

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: Diomedeidae 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 PROCELLARIIDAE fulmars, petrels, prions, shearwaters

The family Procellariidae represents the main radiation of medium-sized 'true petrels', characterized by having united nostrils with a median septum and the outer functional primary at least as long as the next. It tends to be dominant among the birds of the Southern Ocean, though in the n. hemisphere the Charadriiformes are more numerous. The giant-petrels *Macronectes* have also developed as large scavengers and predators, showing some convergence in appearance and behaviour with the Diomedidae. The Procellariidae may be divided into four main groups with some intermediate species, which makes it hard to draw distinctions between them.

(1) The fulmars *Macronectes*, *Fulmarus*, *Thalassoica*, *Daption* and *Pagodroma* consist of seven species of surface predators and filter-feeders of rather varying structure and appearance (Voous 1949) that breed in high latitudes but may migrate along cool currents into much lower ones. *Fulmarus* appears to have colonized the n. hemisphere in the Tertiary. Six of the seven species are essentially confined to our region.

(2) The gadfly-petrels *Pterodroma* are a large series of some 30 agile species; 16 breed in our region and another six occur rarely or rather rarely. Their short sturdy bills are adapted for seizing soft prey at the surface, and their twisted intestines, for digesting marine animals with an unusual biochemistry, which are also found throughout the warmer oceans (Imber 1985). They show complex markings of face and wings that must serve as interspecific recognition-marks (Murphy & Pennoyer 1952). Some species placed in this group have an intermediate structure and intergrade with all other groups distinguished here: *Pterodroma (Lugensa) brevirostris*, which moves S in winter, has distinctly big eyes like *Pagodroma*; *Halobaena caerulea* has a plumage similar to that of prions; *Bulweria* has some structural resemblance to shearwaters. At present it is difficult to determine their precise relationships.

(3) The prions *Pachyptila* are a specialized group of six (perhaps five) very numerous species, all in our region, that show a progressive adaptation of a small, agile, cryptically coloured, fulmarine form for filter-feeding on zooplankton. There has been dispute over their classification (Cox 1980; Harper 1980) but the arrangement discussed by Fleming (1941) seems best except that the Broad-billed Prion *P. vittata* appears to intergrade with Salvin's Prion *P. salvini* through *macgillivrayi* of Ile St Paul; so they may be better treated as subspecies of the same species.

(4) The shearwaters *Procellaria*, *Calonectris* and *Puffinus* include some 20 agile species with long bills adapted to catch prey more or less under water throughout the warmer seas (Kuroda 1954); 13 species breed in our region, some migrating into the n. hemisphere; six others are chance or perhaps regular visitors. From the fossil record (Brodkorb 1963; Olson 1975); they seem to have been particularly common in the great Tethys Ocean of the middle latitudes of the n. hemisphere in the Tertiary, so this development of aquatic habits may have occurred there without competition from penguins with a subsequent return S by the more successful forms.

General features of the family are: body, ovate, or elongate in shearwaters; wings, long and narrow, 11 primaries, p10 longest, p11 minute; 20-29 secondaries, short, diastataxic; tail, short, 12 feathers; bill, heavy (*Macronectes*), slender (shearwaters), broad (prions) or stubby (gadfly-petrels), hooked, formed of several horny plates; nostrils in dorsal tube of varying length; legs set far back, laterally flattened but round in gadfly-petrels; three toes, webbed, hind toe vestigial, raised. Oil-gland feathered. Peculiar musky odour. Sexes similar, male usually larger than female. Plumage, black or grey above, white below, or all dark; light and dark morphs in some species. Juveniles and immatures usually like adults.

Cosmopolitan throughout the oceans, essentially pelagic; more abundant in cool or cold waters rich in plankton and mostly away from ice. Swim well but usually aerial except when feeding or resting. Fly with alternate swooping and flapping action close to the surface but often arcing high in some gadfly-petrels. Gait on land, a shuffling crouch, being unable to walk properly with feet set so far back; generally avoid open areas on land, being thus vulnerable to predators. Nest colonially; for the most part in burrows and cavities in all sorts of terrain, sometimes far from the sea and in mountainous areas but some species, e.g. *Macronectes*, nest on open ground. Hole-nesters usually nocturnal at colonies, when often extremely vocal, though generally silent at sea. Migratory and dispersive. Some species divide the year between s. and n. hemisphere, often migrating in large flocks that may settle on the sea in huge dense rafts. Feed mostly on fish, cephalopods and crustaceans obtained by flight-feeding, plunge-diving, surface feeding, surface-diving and underwater pursuit; hydroplaning (Murphy) is a characteristic method used particularly by prions.

Probably all defend small nesting territories to which they return regularly while undisturbed; certainly so in some hole- and burrow-nesting forms. Agonistic and sexual behaviour of nocturnal, hole-nesting species very poorly known but generally seem to have little specialization for visual displays. Tactile actions such as allopreening and billing used but olfactory and vocal communication is probably important. Breeding is usually seasonal, generally with synchronized laying, often after a pre-laying exodus but some may not nest annually; some have shorter

cycles or nest continually. For the most part, little attempt to make substantial nests. Eggs, ovate, mat, white. Clutch-size, invariably one; single-brooded; no replacement laying. Incubation by both sexes in alternate spells of 1-11 days. Single median brood-patch. Incubation period, 45-55 days. Eggshells probably always trampled in nest. Young, semi-altricial, nidicolous; hatched in down. Rarely left alone in nest for first 1-2 weeks. Cared for and fed by incomplete regurgitation by both parents. Nestling period generally shorter in cliff- and ledge-nesting species than in hole-nesters. Young attain greatest weight, often well above that of adult, some days before fledging, by which time weight has been reduced to about the same as an adult, but no clear evidence that young are totally deserted for last few days in nest. Adults and young of most species liable to eject stomach-oil in defence. Young independent at fledging. Maturity reached at minimum of 3-4 years, in some 6-12 years.

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Procellaria aequinoctialis **White-chinned Petrel**

COLOUR PLATE FACING PAGE 561

Procellaria aequinoctialis Linnaeus, 1758, *Syst. Nat.*, ed. 10: 132, based on 'The Great Peteril' of Edwards, 1747, *Nat. Hist. Birds*: 89 — Cape of Good Hope. Type from South Georgia, *vide* Dabbene, 1923, *Hornero* 3: 5.

The generic name is a modern adjectival form of the latin word for a storm (*procella*) and gives the meaning of 'creatures of the storm' as is appropriate.

OTHER ENGLISH NAMES Cape Hen, Shoemaker, Spectacled Petrel.

Cape Hen could cause confusion with *D. capense*. **Spectacled Petrel** is appropriate only for one subspecies. **Shoemaker**, traditional among seafarers and whalers, originated because the bird 'sits in his shop and sings' (Murphy), which refers to the great noise produced by the species from its nesting burrows. However, the name is uninformative and best disregarded for a descriptive epithet (**White-chinned**), even if the feature is not too obvious in the field.

POLYTYPIC Nominate *aequinoctialis* breeds Falkland Is, S. Georgia, Prince Edward, Marion Is, Iles Crozet, Iles Kerguelen, Auckland, Campbell and Antipodes Is; perhaps also Gough I.; *conspicillata* Gould, 1844, breeds only Inaccessible I., Tristan da Cunha Grp in South Atlantic.

FIELD IDENTIFICATION Length 51–58 cm; wingspan 134–147 cm; weight: males 1390 g, females 1280 g. Large, heavily built, sooty-black petrel with black legs and feet and a chunky pale bill; varying white patch, on chin or throat or both, diagnostic but often small and invisible. Largest species of *Procellaria*; except for noticeably different profile of bill, identical in shape to slightly smaller Westland Petrel *P. westlandica*. Head small, somewhat angular and flat-crowned in profile, held hunched into body, neck appearing thick; appears deep-chested, with thickset barrel-shaped body tapering to short, rather narrow-based, wedge-shaped tail (usually partly fanned and in shallow dihedral); tips of feet usually project a beyond tip of tail; wings, long, broad at base, carpals held gently forward. Sexes alike; no seasonal plumage differences. Juveniles inseparable.

DESCRIPTION ADULT. Entire body, uniform sooty-black except white patch of varying size and shape on chin or throat or both, often hard to see; many appear dark-chinned; when obvious, white patch extends back to line of eye, and may curl up onto cheeks, giving bird grinning expression; full range of variation from totally dark-chinned to extreme white-chinned birds in all populations; dark-chinned birds may predominate in NZ populations and are common in A'asian waters. Body and upperwing, sooty-black. Marginal, lesser and median under wing-coverts, solid sooty-black, contrasting with slightly paler, glossier greater coverts and remiges, which, in bright sunlight, form diffuse silvery area on underwing. Plumage fades to blackish-brown; especially on breast, belly, vent and flanks where tips of feathers become rusty, giving barred effect; badly worn and faded individuals develop conspicuous pale-brown or coffee-coloured tips to feathers of dorsum and venter behind head, heightening barred aspect and giving patchy appearance above. Bill large, powerful and chunky, deep-based; tubed nostrils set prominently over basal third; well-rounded and strongly hooked maxillary unguis large in proportion to rest of bill, giving bulbous tip. Bill, greenish-horn, yellowish-horn or straw-coloured, whitish at distance, with black saddle on upper mandible between nostrils and maxillary unguis; posterior edge of nostrils, naricorn and sulcus, black, ending in black triangle above gonyes; narrow blackish cutting edge to maxillary unguis; unguis, uniformly horn-coloured as side plates but often appearing slightly paler than side plates. Legs and feet, black.

SIMILAR SPECIES Combination of large size and robust, bull-necked and broad-winged jizz, plus all-dark plumage and chunky pale bill with black saddle and sulcus, ought to prevent confusion with other procellariiforms, except dark-plumaged congeners; white patch on chin and throat diagnostic when present. Most likely to be confused with **Westland Petrel**, which appears identical in size, shape and flight (*q.v.* for full distinctions). **Black Petrel** *P. parkinsoni* is c. 20% smaller, less bulky, with finer, more rounded head and more slender neck and does not appear bull-necked; has same deep, angular chest but more slender-bodied, not so deep-bellied or rotund; wings narrower and appear longer; flight, slightly freer, less laboured. Bill, smaller, more compact, slightly brighter yellowish-horn or greenish-yellow in adults (horn-coloured with bluish-grey tinge in juveniles); tip, always black and not bulbous. Combination of size, structure, shape, colour and pattern of bill essential for correct identification of Westland and Black Petrels. **Flesh-footed Shearwater** *Puffinus carneipes* one-third smaller and slimmer; plumage browner; legs and feet, flesh-coloured (not black); bill, slen-

der, pinkish-horn, conspicuously tipped black. **Giant-petrels** *Macronectes* spp in wholly dark plumage are much larger (c. 40%), with longer and narrower wings, no bull-necked appearance, much larger bills with longer nostrils and no black saddle and sulcus. Also, flight more ungainly, with bouts of laboured stiff-winged flapping between long glides; hunch-backed silhouette.

Rarely sighted from land. In light winds, flight appears somewhat laboured, with periods of sustained gliding, gentle banking and shearwatering low to water interspersed with brief series of unhurried wing-beats; in stronger winds, more confident and powerful, progressing in series of shearwater-like arcs (rising up to 10 m; wings held strongly flexed) or stronger albatross-like soaring, wheeling and banking motions. Swim well. As with congeners, float buoyantly on water, wing-tips extending beyond tip of tail. Feed by surface-seizing and surface-diving; less often by deep plunging. Swim underwater with partly outstretched wings. Associate with cetaceans. Usually solitary at sea, but large numbers congregate round trawlers and compete for offal. Habitually follow ships. Breed colonially on well-vegetated subantarctic islands. Some birds appear over breeding islands in late afternoon and circle in loose flocks, occasionally landing; most arrive at or after dark when they call noisily from surface and burrows. Main call, shrill chattering or rattle. Usually silent at sea but noisy when attending trawlers: give high-pitched trilling call and aggressive *kek, kek, kek*.

HABITAT Marine, pelagic. In breeding season, in Subantarctic Zone; less commonly in Antarctic Zone, S to edge of pack-ice (Murphy). At some breeding islands, birds present all year (S. Georgia; Murphy); others deserted in winter, when birds move to subtropical waters, especially cool currents along continental shores (Murphy; Rowan *et al.* 1951; Summerhayes *et al.* 1974; Enticott & O'Connell 1985; Weimerskirch *et al.* 1985). Round breeding islands, occupy offshore shelf waters >3 km from land; at Iles Crozet, concentrate in areas of high productivity, over convergence zones and upwellings in subtropical water eddies; able to feed in areas of concentrations of food and birds, being unaffected by interspecific competition (Jouventin *et al.* 1982b; Stahl *et al.* 1985). May follow ships to inshore waters and feed on refuse in harbours and bays (Rootes 1988). In Antarctic, frequent open sea, occasionally reaching but not penetrating edge of pack-ice (Routh 1949); rarely in pack-ice of >25% cover (Montague 1988). In wintering quarters, occur mainly over edges of continental shelves (Summerhayes *et al.* 1974; Enticott & O'Connell 1985). Off se. Tas., observed over shallow offshore waters and over seamount (depth <1500 m), but not over deep waters (Blaber 1986). In South Africa, densities highest in waters more than 200 m deep; offshore distribution may partly reflect attraction to fishing trawlers, which concentrate in this zone (Jackson 1988).

Breed on subantarctic islands, range extending into Antarctic Zone at S. Georgia. Nest in peaty ground on flat or sloping terrain; well-drained or waterlogged; terraces on mountain sides, lava outcrops, low ridges, or level ground at cliff edges (Rand 1954; Warham & Bell 1979; Imber 1983). On Antipodes I., at all altitudes (up to 400 m asl) (Imber 1983). Burrow in bare ground or among tussock grass (*Poa*) and fern (Antipodes I.; Warham & Bell 1979). On S. Georgia, burrows concentrated in sheltered positions, on ground with good drainage; particularly upper parts of steep banks, ridges and hills, among tussock clumps up to 1 m height (Murphy; Crox-

all & Prince 1980; Hall 1987). Excavation may begin while ground frozen, and thaw may flood burrows (Murphy). On Inaccessible I., Tristan da Cunha, burrows largely confined to small marshes and hollows on summit plateau, 500 m asl; among flat hummocks of sedge with water flowing between; the most waterlogged areas chosen and large areas covered by soft dry soil not used (Rowan *et al.* 1951).

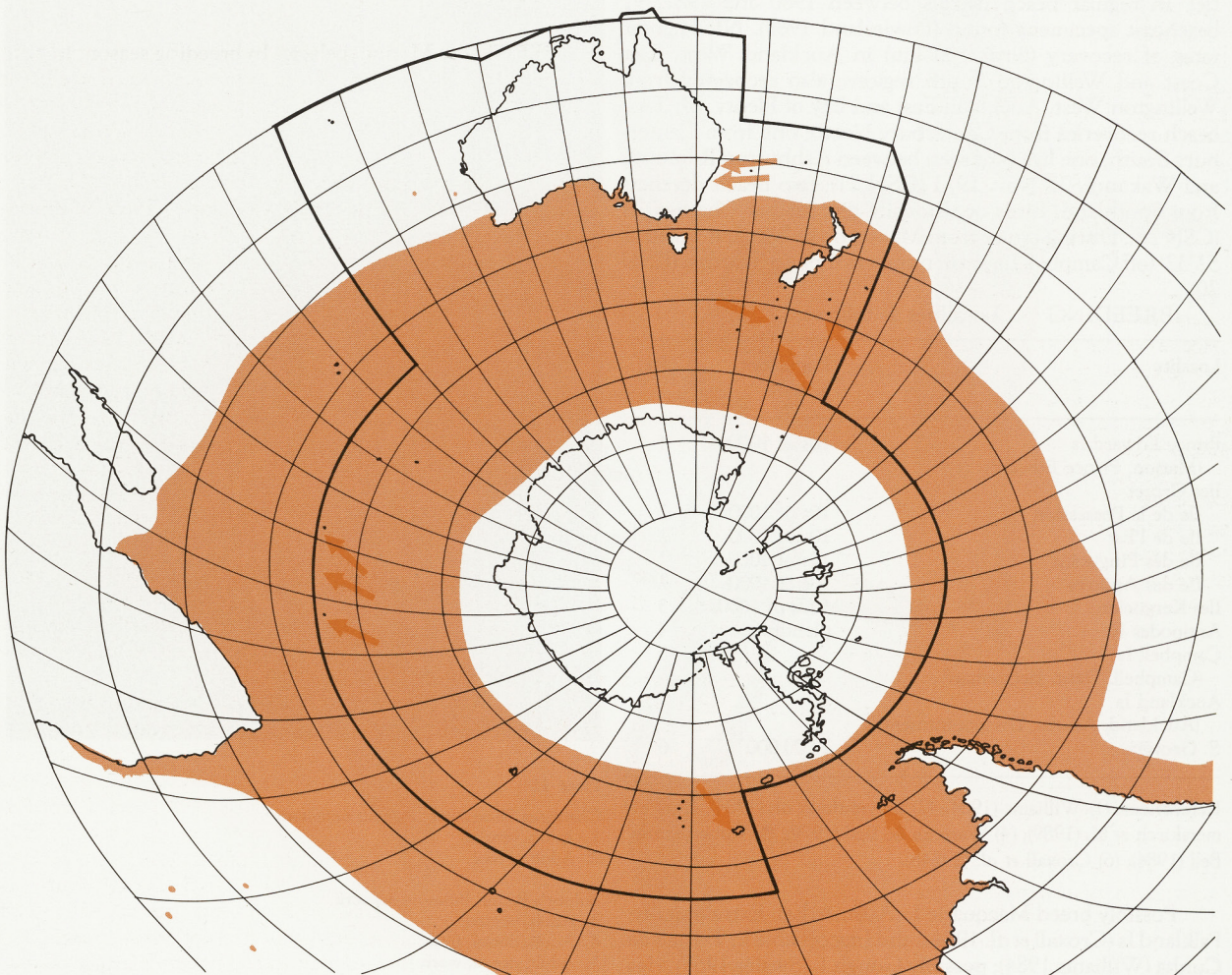
DISTRIBUTION AND POPULATION Pelagic in Antarctic, subantarctic and subtropical waters; breed subantarctic islands in South Atlantic, s. Indian and sw. Pacific Oceans.

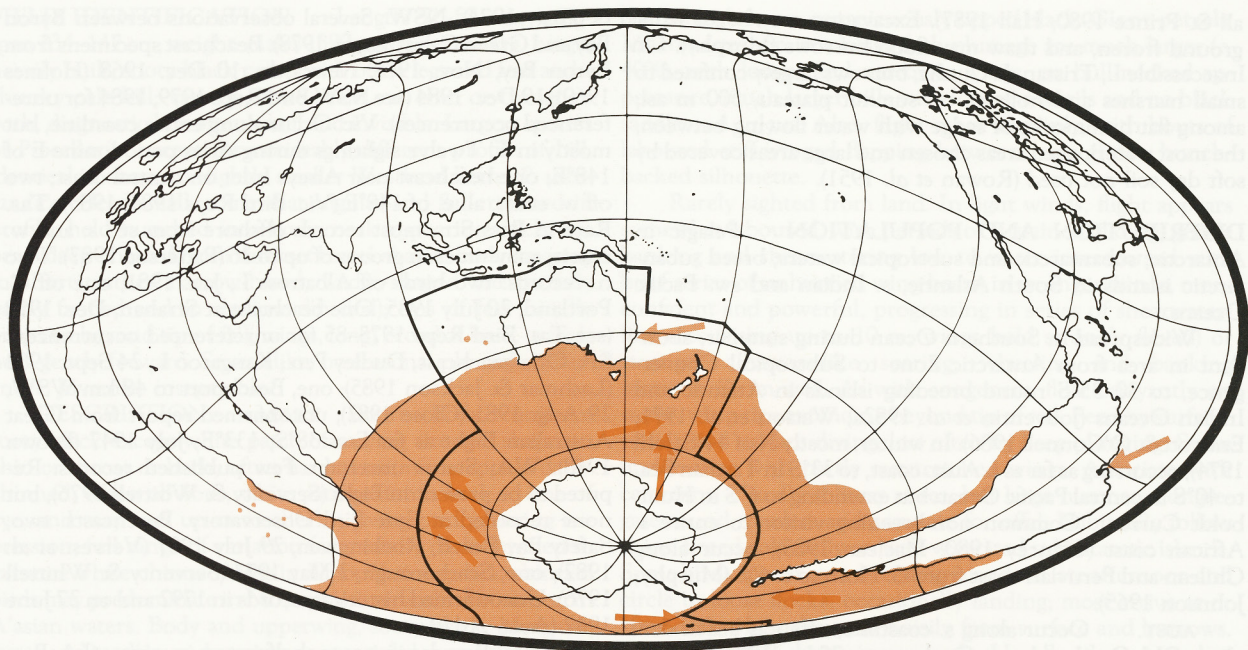
Widespread in Southern Ocean during summer, abundant in area from Antarctic Zone to Subtropical Convergence, to 30–35°S round breeding islands in Atlantic and Indian Oceans (Jouventin *et al.* 1982a; Watson *et al.* 1971; Enticott & O'Connell 1986). In winter, mostly N of 44°S (Jehl 1974), occurring as far as s. Aust. coast, to 33°S in Tasman Sea, to 40°S in central Pacific Ocean but extending to 6°S in Humboldt Current. Common non-breeding visitor to entire s. African coast (Clancey 1980; Maclean 1985); occur along Chilean and Peruvian coast from C. Horn to c. 6°S (Murphy; Johnson 1965).

AUST. Occur along s. coastline, often as beach derelicts. **Qld.** One beachcast, Coolangatta, 28 Jan. 1974 (Vernon

& Fleay 1974). **NSW.** Several observations between Byron Bay and Green Cape (Barton 1978). Beachcast specimens from Byron Bay, Nov. 1978; Newcastle, 10 Dec. 1968 (Holmes 1969); 19 Dec. 1984 (see NSW Bird Repts 1979, 1984 for unreferenced occurrences). **Vic.** Occur along entire coastline, but mostly in E. Twelve sightings during Atlas period: nine E of 148°E; one beachcast near Aireys Inlet on central coast; two off w. coast, all e. of 148°E (Vic. Bird Repts 1984, 1985). **Tas.** Rare in Bass Str.; most records offshore from se., s. and w. coasts, sometimes in groups of up to 36 (Patterson 1987). Two n. records: two birds off Albatross I., Jan. 1981; one off C. Portland, 20 July 1985. One beachcast at Strahan, Dec. 1978 (see Tas. Bird Repts 1978–85 for unreferenced occurrences). **SA.** One beachcast, Dudley Pen., Kangaroo I., 24 Sept. 1983 (Lashmar & Jackson 1985); one, Beachport to 48 km WSW, 29 Aug. 1981 (Close 1982); unconfirmed report from Great Australian Bight as far E as 38°S, 133°E, July 1947 (Brown 1948). **WA.** Status uncertain. Few published records. Reputed to be present in Bight (Serventy & Whittell 1976), but none recorded at Eyre Bird Observatory. Beachcasts: two, Safety Bay Beach, Rockingham, 29 July 1987 (Vervest *et al.* 1987); one, Scarborough, 2 May 1973 (Serventy & Whittell 1976). Unconfirmed historical records in 1792 and on 27 June 1947 (Aust. Atlas).

NZ Regular visitor to shelf waters in winter (J.A. Bar-





tle). In regular beach patrols between 1960 and 1987, 91 beachcast specimens found (Powlesland 1989). NI. Highest rates of recovery (birds/100 km) in Auckland West, East Coast and Wellington South regions; also recovered from Wellington West, Auckland East and Bay of Plenty. SI. Two beach recoveries from Canterbury North; one from Canterbury South; one live bird seen between Ashburton R. mouth and Wakanui, 23 Nov. 1973 (CSN 21); two beach derelicts from Southland. Birds occasionally recorded at Chatham Is (CSN 26). During cruise from McMurdo to NZ, first noted at 52°32' (off Campbell I.); small numbers then to NZ coast (CSN 20).

BREEDING Localities as follows:

Locality	Population (pairs)	Ref.
Prince Edward Is (Marion, Prince Edward)	10s of 1000s	1
Iles Crozet		
Ile de la Possession	10s of 1000s	2
Ile de l'Est	10s of 1000s	2
Ile des Pingouins	10s of 1000s	2
Ile des Apôtres	10s of 1000s	2
Iles Kerguelen	100s of 1000s	3
Antipodes Is	plentiful	4
Campbell Is (Campbell, Dent, Jacquemart)		5
Auckland Is (Auckland, Adams, Disappointment)		5
S. Georgia	2 000 000	6

References: (1) Williams (1984); (2) Jouventin *et al.* (1984); (3) Weimerskirch *et al.* (1989); (4) Warham & Bell (1979); (5) Robertson & Bell (1984); (6) Croxall *et al.* (1984b).

Possibly breed Macquarie I. (Aust. Atlas). Extraliminally: Falkland Is (Croxall *et al.* 1984a) and Inaccessible I., Tristan da Cunha (Williams 1984); possibly Gough I. (Swales 1965). Has

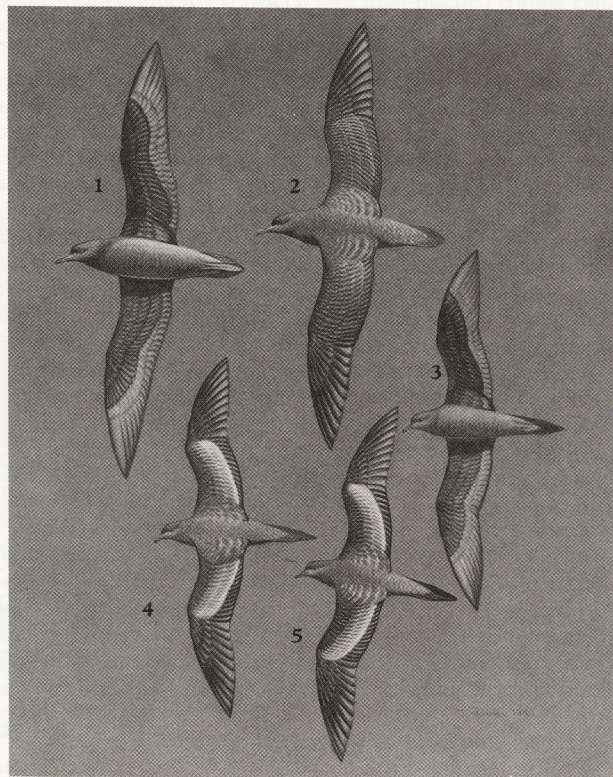


Plate 41

Christmas Shearwater *Puffinus nativitatis*

1. Adult, ventral
2. Adult, dorsal

Bulwer's Petrel *Bulweria bulwerii*

3. Adult, ventral
4. Adult, dorsal, fresh
5. Adult, dorsal, worn

not bred Ile Amsterdam *contra* Paulian (1953).

Extirpated on Ile aux Cochons, Iles Crozet (Jouventin *et al.* 1984) and possibly on Campbell I. (G. Taylor) by feral cats; cats have reduced populations on Marion I. (Williams 1984). Rats take eggs and chicks at Campbell I., Ile de la Possession and S. Georgia (Robertson & Bell 1984; Jouventin *et al.* 1984; Croxall *et al.* 1984b). Introduced Black Rats *Rattus rattus* kill chicks on Iles Crozet (Mougin 1970).

MOVEMENTS Dispersive or migratory, highly dispersed during summer but most populations apparently moving to continental shelf waters of Aust., NZ, Africa and South America in winter.

DEPARTURE At Bird I., S. Georgia mean fledging date 1978–81, 19 Apr. (16–25 Apr.; Hunter *et al.* 1982); 1985, 21 Apr. (6.4 days; 9 Apr.–9 May; 24; Hall 1987). At Iles Crozet, fledging 17 Apr. (8 days; 4–29; 6) with last adult seen 7 May (Mougin 1970). On Antipodes Is, most young probably fledge early May (Hutton 1865; Warham & Bell 1979).

NON-BREEDING Pattern of winter movements poorly known. Vacate open ocean S of 44°S (Sziij 1967; Jehl 1974) and, though some continue to come ashore at Tristan da Cunha in winter (Rowan *et al.* 1951), none do so at Iles Crozet (Jouventin *et al.* 1985) and not seen at sea near either island group at this time (Enticott & O'Connell 1985; J-C.Stahl).

Spectacled form *conspicillata* moves from Inaccessible I. to South American continental shelf where some remain in summer; few also visit South African waters (Enticott & O'Connell 1985). Off s. Africa, more common in winter than summer (Summerhayes *et al.* 1974; Brooke & Sinclair 1978); probably from s. Indian Ocean; birds banded Iles Crozet recovered both se. and sw. Africa (J-C. Stahl). Smaller numbers may also visit w. and s. Aust. waters. Birds breeding NZ waters may move as far E as Chile (Jehl 1973) but some move to NZ shelf-waters (J.A. Bartle).

RETURN Arrival Bird I., early to late Sept. 1983, 1984, 10 Sept. 1985 (Hall 1987); Possession I., 15 Sept. 1966, 16 Sept. 1968 (Mougin 1970).

BREEDING During summer, follow Humboldt Current as far N as 6°S (Murphy) with maximum foraging range from breeding islands estimated at 1650 km (Croxall & Prince 1980). Also most common in Tas. and Vic. waters during summer, though present in all seasons (Vic. Atlas; D.W. Eades) and common off Iles Amsterdam and St Paul only Sept.–Apr. (Roux & Martinez 1987).

BANDING
46S51E 03 P U 14 2837 288M CRBPO
46S51E 03 P U 11 4534 296 CRBPO.

FOOD Non-breeding birds take fish and offal with few crustaceans and cephalopods when available; when breeding, mostly cephalopods with some crustaceans and few fish and tunicates. **BEHAVIOUR.** Food taken either by surface-seizing or surface-diving, occasionally pursuit-plunging (Harper *et al.* 1985). Of 13 observations by Harper (1987) 85% were surface-seizing, 15% deep-plunging, 62% at night, 39% during day; Griffiths (1982) and Ainley & Boekelheide (1983) saw only surface-seizing. Take both carrion and live prey by surface-seizing, taking up to 24 prey items per minute. Often feed among other seabirds, particularly round fishing boats. Groups will barge among albatrosses to drive them from food and attempt to snatch food from beaks of giant-petrels *Macronectes* (Harper 1987). Near South Africa, obtain much food from behind trawlers (Jackson 1988). Of all seabirds in African sector of Southern Ocean, most often associated with cetaceans, particularly pilot whales *Globicephalus* and Southern Right Whale Dolphins *Lissodelphis peronii* (Enticott 1986), which may have pre-adapted it to following trawlers (Summerhayes *et al.* 1974). Appear to locate food partly by scent (Lequette *et al.* 1989).

NON-BREEDING In **Benguela Region**, South Africa (106 stomachs, 120 gizzards; Jackson 1988) mostly offal from trawlers (fish *Merluccius capensis* — probably heads and entrails — stomach 2.7% dry wt., 1.3% no., 6.1% freq., gizzard 0.8% no., 16.8% freq., *Coelorinchus fasciatus* 12.8, 13.1, 20.3, 1.0, 14.9, unident. 35.7, -, 19.5, -, 0.6); the rest, self-caught (*Etrumeus teres* 6.9, 1.3, 0.7, -, -, *Engraulis capensis* 1.2, 0.9, 1.7, 0.1, 2.3, *Maurollicus muelleri* 2.7, 6.7, 3.6, 0.4, 5.1, *Lampancytodes hectoris* 1.6, 17.6, 8.2, 2.4, 12.9, *Trachurus trachurus* <0.1, 0.4, 1.9, -, -, unident. 8.8, 11.3, 20.7, 0.2, 7.0), crustaceans (stomatopods *Squilla armata* 12.7, 13.9, 15.7, <0.1, 7.8, amphipods <0.1, 3.9, 0.7, euphausiids *Euphausia lucens* <0.1, 5.1, 1.5, -, -, crab megalopa <0.1, 0.1, 0.7, -, -, unident. 0.5, -, 5.6, -, 1.2) and cephalopods (Sepiidae 11.4, -, 12.2, -, -, unident. beaks -, 24.7, 13.6, 95.1, 76.9), also *Loligo reynaudi* (Jackson 1986).

In **Drake Passage** (four stomachs; Linkowski & Rembiszewski 1978) cephalopods 75% freq., euphausiids 25 and fish 25. In **South Atlantic** (Harper 1987) one seen taking 24 eu-

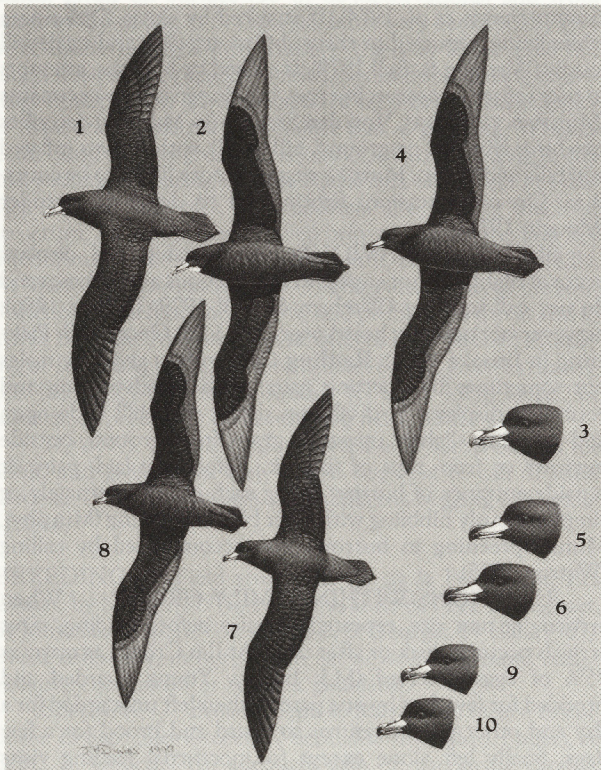


Plate 42

White-chinned Petrel *Procellaria aequinoctialis*

- 1. Adult, dorsal, fresh
- 2. Adult, ventral, fresh
- 3. Adult

Westland Petrel *Procellaria westlandica*

- 4. Adult, ventral, fresh

- 5. Adult
- 6. Juvenile

Black Petrel *Procellaria parkinsoni*

- 7. Adult, dorsal, fresh
- 8. Adult, ventral, fresh
- 9. Adult
- 10. Juvenile

phausiids, and one seen pecking at cephalopods at surface and carrying silvery fish in bill (Griffiths 1982); in s. Indian Ocean cephalopods (Carter 1913). Lipids make up 7.5–8.9% wet wt. stomach contents (n=2), 21.1–82.3% stomach oils (4; Horgan & Barrett 1985).

BREEDING At Ile de la Possession (21 stomachs; Mougouin 1970) cephalopods 90% freq., crustaceans 19, fish 14; other samples contained only cephalopods (3; Despin *et al.* 1972; Mougouin 1975). At Auckland and Campbell Is (3, 79 items; Imber 1976) cephalopods 100% freq.: *Abralia* 3.8% no., *Ancistrocheirus lesueurii* 1.3, *Gonatus antarcticus* 2.5, *Histioteuthis* (incl. *H. atlantica*, *H. eltaninae*, *H. macrohista*, *H. meleagroteuthis*, *H. miranda*) 22.8, *Nototodarus sloani* 2.5, *Taonius* spp 7.6, unidentified. Cranchiidae 2.5, *Vampyroteuthis infernalis* 1.3, *Argonauta nodosa* 2.5; salps 67% freq.: *Salpidae* 13.9% no., *Pyrosoma* 1.3; crustaceans 33% freq.: anomurans *Munida* 22.8% no.; fish 33% freq.: *Coelorinchus* 1.3. Though, at S. Georgia, diet mostly of crustaceans implied by Hall (1987), preliminary analyses there (Croxall & Prince 1980) had found mostly cephalopods (47% wt; principally *Kondakovia*, *Todarodes*, *Teuthowenia*; Prince & Morgan 1987) with rest fish (24) and crustaceans (29; amphipods 1, euphausiids 28, decapods 1). Amphipods *Eurythenes obesus* reported from Iles Crozet (Bellan-Santini & Ledoyer 1974); at Tristan da Cunha, cephalopods 67% freq., fish 33, decapod crustaceans 33 (3; Hagen 1952). Food contains 67.8% water (20.1–75.7), 17.0% lipid (8.3–43.9), 15.2% protein (5.7–47.9) and has energy content of 9.3 ± 4.7 kJ/g (wet wt.; 5.3–20.7, n=14; Berutti *et al.* 1985).

INTAKE At Ile de l'Est, Iles Crozet, interval between meals 1.97 days (0.42; 1.50–2.52; 156 weighings of six chicks) with weight increase during 24 h feeding period 133.1 g (102.6; 0–530; 72; Jouventin *et al.* 1985). Mean wt. of meal 190.3 g (127–217; 133), meals being of fairly constant weight from 8 to 91 days of age but lighter in last 5 days (Berutti *et al.* 1985). Efficiency of assimilation by chicks at Marion I. (corrected for nitrogen) varied between foods: fish *Maurolicus muelleri* 69.1% (1.7; 66.1–71.2), cephalopods *Loligo reynaudii* 68.0 (1.8; 64.4–69.2), euphausiids *Euphausia superba* 67.5 (1.7; 66.3–70.4; Jackson 1986); by weight fish are >75% digested in 4 h, cephalopods 8 h, euphausiids 12 h, by no. fish 2 h, euphausiids 12 h, cephalopods >3 weeks (Jackson & Ryan 1986).

SOCIAL ORGANIZATION Based on information provided by M.J. Imber. Usually solitary at sea. May form groups at sources of food; 36 reported following ship off Tas. (Patterson 1987); sometimes associate with albatrosses, shearwaters and fulmars. Feeding birds gather in small flocks on water (Watson 1975). At breeding islands, arrive late afternoon circling in loose flocks (Imber 1983).

BONDS Probably monogamous. Divorce not unusual (Mougouin 1970). Pairing appears to take place soon after landing at breeding grounds (Murphy). At Iles Crozet, courtship and mating occur for 1 month from mid-Sept. to mid-Oct.; after mating feed at sea for 2 to 3 weeks (M.J. Imber). Incubation shared by male and female: males 52.7% (5.6; 42–63), females 47.3 (5.6; 37–58) (Hall 1987); males 55%, females 45% (Mougouin 1970). Young fed by both parents and, after 8 days old, left alone except during feeding visits. Young independent after fledging.

BREEDING DISPERSION Loosely colonial but varying. Territorial, defending nesting-burrow and area round entrance only.

ROOSTING Rest during day. At sea, solitarily, presumably on water if conditions favourable; suspected also to rest on wing like many other oceanic birds; Murphy observed large rafts settling on ocean at dusk; Warham & Bell (1979) noted small raft of what was almost certainly this species resting off breeding colony in late afternoon. Arrive late afternoon at breeding sites; some land in daylight and move to cover; after dark, some birds (perhaps non-breeders) sit on ground or on tussocks intermittently calling (Imber 1983). Rest singly during incubation, probably during both day and night. When walking, often rest in squatting posture (Murphy).

SOCIAL BEHAVIOUR No major studies; based on information provided by M.J. Imber and references cited. Difficult to observe as breeding activities take place at night and usually in nesting-burrow; thus vocal displays probably most important in defence of burrow and attraction of mate (Brooke 1986).

AGONISTIC BEHAVIOUR Defend burrow and area round it. **THREATEN** intruders to burrow with **Wheezy Call** (Brooke 1986). At sea, regularly seen in aggressive display with conspecifics: two individuals face each other 15–30 cm apart; raise back feathers, gape bills, position necks well down and thrust heads upward, forward chattering at each other until one bird breaks away and is chased a few metres by other (Summerhayes *et al.* 1974). If attacked by skuas *Catharacta* while flying, reported to thrust bill at attacker and rattle bill loudly (Warham & Bell 1979). If chased by humans, attempts to take refuge in nearest burrow, but driven out by occupants (Murphy). **FIGHTING**. Von den Steinen (in Murphy) describes two birds lying flat on ground, bill to bill, with throats inflated and bills wide open; Murphy suggests more likely to be courtship. On one occasion, fighting led to death of intruder (Mougouin 1970).

SEXUAL BEHAVIOUR Courtship and displays occur at night. Do not engage in conspicuous aerial chases and do not call in flight (Warham & Bell 1979; Brooke 1986); however occasionally heard over Bird I., S. Georgia (S. Pickering in Brooke 1986). **Rattling Call**, mainly given by males but sometimes by duetting pairs; used in advertising and courtship displays. Bird vibrates throat with bill wide open and pointing slightly upwards; given from ground, outside burrows or from tops of tussock. Before egg laid, pairs sit outside entrance of burrow facing each other, alternately or simultaneously nibbling with their bills and calling (Murphy). Mutual preening in burrows also accompanied by calling (Watson 1975).

RELATIONS WITHIN FAMILY GROUP When arriving at nest site, repeatedly circles before landing; most arrivals occur at dusk or after dark. At Iles Crozet, as many as 75% of eggs deserted (M.J. Imber). Young guarded and brooded for few days by one parent, then left unguarded for a day and other parent returns to guard and brood for a few days; finally left alone except for nocturnal feeding visits (Murphy; Warham & Bell 1979). Some evidence to suggest that parent-young recognition not well developed or not important (Brooke 1986; M.J. Imber), probably latter. Adults leave young before they fledge (c. 94–95 days old) (Watson 1975; M.J. Imber).

VOICE Well known; detailed studies at Antipodes Is (Warham 1988) and Marion I. (Brooke 1986); information supplied by M.J. Imber. Generally silent at sea; loud shrill

rattling chattering calls given from surface or in burrows at breeding colonies though noisiness varies from night to night. Two main calls described at Marion I.: Rattle and wheezy groan (Wheezy Call); at Antipodes Is, high-pitched squeals also reported. Most calling in 2-3 h after sunset, declining through night and increasing again towards dawn when birds leave colony. Probably function in advertising territory and availability as mate. Calls similar to those of other *Procellaria*. Apparent individual differences but not in structure of syllables, birds probably recognize calls of mates (Brooke 1986). Both males and females use same calls but females significantly less likely to give Rattle Call and then usually only in duet with male whereas male will give Rattle independently for advertisement (Brooke 1986). No information on geographical variation. Non-vocal sounds: apparently rattle mandibles as threat when defending themselves e.g. against skuas (Warham 1988).

ADULT Rattle. Rapid chattering consisting of series of staccato pulsed notes, as repeated two- or three-note syllables; at Antipodes, syllables given at rate of 5-10/s, equivalent to rate of repetition of notes from Marion I., of c. 18/s. At Antipodes, each note c. 0.03 s long and across wide range of frequencies, the first note of a syllable sounding like a click with most sound energy in second note; calls lasted 11 s (2-34; 10). Main call heard significantly more often from males; given on surface (50 of 86 observations) and from burrows (36 of 86); at S. Georgia, birds very occasionally give brief Rattle in flight (M.J. Imber). Used by both sexes but much less often by female, sometimes in duets during courtship. Functions in advertisement of territory and availability as mate and in courtship; possibly also as greeting. **Wheezy Call.** Loud wheezy groans or squawks, often preceding Rattle and sometimes during or after Rattle call; at Marion I., syllables given at rate of c. 3-8 repeats/s and varying much in structure. At Antipodes Is, given only as single notes and not in continuous use whereas at Marion I., call used repeatedly. At Marion I., given mostly (28/31 observations) from burrow. Functions in defence of burrow, and probably as threat and in alarm. **Squeals.** At Antipodes Is, uttered high-pitched squeaking or squealing in response to human threat; given as drawn-out frequency-modulated squeals (c. 0.8 s long) alone, or sometimes preceding or developing from Rattle Calls.

YOUNG Only call reported is Wheezy Call, as for adult, and given from early age in response to call of adult (Brooke 1986; M.J. Imber). Any different begging call undescribed.

BREEDING Field studies at Ile de la Possession, Iles Crozet, by Mougouin (1970, 1971) and at Ile de l'Est, Iles Crozet, by Jouventin *et al.* (1985); at Bird I., S. Georgia, by Hall (1987). Breed colonially, in burrows in flat or sloping ground under subantarctic tundra or tussock grassland.

SEASON Broadly Sept. to May. Birds return to colonies: 15 Sept., Iles Crozet; 10 Sept., Marion I. (M.J. Imber); 10 Sept., S. Georgia. No adequate data on pre-laying exodus. Departure: Apr. to early May (Iles Crozet; S. Georgia; Antipodes Is) (Oliver).



SITE On tundra and tussock grassland usually on hillsides; burrows most dense on inland- to eastward-facing

slopes (Murphy). Sometimes on flat ground in either waterlogged or well-drained soil.

NEST, MATERIALS Burrows 1-2 m long, 20-27 cm (to 35; Murphy) in diameter. Used traditionally from year to year. Recorded sharing burrow with Kerguelen Petrel *Pterodroma brevirostris* on Iles Kerguelen (Hall 1900) and on Marion I. (Schramm 1983). Where specially dense, burrows may anastomose (Murphy). Role of sexes in excavation not known but soil, often still frozen and containing lumps of ice, picked out with bill and then scraped out of burrow with feet (Matthews 1929). Shallow bowl, usually with little lining of plant material, raised on pedestal of earth where area waterlogged; pedestal formed by raking earth together with bill (Oliver). No further information.

EGGS Oval or short ovate to greatly attenuated; smooth- and fine-shelled; white, becoming stained (Murphy).

MEASUREMENTS: Marion I.: 82.0 (2.53; 76.7-86.5; 31) x 54.9 (1.38; 51.9-57.6) (M. de L. Brooke);

S. Georgia: 82.9 (72.0-89.0; 56) x 53.7 (49.0-58.6) (Hall 1987).

WEIGHTS: S. Georgia: 134.3 g (110-150; 32) (Hall 1987).

CLUTCH-SIZE One. No replacement after loss.

LAYING Early Nov. to mid-Dec. (Iles Crozet, S. Georgia). Fairly synchronized: Iles Crozet, 8 Nov.-20 Dec., peak 22 Nov. (n=22); S. Georgia, 13 Nov.-10 Dec., peak 22 Nov. (n=41); Antipodes I., peak about end Nov. (Imber 1983). No variation over four seasons in Iles Crozet (Jouventin *et al.* 1985). Usually at night. One record of two females laying in same burrow (Jouventin *et al.* 1985).

INCUBATION By both sexes, starting with female for average 2.4 days (1-8); total of 9 (S. Georgia) and 6-7 (Iles Crozet) stints by both birds. Length of stints: S. Georgia, males, average 9.4 days (1-19; 88) and females, 6.5 days (1-14; 109) (Hall 1987); Iles Crozet, males 9.5 days (5-13; 13) and females, 6.1 days (1-15; 18). Incubating bird fasts, covering egg continuously but desertions common in some years (Mougouin 1970). **INCUBATION PERIOD** averaged 58.9 days (57-62; 14) (Hall 1987). Successful breeders not known to leave egg unattended (Jouventin *et al.* 1985). Eggshells trampled into nest, unhatched eggs usually kicked out of nest. Sitting birds gently fence and nibble fingers of hand intruded into burrow before snapping and scratching (Matthews 1929).

NESTLING Semi-altricial, nidicolous. Hatched with sooty-black proptile, 'coffee-brown' (Paganstecher 1885); dark grey mesoptile. Attended by both parents; after hatching, brooded for few hours (Jouventin *et al.* 1985) and then, at S. Georgia, guarded on average for 3.8 days (2-8; 24). Fed by incomplete regurgitation; feeding shared equally by parents, visiting on 45.4% of nights during increase of weight by chicks (Jouventin *et al.* 1985); thus, each parent spends average of 3.8 days at sea. **NESTLING PERIOD.** S. Georgia, 98.1 days (87-106; 9) (Hall 1987); Iles Crozet, 96 days (91-105; 6) (Mougouin 1970).

GROWTH Weight of nestling at hatching: S. Georgia, 92.6 g (n=16); Iles Crozet, 94 g (n=1). Maximum weight: S. Georgia, 1687 g (n=36); Iles Crozet, 1417 g (n=6). Weight at departure: S. Georgia, 1215 g (n=2); Iles Crozet, 1000 g (n=6); thus, fledge at 93 and 82% of average adult weight respectively at S. Georgia and Iles Crozet. Measurements, graphs of wing, culmen, etc. in Hall (1987).

FLEDGING TO MATURITY Young leave at night, independent of adults. No information on age of first

pairing, breeding, longevity.

SUCCESS S. Georgia: 67 eggs laid, 34 (51%) hatched, 19 (30%) fledged (Hall 1987); Iles Crozet, 1967-68 season, 14 eggs laid, 11 (79%) hatched, six (43%) fledged; 1968-69 season, 19 eggs laid, two (11%) hatched, one (5%) fledged (Mougin 1970). Black Rats *Rattus rattus* kill chicks in some years on Iles Crozet (Mougin 1970). Skuas *Catharacta* take eggs and chicks at S. Georgia (Hall 1987). Human interference may have caused extinction on Chatham I. On Ile Amsterdam and parts of S. Georgia introduced predators (e.g. rats) have caused local extinctions (Olstad 1930; Paulian 1953).

PLUMAGES

ADULT Probably basic. **HEAD AND NECK**, blackish in fresh plumage, rapidly becoming blackish brown (c119) with wear, save for white inter-ramal region and chin. Extent of white varies between birds; in many, white patch no wider than distance between inter-ramal region, while in others may extend from rictus to rictus and extend back to line of eye. Specimens with no white patch at all reported (Oliver), but few; some have considerably more white on one side of head than on other. Isolated white feathers sometimes seen in moustachial area, and isolated brown feathers sometimes seen in proximal part of throat patch. **UPPERPARTS**, uniform blackish brown. When fresh, feathers, blackish with narrow grey (79) open pennaceous tips and concealed light-grey (85) bases. Feathers become browner with age; when very worn, dark brown (221) with narrow brownish (239) tips. **TAIL**, blackish, becoming blackish brown (221) with wear. **UPPERWING**. Most coverts as upperparts; some inner primary coverts of most birds have short off-white to buffish shaft streaks near feather tip; shaft streaks occasionally seen on inner primaries. Remiges, black (82-89) when fresh with dark grey (82-83) inner webs. When worn, remiges, dark brown (221) with grey-brown inner webs. **UNDERPARTS**, as upperparts, but narrow pale tips more readily lost with wear. **UNDERWING**, similar to upperwing, but most coverts always appear fresh. In some lights, remiges and greater under wing-coverts have silvery grey gloss. Outer remiges have black (82-89) tegmen.

JUVENILE As fresh adult in first summer. Can be recognized in first winter on slight uniform wear.

DOWNY YOUNG Protoptile, uniformly dark sooty brown or black. Mesoptile, uniformly coffee-brown with richer brown (121) crown. Mougin (1970) found chick in protoptile with patches of white in chin, cheek and underparts; these lost when mesoptile assumed.

ABERRANT PLUMAGES Partial and complete albinos known (Mougin 1970; Nicholls 1978).

BARE PARTS Based on labels (NMNZ; MV; HLW), Mathews (1910-27), Murphy, Falla (1937), Mougin (1970) and photos in Lindsey (1986).

ADULT Iris, dark to blackish brown; hazel also reported. Tip and cutting edge of maxillary unguis, all of culmicorn and naricorn, black (89). Sulcus and junction of mandibular unguis and ramicorn, black (89). Rest of bill, ivory white to pale cream (c. 54). Greenish horn also reported (e.g. Hall 1900; Hagen 1952; Vooren 1973; Close 1982). Some birds have pale blue-grey (88) mandibular unguis and base of latericorn. Bill has flaky texture. Tarsus and feet, dark grey (83) to blackish (82), sometimes with brownish tinge. Few birds have yellow or yellowish white patches on webs.

JUVENILE As adults, but bill has smooth texture, at least until first winter.

DOWNY YOUNG Bill and iris, similar to juveniles.

Feet, slate-grey to black, with paler webs. Patches of cobalt-blue on tarsus and toes.

MOULTS Based on birds from Indian Ocean and NZ region; no evidence for geographical variation in moult.

ADULT POST-BREEDING Pre-basic. Primaries outwards; as many as five adjacent inner primaries, but only two to three outer primaries may be found growing simultaneously. Secondary moult occurs about this period. Tail-moult begins when wing-moult almost complete, apparently proceeding inwards from t6 and t3, but more data needed. Wing-moult observed Jan. to Mar. (when almost complete) in birds of unknown breeding status; no observations of breeding birds in wing-moult.

Body-moult begins before wing moult and has been observed on Antipodes Is as early as Nov. Proceeds during breeding; unknown when body-moult stops, but some beach-cast adults show no active wing-moult in early winter. Often few body feathers and wing-coverts are not replaced. Adult with moult score 47 in mid-Mar. had completed moult of scapulars, rump, lower back and wing coverts; other body tracts were in active moult. Hagen (1952) recorded bill flaking in *conspicillata* in Mar.

POST-JUVENILE No data; no moult observed in juveniles in first winter (NMNZ; MV).

MEASUREMENTS (1) Breeding grounds on NZ off-shore islands, skins (NMNZ). (2) Antipodes Is, adults, live; flattened chord, other methods as HANZAB (Warham & Bell 1979). (3) Antipodes Is, skins; flattened chord, other methods as HANZAB (Warham & Bell 1979). (4) Iles Kerguelen, skins (Hall 1987). (5) Iles Kerguelen, skins (Mougin 1985). (6) Iles Crozet, live (Jouventin *et al.* 1985). (7) Iles Crozet, adults, skins (Mougin 1970). (8) Iles Crozet, juveniles, skins (Mougin 1970). (9) Marion I., adults, live (M. de L. Brooke). (10) S. Georgia, live (Hall 1987). (11) S. Georgia, Atlantic and Humboldt coasts, skins; methods unknown, probably as HANZAB (see reasoning in account for *Pelecanoides urinatrix*) (Murphy). (12) Subspecies *conspicillata*, Inaccessible I., Tristan da Cunha, probably skins; flattened chord, other methods as HANZAB (Hagen 1952). Sources (2)-(6) may have included juveniles.

	MALES	FEMALES	
WING	(1) 387.8 (3.76; 381-392; 5)	390.1 (5.77; 384-397.5; 4)	
	(3) 382.8 (5.8; 9)	376 (n=3)	
	(9) 378.5 (6.43; 367-395; 25)	373.2 (7.86; 358-387; 25)	
	(10) 396.1 (9.0; 397-415; 26)	387.3 (7.0; 374-402; 26)	
	(11) 385 (355-400; 14)	377 (357-383; 8)	
	(12) 348.0 (11.74; 337-364; 4)	355.2 (10.72; 339-363; 6)	
8TH P	(1) 237.5 (4.19; 232-244; 6)	237.0 (3.95; 231-243; 5)	
	TAIL	(1) 126.3 (5.12; 120-134; 4)	129.0 (2.16; 126-131; 3)
		(3) 124.8 (3.7; 9)	127 (n=3)
(11) 124 (116.3-131.5; 14)	123.7 (113-134.1; 8)		
BILL	(12) 119.1 (3.42; 116.5-124; 4)	117.3 (4.45; 113-125; 4)	
	(1) 51.9 (1.32; 49.6-53.2; 5)	50.4 (1.38; 48.0-51.5; 4)	
	(3) 52.6 (2.4; 8)	52.5 (n=3)	
	(9) 54.0 (1.38; 51.6-57.2; 27)	51.4 (1.02; 49.7-53.2; 25)	
	(10) 53.0 (1.2; 50.5-55.2; 26)	51.1 (1.3; 47.9-53.3; 26)	
	(11) 51.7 (48.6-55.3; 14)	50.4 (48-51.6; 8)	
TARSUS	(12) 51.8 (1.44; 50-53.5; 4)	50.8 (2.07; 49-54.5; 6)	
	(1) 67.9 (1.18; 66.1-69.6; 5)	66.0 (0.13; 65.8-66.1; 4)	
	(3) 65.3 (2.0; 9)	64.3 (3)	

	(9)	68.3 (1.66; 64.9-70.9; 27)	65.7 (1.51; 62-68; 25)
	(10)	67.0 (2.9; 61.5-74.0; 26)	63.9 (2.4; 60.0-69.0; 26)
	(11)	65.6 (60-68.2; 8)	63.2 (62.2-66.2; 8)
	(12)	61.0 (0.48; 61.5-62.5; 4)	62.0 (2.59; 58-64.8; 6)
TOE	(1)	86.6 (1.25; 85.1-88.8; 5)	84.6 (2.09; 82.4-87.9; 4)
	(3)	85.2 (2.1; 6)	84.1 (3)
	(11)	81.1 (78.6-83.7; 14)	80.6 (77-84.3; 8)
	(12)	83.9 (1.38; 82.5-85.5; 4)	81.2 (0.96; 80-82; 6)
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WING	UNSEXED		
	(2)	401.2 (9.1; 6)	
	(4)	375 (345-381; 7)	
	(5)	381 (14; 345-402; 14)	
	(6)	372 (11; 350-390; 30)	
	(7)	372 (345-390; 21)	
	(8)	355 (325-365; 6?)	
	(8)	355 (325-365; 6?)	
TAIL	(2)	129.2 (3.1; 4)	
	(4)	125 (108-140; 7)	
	(7)	113 (92-131; 21)	
	(8)	110 (105-118; 6?)	
BILL	(2)	51.3 (1.4; 10)	
	(4)	51.0 (48.2-53.0; 7)	
	(5)	52.1 (1.5; 50.0-54.4; 13)	
	(6)	52.3 (2.0; 47.0-56.0; 30)	
	(7)	52.1 (49.0-55.5; 21)	
	(8)	48.8 (46.6-51.5; 6?)	
	(8)	48.8 (46.6-51.5; 6?)	
	(8)	48.8 (46.6-51.5; 6?)	
TARSUS	(2)	65.2 (2.4; 6)	
	(4)	60.4 (56.0-64.8; 7)	
	(5)	65.7 (2.2; 61.8-68.5; 10)	
	(6)	65.0 (2.4; 61.0-70.0; 30)	
	(7)	64.5 (60.5-67.9; 21)	
	(8)	64.3 (60.5-67.5; 6?)	
	(8)	64.3 (60.5-67.5; 6?)	
	(8)	64.3 (60.5-67.5; 6?)	
TOE	(2)	90.4 (3.4; 5)	
	(7)	87.2 (81.2-94.9; 21)	
	(8)	86.3 (82.2-91.8; 6?)	

WEIGHTS S. Georgia, adults: males 1.39 kg (0.12; 1.13-1.55; 26), females 1.28 kg (0.09; 1.10-1.45; 26) (Hall 1987). Iles Kerguelen, presumably adults 1230 (105; 1080-1380; 6) (Mougin 1985). Iles Crozet, unsexed adults 1270 (1100-1885; 16); unsexed juveniles 1000 (680-1230; 6) (Mougin 1970). Breeding grounds on NZ offshore islands, sexes mixed, juveniles excluded: 1095 (118.9; 965-1295; 6) (NMNZ). Initial incubation weights at S. Georgia: 1394 (117; 1225-1650; 24). Daily % weight loss 2.2% (0.86; 24) (Hall 1987). At Antipodes Is, three males at start of incubation 1320, 1425, 1510. Two females after 2 or 3, and 3 days incubation weighed 1050 and 1085 respectively. Weights of NZ beachcasts (mixed sexes, juveniles excluded) 789 (108.6; 665-937; 6); many emaciated.

STRUCTURE Wing, long and narrow. Eleven primaries; p11 minute, p10 longest. In *aequinoctialis*, p9 0-9 shorter, p8 15-27, p7 40-52, p6 69-83, p5 92-108, p4 131-150, p3 163-187, p2 196-214, p1 216-231. Twenty-four secondaries, four of tertial form; 4-5 humerals. Tail, rounded; 12 feathers, t1 c. 12 mm longer than t6. Bill, long deep and robust; nares c. two-fifths of length. Nares have rounded edges and point forwards; line along culminicorn to tip of maxillary unguis concave. Lengths of middle and outer toes about equal; mid-toe sometimes slightly shorter; inner toe 75-80% of outer, hallux short. Tarsus laterally compressed.

AGEING In adults, nasal septum higher than roof of nostril; in juveniles, lower.

GEOGRAPHICAL VARIATION Race *conspicillata*

only found breeding on Inaccessible I., Tristan da Cunha; plumage of head differs from nominate (Rowan *et al.* 1951; Southern 1951). White chin similar to that of *aequinoctialis*, but inter-ramal region usually blackish brown. Conspicuous white band of feathers extends from chin-patch, below eye, curling upwards to terminate in ear-coverts. These moustachial stripes joined by broad white band across fore-crown. White spectacles vary considerably in width and extent; crown, moustache and chin patches often unconnected. White markings frequently differ on each side of head. Maxillary unguis may be darker (Hagen 1952).

Mathews (1910-27) recognized four other subspecies, mostly on differences in size of white chin-patch; now rejected because size of patch varies considerably within a colony. Full range of variation can be seen in birds from Iles Kerguelen (Hall 1900; Falla 1937), Antipodes and Auckland Is (NMNZ). Size of chin-patch probably averages larger in Indian Ocean than on NZ offshore islands. Partial albinism observed several times in South African seas (Nicholls 1978) and Iles Crozet (Mougin 1970); apparently unconnected with white markings of *conspicillata*.

DIR

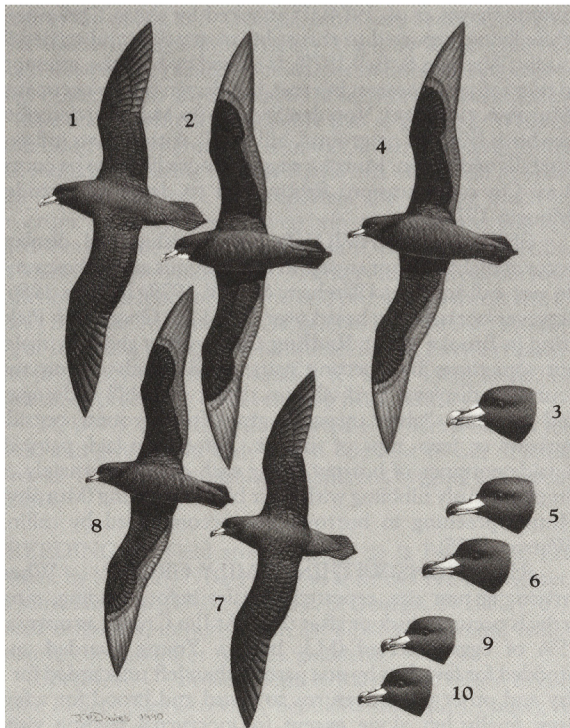
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Volume 1 (Part A), Plate 42

White-chinned Petrel *Procellaria aequinoctialis*

- 1. Adult, dorsal, fresh
- 2. Adult, ventral, fresh
- 3. Adult

Westland Petrel *Procellaria westlandica*

- 4. Adult, ventral, fresh
- 5. Adult
- 6. Juvenile

Black Petrel *Procellaria parkinsoni*

- 7. Adult, dorsal, fresh
- 8. Adult, ventral, fresh
- 9. Adult
- 10. Juvenile

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