood (matching darkest-headed *cauta*) though some paler, matching intermediate *cauta*; with wear, head, mostly white with complete or partial grey hindneck collar. Differs from *cauta* by pattern of tip of underwing: undersurface of primaries wholly black (never with clear white or duller silvery wedge) forming larger, blacker wing-tip sharply demarcated from white lining. Also, grey of hood extends onto anterior flanks to level with or slightly beyond pre-axillary notch; on inner underwing, some have first few rows of lesser coverts behind leading margin tipped grey, forming narrow zone of grey smudging on otherwise clean white lining. Bill, as nominate. IMMATURE. Little known; like adult but bill greyer, with black tip to both mandibles. Differs from immature *cauta* in having full grey hood, merging into grey saddle (no broad pale hindneck collar), and larger dark wing-tip, like adult (Harrison 1983, 1984). Changes in bill undescribed.

Subspecies *eremita*. ADULT. Slightly smaller than *cauta* or *salvini* with proportionately shorter bill. Underwing pattern identical to *salvini*; differs from *salvini* and *cauta* by much darker, nearly uniform dark-grey hood; cap only faintly paler grey than rest of hood (not obviously white-capped); uniform bright-yellow bill with black subterminal spot (formed by black mandibular unguis). JUVENILE. Poorly known. Like adult but hood, uniform dark grey, without faintly paler cap; grey of hindneck merges into dark-grey mantle and back, which do not contrast noticeably with blackish upperwings; some have grey wash extending over upper breast (Harper & Kinsky 1978) and perhaps down flanks; effects of wear on hood, unknown; bill, dark olive-brown, with black unguis forming contrasting black tip; all skin round base of bill, black. Similar to darkest-headed *salvini* and *cauta* but hood much darker and more uniform, without pale cap; no contrasting pale saddle; and bill darker, browner; further differs from *cauta* by solid black underwing-tip and grey wash on flanks (as on *salvini*). Grey wash across breast of some apparently unique to *eremita*. IMMATURE. Undescribed.

SIMILAR SPECIES Mostly white underwing with narrow straight black margins, black tip and diagnostic black pre-axillary notch at base of leading-edge readily distinguishes all subspecies and ages of Shy Albatross from other albatrosses. With experience, almost wholly white appearance of underwing alone enables separation from other black-backed albatrosses at considerable distance; with careful viewing, diagnostic pre-axillary notch also visible at some distance.

Circumpolar in broad range of marine habitats; from pelagic waters to shelf-edge zone, ranging well inshore over continental shelf and entering bays and harbours; commonly observed from land (not *eremita*); largest concentrations occur over rises, along shelf-break and over outer continental shelf. Flight in strong winds graceful and effortless with few wing-beats, soaring and wheeling (on nearly motionless wings) in broad arcs well above horizon; when soaring or gliding, wings held bowed gently downwards. In light winds, flap more, closer to sea; appear less manoeuvrable than smaller, stiffer-winged albatrosses, with longer less stiff wings producing deeper wing-beats and slower, more laboured flight. During



calms, tend to settle on sea, often in large rafts. When taking flight, patter along sea-surface, flapping vigorously till clear of waves. Feed mainly by surface-seizing, also by surface-diving, pursuit-plunging and dipping. Associate with cetaceans and join mixed-species feeding flocks. Solitary or gregarious at sea; attend trawlers in large numbers, squabbling vigorously with other albatrosses and seabirds for offal. Regularly follow or accompany ships. Breed in dense colonies. Noisy at breeding colonies, where main call loud bray and cackle.

HABITAT Marine; in subantarctic and subtropical waters reaching tropics in cool Humboldt Current off South America. Preference for sea surface-temperatures poorly known; in s. Indian Ocean observed over waters of 6.4–13.5 °C (Rand 1963) and in Chilean waters, 11.5–15 °C (Jehl 1973), which indicates mainly s. subtropical and n. subantarctic range. Noted in shelf-waters round breeding islands and over adjacent rises; in non-breeding season, over continental shelves round continents; occur inshore and offshore (Falla 1937; Jehl 1973; Johnstone *et al.* 1975; Cox 1976; Marchant 1977); enter harbours and bays (Oliver; Jehl 1973); scarce in pelagic waters (Falla 1937; Jehl 1973). Gather to scavenge at commercial fishing grounds (Robertson & Jenkins 1981).

Breed on Aust. and NZ islands on either side of Sub-tropical Convergence. Nest on level or gently sloping ledges, summits, slopes and caves of rocky islets and stacks, usually in broken terrain with little soil and vegetation (Fleming 1939; Green 1974; Brothers 1979a,b; Miskelly 1984); but nest on slopes vegetated with tussock and succulents on Auckland Is.

Fly low to moderately high, using updraft from wave fronts for lift. Take food from surface or just below; observed diving to depths of 2 m or more for offal (Nicholls 1979). Scavenge at commercial fishing grounds.

DISTRIBUTION AND POPULATION Pelagic distribution not well known. Circumpolar in subantarctic and subtropical waters, N to about 25°S; breed A'asia and recently found on Iles Crozet. Vagrant to S. Georgia (Prince & Croxall 1983; Jouventin 1990) and to n. hemisphere: Washington, w. USA (Slipp 1952), and Elat, n. Red Sea (Harrison 1983).

Owing to difficulties in separating juveniles and immatures of all subspecies, pelagic ranges of these not well known (Harrison 1985). Subspecies *cauta*, circumpolar, common in A'asian waters; one recorded near Macquarie I.; across s. Pacific Ocean, small numbers E to w. coast South America, though extent of e. movement, little known; scarce in South Atlantic; one record, S. Georgia, 16 Nov. 1926; common off s. Africa; range across s. Indian Ocean (Bourne 1977; Harrison 1985; Aust. Atlas). Subspecies *salvini*, occur South Pacific, ranging E to w. coast South America, where extend N to about 5°S; scarce in s. Indian Ocean though small numbers occur regularly at sea round Iles Crozet (where breeding); rare vagrant to South Atlantic (Prince & Croxall 1983; Jouventin 1990). Subspecies *eremita* found mainly in seas round Chatham Is but ranges to e. and s. coast NZ and central South Pacific; rare vagrant to se. Aust. waters (Harrison 1983; Powlesland 1985; N.P. Brothers).

AUST. Subspecies *cauta*, from Tas. and possibly Auckland Is, occurs from Stradbroke I., Qld, S down e. coast, round Tas., along s. and sw. coasts and N to at least Carnarvon, WA (Swanson 1973; Smyth & Corben 1984; Brothers 1988; D.W. Eades). Beachcast specimens found Fraser I. (Aust. Atlas). More common S of Sydney, through to sw. WA.

In se. Aust., small numbers of *salvini* (Barton 1979; D.W. Eades) and occasional *eremita* (Harrison 1983; N.P. Brothers) also occur.

NZ Subspecies *cauta* and *salvini* regularly found beachcast NI and SI; most *salvini* found W of Wellington, NI, and few in Southland, SI (Powlesland 1985). Subspecies *eremita* found only round Chatham Is and E and S of NZ, rarely near coast (Powlesland 1985; C.J.R. Robertson). A few *salvini* seen at Chatham Is (C.J.R. Robertson); single *cauta* recorded on Snares Is; and a few *eremita* recorded at Snares Is (Miskelly 1984).

BREEDING Population on Albatross I. once large but reduced by collectors of feathers last century; now slowly recovering (Green 1974). Breeding localities as follows:

MOVEMENTS Some populations migratory to waters off South Africa or South America, others remain at or near colonies all year.

DEPARTURE At Auckland Is, young fledge Aug. (Powlesland 1985); apparently most young leave Snares, Bounty and Chatham Is, Apr. (C.J.R. Robertson); young of Tas. population fledge late Mar.–Apr. (N.P. Brothers).

Non-breeding. Adults at Tas. colonies all year; fledged-

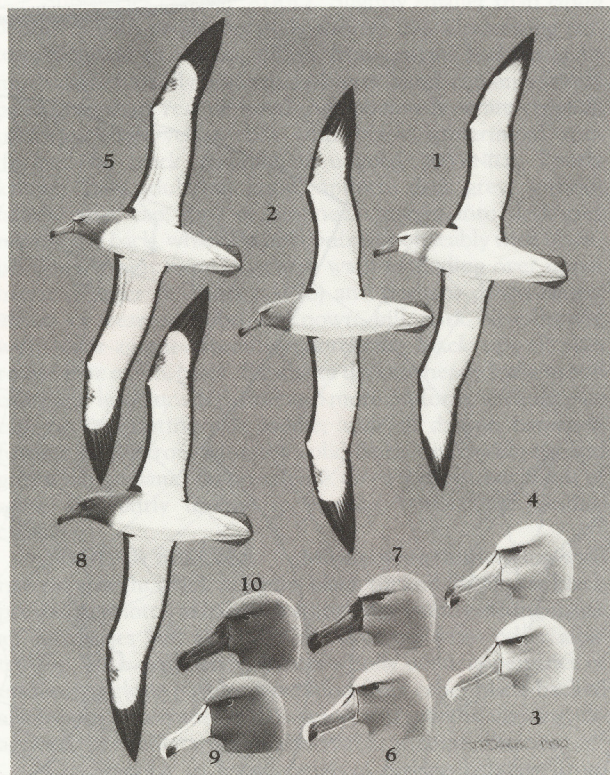


Plate 19

Shy Albatross *Diomedea cauta*

1. Juvenile, subspecies *cauta*, pale, ventral, fresh
2. Juvenile, subspecies *cauta*, dark, ventral, fresh
3. Adult, subspecies *cauta*, head
4. Immature, subspecies *cauta*, head
5. Juvenile, subspecies *salvini*, ventral
6. Adult, subspecies *salvini*, head
7. Juvenile, subspecies *salvini*, head
8. Juvenile, subspecies *eremita*, ventral
9. Adult, subspecies *eremita*, head
10. Juvenile, subspecies *eremita*, head

Table 1. Breeding localities

Locality	Year	Population (pairs)	Ref.	
AUST.	Tas.			
	Albatross I.	1973	1500 nests	1
	Pedra Branca	1978	100	2
	Mewstone	1977	1500-2000	3
NZ	Auckland Is		64 000	4
	Disappointment I.			
	Auckland I.			
	Adams I.			
	Bounty Is	1978	76 000	5
	The Snares			
	Western Chain		1000s	6
	Toru I.			
	Wha I.			
	Rima I.			
	Chatham Is			
	Pyramid Rock		4000	6
ILES CROZET	Ile de Pingouin	1986	4	7

References: (1) Green (1974); (2) Brothers (1979a), *contra* Johnstone *et al.* (1975); (3) Brothers (1979b); (4) Robertson (1975); (5) Robertson & van Tets (1982); (6) C.J.R. Robertson; (7) Jouventin (1990).

lings from Albatross I. appear to move only round s. Aust.

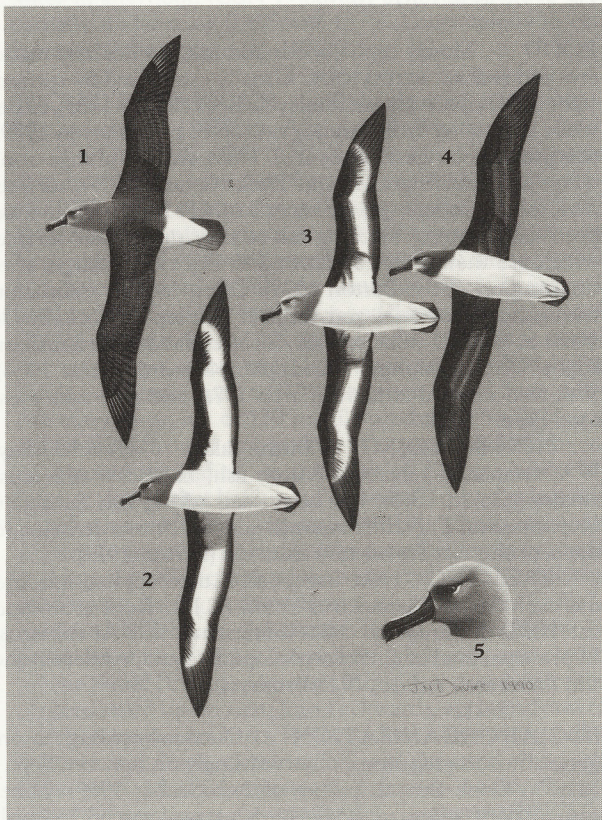


Plate 20

Grey-headed Albatross *Diomedea chrysostoma*

1. Adult, dorsal
2. Adult, ventral
3. Immature, ventral
4. Juvenile, ventral
5. Adult head

where not seen N of Perth in WA; earliest sighting of colour-dyed bird off Albany, May 10, at most 3 weeks after fledging; fledgelings from Mewstone colony move to s. Africa, at least some travelling via sw. Aust. where colour-dyed birds sighted off Carnarvon (Brothers 1988; Lashmar 1990); however, one bird, banded as nestling at Mewstone colony 1 May 1987, recovered near Waikato R. mouth, NZ, 30 July 1989 (Anon. 1990). Few banded recoveries and no sightings of colour-dyed birds from Tas. colonies off NSW (N.P. Brothers). Off se. NSW, the most abundant albatross, present throughout year with peak numbers July–Nov. after which most birds appear to move S to e. Bass Str. (Barton 1979); small numbers present winter and spring off Sydney (Milledge 1977); recorded Stradbroke I., se. Qld, July–Aug. (Smyth & Corben 1984). Records of birds with characters of Tas. and Auckland Is birds from s. Africa in all months but most common, Aug.–Oct. (Summerhayes *et al.* 1974); one young bird banded s. African waters, recovered near banding site a year later and may have remained through summer; another, banded as an adult, recovered there 8 years later (Ross 1986). Movements of birds from Auckland Is poorly known because separation from Tas. birds in field not possible but there is some evidence that at least part of population moves to se. Aust.: abundance of birds with characters of Tas. or Auckland Is subspecies off se. Aust. appears too great to be solely from Tas. population. Several such birds, captured at sea off NZ (possibly Auckland Is birds) were recovered South Africa. Some birds with characters of Tas. and Auckland Is birds move far, adults having been collected Washington State, USA (Slipp 1952) and off S. Georgia (Bourne 1977) and an unaged bird seen in Red Sea (Harrison 1984). In winter most birds from Snares and Bounty Is appear to move to w. South America (Harrison 1983) though present in very small numbers off se. Aust. in all seasons (D.W. Eades); small numbers recorded off South Africa and in Indian Ocean (Bourne 1984; Harrison 1984) where Tas. (and possibly Auckland Is) birds predominate (White 1973; Bourne 1977; Clancy 1978); in South Atlantic, single, adult at S. Georgia, 28 Feb. 1982 banded (later recovered breeding at Iles Crozet) (Prince & Croxall 1983; Jouventin 1990). At Iles Crozet, recorded 1 Apr.–23 Nov. but most present, Sept.–Nov. (Stahl *et al.* 1984). At Chatham Is, sedentary (Harrison 1983) or disperse into central South Pacific, rarely seen coastal NZ (Powlesland 1985; C.J.R. Robertson).

RETURN At Snares Is, birds return Sept.; at

Bounty Is, 7–10 days later (Robertson & van Tets 1982).

BREEDING Peak mortality of Tas. or Auckland Is birds on NZ beaches occurred May–June and Oct.–Dec.; of those from Snares and Bounty Is, Sept.–Dec. and Mar. (Powlesland 1985). Large numbers of Tas. or Auckland Is birds, probably non-breeders, concentrate E of Cook Str., late summer (Bartle 1974).

BANDING Returns from Albatross I. (ABBBS) summarized Fig. 1., from Mewstone (ABBBS), Fig. 2. and from Cook Str. (NZNBS), Fig. 3.

Other records: adult captured and banded S. Georgia later recovered breeding Iles Crozet, 6362 km away (Jouventin 1990); 50S170E 01 1+ U 26 10573 090 NZNBS



Fig. 1. 40S 144E 10X10 ABBBS

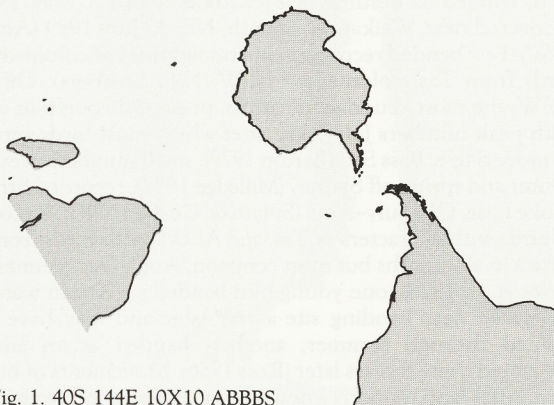


Fig. 2. 43S 146E 10X10 ABBBS



Fig. 3. 41S 174E 10X10 NZNBS

FOOD Mostly cephalopods and fish, particularly mackerel and red bait. **BEHAVIOUR.** Usually catch food by surface-seizing (3/3 observations; Ainley & Boekelheide 1983), either while swimming or by landing on top of prey (Barton 1979); also pursuit-plunge (Harper *et al.* 1985), surface-plunge using wings for propulsion (Gibson 1960; Nicholls 1979), surface-dive, staying submerged for up to 5 s (N.P. Brothers), and has been seen dipping, catching fish as they ripple near surface, which are then either swallowed in flight or, if large, after alighting on water (Barton 1979). Often feed in association with other albatrosses and seabirds (Ainley & Boekelheide 1983) as well as pilot whales *Globiocephala* and Southern Right Whale Dolphins *Lissodelphis peronii* (Enticott 1986). Will feed on offal at night (Bartle 1974) and may take most food then.

NON-BREEDING Birds taken Recherche Bay, WA, contained remains of large fish, barnacles and crustaceans (Gould 1865); has been seen taking fish *Sardinops neopilchardus*, *Engraulis australis* and *Trachurus declivis* and the cephalopods *Sepioteuthis australis* (Barton 1979).

BREEDING At Campbell I. take euphausiids and the cephalopod *Nototodarus sloani* (C.J.R. Robertson) and fish heads of *Paraperchias colias* (Sorensen 1950). At Albatross I., principal food of chicks cephalopods (squid, cuttlefish) and fish (mackerel, red bait; N.P. Brothers).

SOCIAL ORGANIZATION Outside breeding season, generally non-gregarious; observed singly or, between Sept.–Mar. in Cook Str., in parties of 2–3 (Secker 1969). Other observations often of single birds at well-spaced intervals (Gibson 1960; Green & Mollison 1961). Parties of up to 12 seen Cook Str., Apr.–Aug. (Secker 1969). May congregate in numbers (up to 20) at boats (Green & Mollison 1961). Feeding flocks of up to 60 birds may form (Hindwood 1955), often in association with other seabird species (and other marine life e.g. dolphins, barracouta, fur seals) (Barton 1979).

BONDS No information. Both parents take turns at

nest; when one on nest, mate often sits close beside (Le Souëf 1895). Nestlings fed after soliciting food from adults (Miskelly 1984).

BREEDING DISPERSION Colonial; may be as few as six nests (MacDonald & Green 1963). Nests often occur in groups within colony (Armstrong 1910; Brothers 1979a) but a few may be isolated (Armstrong 1910; MacDonald & Green 1963). Densities unrecorded; a section of colony on Albatross I. (230x35 m) contained 500 nests (MacDonald & Green 1963). Distance between nests varies; some close together (just beyond pecking reach) 30–100 cm apart (Le Souëf 1895; Armstrong 1910; MacDonald & Green 1963), or well dispersed. On Pyramid Rock, closely packed (Dawson 1973) and on Pedra Branca, nests gradually become spread out (Brothers 1979a). Territorial round nest-site: when walking through colony, a bird is lunged at by each sitting bird it passes (Le Souëf 1895); returning birds usually land near or beside their own nest (Green 1974).

ROOSTING Communal roosting at breeding colonies, where adults congregate in sheltered areas away from nests (Kurth 1951; Sagar 1977). In late afternoon, adults begin arriving in preparation for roosting: areas away from nests fill up; both parents return to rest each night. After dark, area crowded with adults (Johnstone *et al.* 1975). Some apparently come ashore only to rest. Congregations observed sitting on water in afternoon (CSN 19). Sleep with head turned back, partially under wing (Le Souëf 1895). Leave colony in early morning (Johnstone *et al.* 1975).

SOCIAL BEHAVIOUR Only detailed study that of Johnstone *et al.* (1975) on Albatross I., Bass Str.

AGONISTIC BEHAVIOUR Small area round nest defended by sitting bird against passers-by (Johnstone *et al.* 1975): lunge at intruder with open beak (Le Souëf 1895). **THREAT.** In agonistic encounters between several birds, may bow with head and neck tilted downwards, tail spread and mandibles vibrated rapidly. As display increases in intensity, head and neck quickly bobbed up and down. Accompanied by rapidly pulsed neighing call lasting c. 6 s. In defence of nest-site, may **Gape:** stands erect with neck outstretched, tail expanded and beak open to 90°; head then tossed from side to side through an arc of 120°, while producing harsh bleating call for c. 2 s. Strip of orange skin, from gape to below eye, may be exposed depending on intensity of display. Adults may Gape at a chick that has lunged at them. Threat displays occasionally intensify into vigorous **FIGHTS**, where opponents attempt to grapple with and pull one another to the ground by pecking and locking beaks (Johnstone *et al.* 1975). Adults may use Gaping display to drive away scavenging Silver Gulls *Larus novaehollandiae* (Johnstone *et al.* 1975). When approached at nest, parent sits tightly, glowering and clashing bill (Le Souëf 1895; Armstrong 1910). Closer approach causes adult to stand up on nest, lean backwards, apparently on tail, and face intruder. Utters loud cackling noise while shaking head up and down, clattering bill and exposing orange skin from gape. May regurgitate as defensive action. Remains seated on nest, even after eggs stolen (Le Souëf 1895). When young approached at nest, behave similarly: stand erect, facing intruder and clattering bill. May regurgitate oily liquid accurately for over a metre (Fleming 1939; MacDonald & Green 1963; Miskelly 1984). **Bowing** may be used to show ownership of nest-site; perhaps also used by subadults when approaching and occupying empty nests (Johnstone *et al.* 1975). **SUBMISSIVE POSTURE** consists of hunched body, head

and neck retracted and tail spread away from opponent, accompanied by rolling or waddling gait; adopted by those that lose agonistic encounters and those unavoidably passing close to sitting birds (Johnstone *et al.* 1975).

SEXUAL BEHAVIOUR All displays occur on ground, but occasionally individuals hover in strong up-draughts, attracting attention of others in colony (Johnstone *et al.* 1975). **Bowing** may occur in **GREETING:** when two adults meet one another; or on approaching chick on return to colony, possibly enabling chick to recognize its parent (Johnstone *et al.* 1975). **ALLOPREENING.** Bird leans toward another, with tail expanded and neck stretched forward, and **Bill Pointing** at base of the other's bill. If other bird responds favourably, **Bill Aligning** may occur, where bills positioned side-by-side, tip to base. May be followed by **Bill Touching**, involving light contact between bills, and nibbling of gape and underside of bill. One bird may preen head and neck of other, which presents its head to its partner with eyes closed. Occasionally one bird may bill point, align bill and bill touch, then retract, allowing second bird to reciprocate actions. Assumed to be used in pair-bonding, but occasionally involves three or more birds (Johnstone *et al.* 1975). Sometimes display interrupted by bird placing bill at front edge of folded wing, or preening back or flank. Head then held above its back, and wings raised slightly to hide down-pointing beak. Sometimes accompanied by chuckling noise. Bird then resumes display. Gaping displays occasionally concluded in this manner (Johnstone *et al.* 1975). On Snares Is, a *D.c. cauta* observed displaying with a group of non-breeding *D.c. salvini* (Miskelly 1984). At sea in South African waters, observed rubbing bills with Black-browed Albatross *D. melanophrys* (Cooper 1974).

RELATIONS WITHIN FAMILY GROUP Upon return to nest, parent greets young with Bowing accompanied by soft calls. May then preen round chick's gape. Chick gradually becomes more active, rapidly pecking parent's bill tip, uttering high repetitive *ma-ma-ma* call to stimulate feeding. When adult begins regurgitation, chick places its bill inside and across parent's, near base of tongue, scooping up food. Adults rest after 3–4 regurgitations, despite constant pestering by chick (Johnstone *et al.* 1975). Both parents feed young. On warm days, adults may help thermoregulation of chick by standing up and leaning back, possibly to allow cross-draughts to cool young (Le Souëf 1895).

VOICE Not well known. No detailed studies. Some information from Johnstone *et al.* (1975) and Warham & Fitzsimons (1987; including sonagrams); some information supplied by C.J.R. Robertson. Usually silent at sea except harsh croaking when squabbling over food; noisy at breeding colonies, uttering croaking and cackling calls. Form and range of calls similar to those of other small albatrosses (Warham & Fitzsimons 1987) but details not known; Croak, Groan, and Wail reported; Warham & Fitzsimons (1987) specifically describe Croak and Groan; Johnstone *et al.* (1975) also describe Wail and several non-vocal sounds. No information on sexual or individual differences. Some evidence of geographical differences between subspecies but detailed study needed: calls of *salvini* among *eremita* at Pyramid Rock, Chatham Is, were obviously different (C.J.R. Robertson). Non-vocal sounds: clashing, closing or rattling bills.

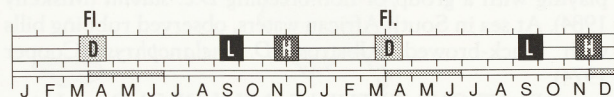
ADULT Croak. Neighing or braying croak composed of series of rapidly repeated notes; c. 7–8 notes per second between 0.25 and 4 kHz (one sonagram; Warham &

Fitzsimons 1987); duration 6.1 s (1.1–10.0; 15) (Johnstone *et al.* 1975); given by adults approaching chick on nest, as greeting and before many displays, including agonistic. **Wail.** Probably equivalent to loud harsh strident *baaing* of Johnstone *et al.* (1975); duration 2.1 s (1.0–3.7; 15); no details given by Warham & Fitzsimons (1987) but all small albatrosses have Wail. Given during Gaping display, in agonistic circumstances. **Groan.** Low-frequency, low-amplitude calls; probably equivalent to low hollow croaking described by Johnstone *et al.* (1975); c. 2 s duration, fading to quiet gurgle at end; given during Scapular Action and when greeting chick at nest. **NON-VOCAL SOUNDS.** During Bowing display, birds vibrate mandibles rapidly. Hollow-sounding **Bill-clop** as threat.

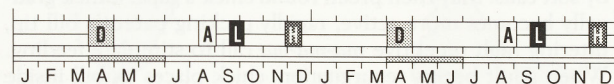
YOUNG Two calls reported: a repeated harsh *ma-ma*... when begging for food and a deeper more guttural repeated note when being fed. When threatened, **Bill-clop**: hollow sounding clop as bill closed (Johnstone *et al.* 1975; Miskelly 1984).

BREEDING Poorly known. No detailed studies. Information supplied by J.R. Starks. Breed colonially; at some colonies mingled with Australasian Gannets *Sula serrator*.

SEASON Round Tas., eggs from mid-Sept.; hatching late Nov.–early Dec. (Johnstone *et al.* 1975). Chatham Is: adults arrive late Aug.; laying mid-Sept.–early Oct. (Dawson 1973). Bounty Is: hatching mid-Nov. and so, laying probably early Oct. (Oliver; Robertson & van Tets 1982). Fledging late Mar.–early Apr.



a) Tas. (Fl.D. – departure of fledgelings only)



b) Chatham I.

SITE On slopes, cliffs and ledges, under overhangs, in crevices between boulders; on Auckland Is, on slopes vegetated with *Ligusticum*, *Anisotome*, *Kirkophytum*, and *Pleurophyllum* (Oliver). On Bounty Is, mean density of nests on flat ground, 1 nest/1.9 m² (Robertson & van Tets 1982). Nests in open colonies on sheltered sides of islands (Miskelly 1984); from 15 m asl upwards (Brothers 1979b).

NEST, MATERIALS Conical mound of mud, guano, rock fragments, feathers, plant material, fish and bird bones, lined with fine material (Oliver; Miskelly 1984; MacDonald & Green 1963); varies from solid column on flat sites to small lip on sloping rocks (Robertson & van Tets 1982). Dimensions: c. 45 cm high; c. 35 cm diameter; c. 20 cm width of bowl (Oliver); at Snares Is (35 nests): diameter, 37 cm; depth 35 mm; nests 1.2 m apart; density 1 nest/1.9 m² (Robertson & van Tets 1982). Adults build by reaching out, picking up material from nearby and dropping it on the rim of nest; may collect mud from 2 m away. Chicks maintain nest by similar methods but do not leave nest to gather material (Johnstone *et al.* 1975). Nests re-used annually and layers of dead chicks from previous seasons sometimes visible (Robertson & van Tets 1982).

EGGS Elliptical; rough textured, mat; white, flecked with reddish brown at blunt end (Fleming 1939; Oliver).

MEASUREMENTS:

Albatross I, Tas.: 106 (95–121; 34) x (67; 60–94) (HASB); Snares Is: 102.6 (4.1; 96–109; 8) x 66.5 (1.0; 68–68.5) (Sagar 1977);

Bounty Is: 103.6 (3.4; 100–107; 4) x 67.6 (1.4; 66–69) (Oliver); Snares, Bounty Is: 104 (4; 42) x 67 (Robertson & van Tets 1982)

Chatham Is: 100.9 (2.9; 97–104.5; 6) x 67.8 (2.0; 65–68.5) (Fleming 1939);

Chatham Is: 102 (4; 74) x 67 (Robertson & van Tets 1982)

Auckland Is: 106 (4.3; 100–110; 4) x 71 (1.7; 69–73) (Oliver).

WEIGHTS: 238 (188–270; 6) (Campbell).

CLUTCH-SIZE One.

LAYING No data but probably synchronized (see above).

INCUBATION By both sexes in alternate shifts; average complete shifts 4.2 days (1–7; 52). Pipping to emergence, 5 days. No further information. **INCUBATION PERIOD:** 72 days (68–75; 15) (Robertson & van Tets 1982).

NESTLING Altricial, nidicolous. Hatched in down, dirty white, light ashy-grey; pale slaty-grey later (Oliver). Adults guard chick for some time after hatching, gradually leaving it alone for longer periods, once it can sit up and defend itself (Fleming 1939; Brothers 1979b). Fed by incomplete regurgitation by both parents; bout of feeding consists of 3–4 meals (Johnstone *et al.* 1975). Independent of parents when fledged. No further information on growth, fledging to maturity, or success.

PLUMAGES Nominate *cauta* (based in part on information supplied by D.W. Eades).

ADULT Age at first breeding unknown. **HEAD AND NECK.** Forehead and crown, white. Hindneck, mostly white, but may be suffused with light grey (85), extending to foreneck as collar; with wear, light-grey (85) tips largely lost, exposing white bases of feathers. Lores, grey (84), merging to grey-black (82) posteriorly and forming loreal stripe which extends short distance past eye. At lower hind margin of eye, narrow crescent-shaped line of sharply contrasting, white feathers. Malar region and ear-coverts, light grey (85), diffuse on upper and lower margins and lost with wear, thus giving some birds mostly white head. Chin and foreneck, white. **UPPERPARTS.** Upper mantle, rump and tail-coverts, white. Lower mantle and back, grey (84), fringed light grey (85); basal half of feathers, white; rachis, white at base, merging to brown-grey (79) distally; feathers become dark brown (121) with wear; fringes, dark brown (119A). At demarcation between back and rump, feathers diffusely tipped brown-grey (79). Scapulars, black-brown (119). **TAIL,** grey (84); inner webs of rectrices slightly paler; rachis, dull cream (c54); when worn, dark brown (121). **UPPERWING.** Remiges, black-brown (119). Rachis of primaries, dull white at base, merging to grey-black (82) distally; dull-white primary shafts obvious when wing outstretched. All coverts, dark brown (121), fringed slightly paler. Alula, dark brown (121). Concealed basal inner webs of greater coverts, secondaries and tertials, white; rachis, white; largest tertials, broad with rounded webs. **UNDERPARTS,** entirely white, including axillaries. **UNDERWING.** Remiges, dark brown (121) with inner webs of primaries, white for three-quarters length; distal quarter, pale dark-brown (121), extends as narrow edge along inner web; white inner webs form large white wedge over basal three-quarters of primaries. Some birds have white on inner webs of primaries reduced and not so sharply demarcated from pale dark-brown (121) on rest of

feather; results in shorter duller pale wedge covering only bases of primaries. Lining, mostly white; marginal coverts along leading-edge of wing and outermost median and lesser primary coverts, dark brown (121) forming dark leading-edge; usually, some marginal coverts, from inwards of elbow to dark pre-axillary notch, white; innermost marginal coverts and first row of lesser coverts nearest body, dark brown (121), forming diagnostic small rectangular pre-axillary notch. Some individuals have marginal coverts, from inwards of elbow to pre-axillary notch, dark-brown (121) forming wholly dark leading-edge. Some innermost greater coverts, white, tipped pale dark-brown (121).

DOWNY YOUNG Protoptile, dull white. Mesoptile thicker, and white; down shorter on side of face, forming mask.

JUVENILE Differs from adult in: **HEAD AND NECK.** Amount of grey varies. Darkest have head and neck, largely dark brown-grey (79), forming dark hood; faintly paler greyish-white round base of bill, on chin and centre of upper throat; forehead, greyish-white (-), merging into dark brown-grey (79) of crown. Palest have head mostly white with dark brown-grey (79) collar tapering from hindneck to midline of foreneck; collar reduced by wear. Gradation between extremes. **UNDERWING.** Inner web of p10, dark brown (121); inner webs of rest, mostly white, like adult, forming large white wedge over basal three-quarters of primaries. On others amount of white on inner webs, reduced, less sharply defined, forming shorter duller diffuse pale wedge covering bases of primaries (clearest on p9 and p8, contrasting with dark p10). Dark leading-edge usually continuous, connecting with pre-axillary notch. Some lesser primary coverts adjoining black leading-edge, mid-way between carpal joint and base of p10, grey, forming small dusky patch; not always present or faint.

SUBSEQUENT PLUMAGES (IMMATURE) Plumages represent a gradual whitening of crown, hindneck and foreneck; often a narrow collar on foreneck present. Most birds have grey malar area; in others, white; this character either varies according to wear or is a feature of immaturity (Johnstone *et al.* 1975). Full adult plumage attained in either fourth or fifth year at sea (D.W. Eades).

BARE PARTS Based on photos in Simpson (1972), NZRD, Lindsey (1986), Fraser (1986) and unpublished (C. Fraser; S. Markham-David; D.W. Eades), except where stated.

Nominate *cauta*.

ADULT Iris, dark brown (219). Culminicorn, light grey (85) sometimes suffused straw-yellow (57) at base. Maxillary unguis and distal half of mandibular unguis, straw-yellow (57); basal half, grey (84) with light blue-grey (88) shade. In some birds, mandibular unguis, black, later reduced to smaller dark grey spot as yellow appears on distal half of unguis. Johnstone *et al.* (1975) said that birds with this spot had plumage characters associated with immaturity; however, recent photos of birds in full adult plumage breeding Albatross I. (S. Markham-David) show some have this spot. Latericorn and ramicorn, grey (84) with light blue-grey (88) shade. Tomia, pale-grey (86). Fleshly skin round base of culminicorn, between culminicorn and latericorn (extending forward to nostrils) and at base of upper mandible, grey-black (82). Narrow fleshy strip of salmon (106) skin extends along base of lower mandible to gape. Strip of salmon (106) skin extends from gape across malar area to ear-coverts, c. 40 mm, forming

cheek-stripe which is exposed during display and when feeding chicks (Johnstone *et al.* 1975). Legs and feet, light blue-grey (88); joints and webs, grey (87); pink veins often visible on webs and tarsus.

DOWNY YOUNG Iris, black-brown (119). Bill, grey-black (82). All fleshy skin round bill, black (89); fleshy skin extending to ear-coverts exposed.

JUVENILE Iris, black-brown (119). Ungues, black-brown; base of culminicorn and latericorn (behind nares), black-brown, forming saddle (119), which is obvious in fledglings, but quickly lost at or following departure. Rest of bill, dark olive-brown (129); after departure, soon becomes paler blue-grey. Legs and feet, dark grey.

SUBSEQUENT PLUMAGES (IMMATURE) Changes of bare parts with age, poorly known. Field observations of colour-banded birds of known age (D.W. Eades; M.J. Carter) give indication of sequence of changes of bill-colour. First significant changes from juvenile appearance occur during second year at sea: tip and sides of maxillary unguis turn dull yellow, leaving ridge of maxillary unguis and mandibular unguis, black. Between second and fourth years: side-plates and culminicorn become paler greyish-horn; yellow areas on maxillary unguis become brighter and larger; black on ridge of unguis becomes paler dusky and smaller; vertical strip of bare skin at base of lower mandible turns dull orange by early in third year. Mandibular unguis, remains black or with paler greyish-black spot after rest of bill and plumage fully adult. Unknown at what age full adult bill-colour attained. Changes in iris, legs and feet, unknown.

Subspecies *salvini*.

ADULT Culminicorn and maxillary unguis, ivory-horn; on some, slightly yellow at base; sides of basal half of maxillary unguis, olive-brown (29) (reduced or lacking on some). Latericorn and ramicorn, light brown-grey (44) with grey-olive (43) tinge; narrow strip along bottom of ramicorn, ivory-horn. Mandibular unguis, black-brown (119). Narrow strip of skin round base of culminicorn, between culminicorn and latericorn (extending forward to nostrils) and at base of upper mandible, black (89). Narrow strip of orange (17) fleshy skin adjoining proximal ramicorn, bordered by black (89) skin. Strip of orange (17) skin extends from gape across malar area to ear-coverts, forming cheek-stripe which is exposed during display and when feeding chicks.

DOWNY YOUNG Undescribed.

JUVENILE Similar to nominate subspecies.

SUBSEQUENT PLUMAGES (IMMATURE) Undescribed; said to be like adult but bill greyer with black tip to both mandibles (Harrison 1985).

Subspecies *eremita*.

ADULT Culminicorn, orange-buff (118). Latericorn, ramicorn and maxillary unguis, straw-yellow (57). Mandibular unguis, black-brown (119). Narrow strip of skin round base of culminicorn, between culminicorn and latericorn (extending forward to nostrils) and at base of upper mandible, black (89). Narrow strip of orange (17) fleshy skin adjoining proximal ramicorn, bordered by black (89) skin. Strip of orange (17) skin extends from gape across malar area to ear-coverts, forming cheek-stripe.

DOWNY YOUNG Undescribed.

JUVENILE Largely unknown. Label data (NMNZ): Iris, dark brown. Bill, dark olive-brown with unguis, black. Legs and feet, fleshy white.

SUBSEQUENT PLUMAGES (IMMATURE) Undescribed. Photos of a bird with adult bill except for sides of

basal half of maxillary unguis, olive-brown (29), may represent older immature.

MOULTS Based on data from D.S. Melville (derived from museum skins), except where stated.

ADULT Primaries moult outwards in staffelmauser. In NZ, birds undergoing moult in Apr. and June. Beachcast birds in NZ in Apr. in moult with primaries missing, or incompletely renewed, and body-moult half-complete (Kinsky 1968). Similarly, birds beachcast May–June in moult (Powlesland 1985). Brooke (1981) gives monthly occurrence of moult, as Apr., June, July and Oct. Stresemann & Stresemann (1966) recorded a *salvini* from Peru in primary moult during Mar. Kinsky (1968) recorded birds in full moult during Feb.; these birds were not moulting primaries on subsequent examination of skins (D.S. Melville). Most beachcast *salvini* moulting in Mar. (Powlesland 1985). Not known whether there are subspecific differences in moult-strategies. Failed breeders probably moult earlier than successful breeders (Brooke 1981).

Post-juvenile. Undescribed. Based on a skin of known age at ARI, feather wear of wing uniform; moult probably occurs when >1 year old.

MEASUREMENTS (1) Nominate *cauta*: live adults; methods unknown (C.J.R. Robertson). (2) Nominate *cauta* from Auckland Is: live adults; methods unknown (C.J.R. Robertson). (3) Subspecies *salvini*: Bounty Is; methods unknown (Robertson & van Tets 1982). (4) Subspecies *eremita*: live adults; methods unknown (C.J.R. Robertson).

	MALES	FEMALES
WING	(1) 562.0 (535–590; 18) (2) 607.0 (595–622; 6) (3) 577.0 (555–600; 17) (4) 570.0 (550–586; 13)	557.0 (545–570; 18) 585.0 (569–595; 7) 574.0 (555–590; 12) 560.0 (537–572; 10)
BILL	(1) 133.0 (128–138; 18) (2) 138.5 (136–141; 6) (3) 129.0 (124–135; 17) (4) 121.7 (116–130; 13)	127.0 (122–132; 18) 131.4 (126–139; 7) 127.0 (123–135; 12) 119.8 (113–124; 10)
TARSUS	(1) 94.3 (88–98; 18) (2) 97.3 (91–104; 6) (3) 92.0 (85–95; 17) (4) 89.5 (84–96; 13)	89.5 (86–92; 18) 95.6 (92–101; 7) 90.0 (87–95; 12) 86.0 (81–90; 10)
TAIL	(1) 221.0 (211–230; 18) (2) 233.0 (227–242; 6) (3) 222.0 (210–235; 17) (4) 236.0 (221–248; 13)	218.0 (210–225; 18) 223.0 (213–238; 7) 219.0 (210–228; 12) 222.0 (214–234; 10)
TOE	(1) 139.0 (134–144; 18) (2) 143.8 (137–147; 6) (3) 139.0 (130–148; 17) (4) --- (120–139; --)	132.0 (125–138; 18) 135.5 (134–139; 7) 135.0 (130–145; 12) --

WEIGHTS (1) Nominate *cauta*: live adults; methods unknown (C.J.R. Robertson). (2) Nominate *cauta* from Auckland Is: live adults; methods unknown (C.J.R. Robertson).

	MALES	FEMALES
(1)	4.35 (3.9–5.1; 18)	3.70 (3.2–4.4; 18)
(2)	4.43 (3.3–5.3; 6)	3.45 (2.6–4.2; 7)
(3)	4.00 (3.3–4.9; 17)	3.59 (3.3–3.7; 12)
(4)	4.00 (3.6–4.7; 13)	3.77 (3.1–3.9; 10)

land Is: live adults; methods unknown (C.J.R. Robertson). (3) Subspecies *salvini*: Bounty Is; methods unknown (Robertson & van Tets 1982). (4) Subspecies *eremita*: live adults; methods unknown (C.J.R. Robertson).

No data on seasonal changes. Details of changes of *salvini* chicks, in Robertson & van Tets (1982).

STRUCTURE Wing, long and narrow. Eleven primaries: p10 longest, p9 8–16, p8 28–49, p7 65–92, p6 112–136, p5 162–210, p4 217–245, p3 c.275, p2–1 no data. No emarginations. About 24 secondaries. Ten humerals. Tail rounded; 12 rectrices, t1 longest, t6 c. 25 mm shorter. Interramal space feathered. Under tail-coverts end c. 20 mm short of tip of tail. Bill, deep at base; laterally compressed and tapering distally; culmen, slightly curved in profile; maxillary unguis, hooked. Nares, operculate; pointing slightly upwards and situated one-quarter the length of bill, in groove of culminicorn and latericorn. Shape and extent of naricorn differs between subspecies. Tarsus, slender; feet webbed. Claws, long and slightly curved. Outer and middle toes about equal in length, inner c. 87% of middle; hind toe absent.

GEOGRAPHICAL VARIATION Three subspecies recognized: *cauta*, *salvini* and *eremita* (Peters). A fourth subspecies, *steadii*, from Auckland Is, proposed by Falla (1933) but doubtfully separable from *cauta* and validity requires study. Said to differ from *cauta* in having longer wing (>600 mm) and averages larger in most measurements (see Measurements); grey wash on cheeks, faint or absent; white cap much less pronounced; bill more brightly coloured, almost uniform bluish-horn except for pale yellow tip (Falla 1933; C.J.R. Robertson); however, recent photos of birds breeding Auckland Is (*steadii*) show they have bill seemingly identical to *cauta*.

ADULT. Subspecies *salvini* differs from *cauta* in: head and neck mostly uniform light grey (c85), forming hood; wholly dark underside to primaries (Vooren 1973; Harper & Kinsky 1978) and so without white wedge on wing-tip; bill, slightly darker, more olive-grey with contrasting pale ivory culminicorn and ramicorn stripes; always retain blackish mandibular spot (for further differences see Bare Parts). Adult *eremita* distinctive; differs from *cauta* and *salvini* in: slightly smaller with shorter bill; head and neck, much darker (dark grey; c83), with only faintly paler cap; bill, mostly bright yellow. Further, differs from *cauta* in wholly dark underside to primaries and so without white wedge on wing-tip (like *salvini*).

JUVENILE. Subspecies *salvini* differ from *cauta* in: grey extends from hood onto anterior flanks; wholly dark underside to primaries and so without white wedge on wing-tip; on inner underwing, some (possibly all) have first few rows of lesser coverts behind leading-edge tipped grey forming narrow zone of grey smudging on otherwise white lining. Juvenile *eremita* has same pattern of under wing-tip as *salvini* but differs from it and *cauta* by: much darker, uniform dark-grey hood (without pale cap); some have unique grey wash extending over upper breast and perhaps down flanks; bill, darker, dark olive-brown.

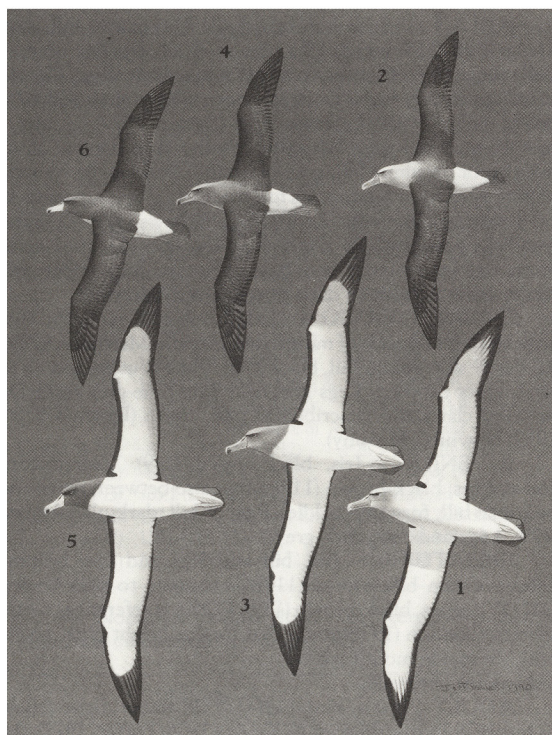
IMMATURE. Plumages and bare parts of subspecies and differences between them, poorly known. Subspecies *salvini* differs from *cauta* in: full, grey hood merging into grey saddle (without pale hindneck collar); and difference in wing-tip as in adults. Immature *eremita* essentially undescribed; at least older immatures should show much yellow in bill, which, combined with much darker hood, would separate from *sal-*

vini; these characters, together with wholly dark under wing-tip, would separate from *cauta*.

Based on morphological and ecological differences, suggested that *cauta*, *salvini* and *eremita* be given specific status (C.J.R. Robertson).

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Volume 1 (Part A), Plate 18

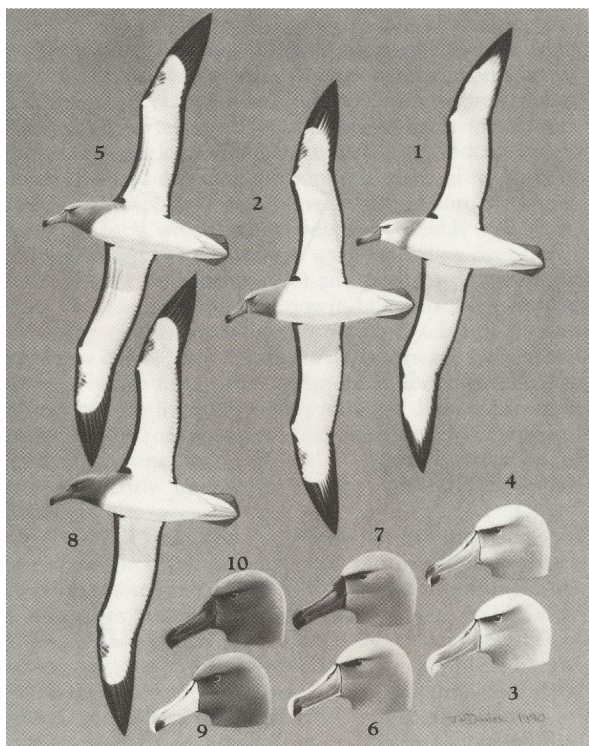
Shy Albatross *Diomedea cauta*

1. Adult, subspecies *cauta*, ventral
2. Adult, subspecies *cauta*, dorsal
3. Adult, subspecies *salvini*, ventral
4. Adult, subspecies *salvini*, dorsal
5. Adult, subspecies *eremita*, ventral
6. Adult, subspecies *eremita*, dorsal

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Volume 1 (Part A), Plate 19

Shy Albatross *Diomedea cauta*

1. Juvenile, subspecies *cauta*, pale, ventral, fresh
2. Juvenile, subspecies *cauta*, dark, ventral, fresh
3. Adult, subspecies *cauta*, head
4. Immature, subspecies *cauta*, head
5. Juvenile, subspecies *salvini*, ventral
6. Adult, subspecies *salvini*, head
7. Juvenile, subspecies *salvini*, head
8. Juvenile, subspecies *eremita*, ventral
9. Adult, subspecies *eremita*, head
10. Juvenile, subspecies *eremita*, head

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