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 Diomedeidae. 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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Pachyptila desolata Antarctic Prion

COLOUR PLATE FACING PAGE 592

Procellaria desolata Gmelin, 1789, *Syst. nat.* 1: 562; based on 'Brown-banded Petrel' of Latham 1785, *Gen. Synop. Birds*, 3: 409 — Desolation Island (= Iles Kerguelen).

Specific name is geographical after the early name for Iles Kerguelen.

OTHER ENGLISH NAMES Dove Petrel or Prion, Banks's Dove-Petrel or Prion, Blue Dove-Petrel, Dove-white Petrel, Whalebird, Snowbird.

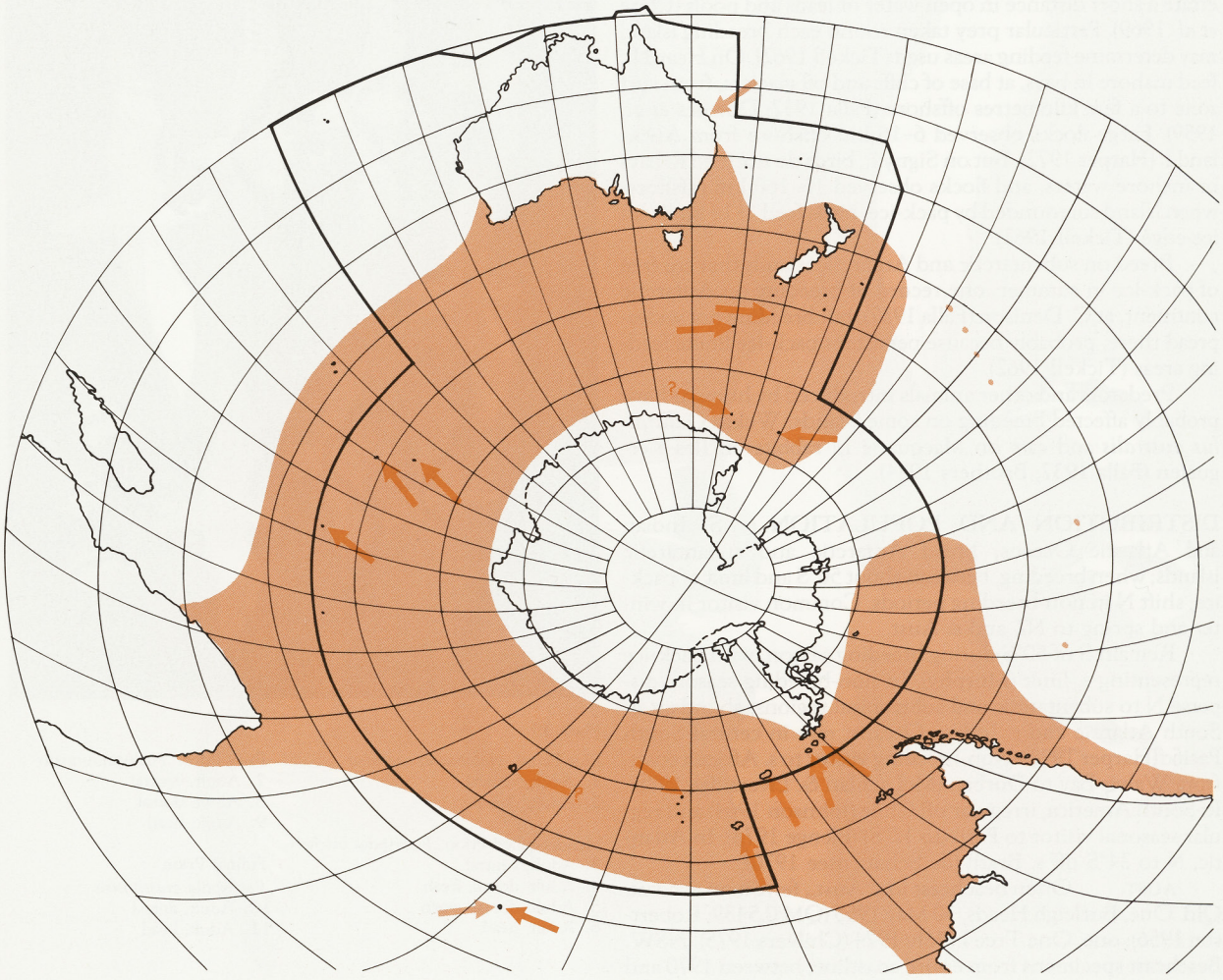
The epithet **Antarctic** recognizes that this is the only species of prion that nests on Antarctic continent and seems to have prevailed over **Dove** in modern literature since the RAOU 1926 Checklist.

MONOTYPIC

FIELD IDENTIFICATION Length 27 cm; wingspan 61–66 cm; weight: 150–160 g. Abundant, medium-sized prion of Antarctic and subantarctic waters, ranging into subtropical waters. Very similar to Salvin's Prion *P. salvini* from which impossible to separate at sea. Sexes similar. Juveniles inseparable. No seasonal plumage changes.

DESCRIPTION ADULT. Forehead, crown and nape, bluish grey, slightly darker than grey of hindneck and saddle; greyish black sub-orbital patch extends from in front of eye to rear of ear-coverts. Colour of lores and extent of supercilium varies: in s. Indian Ocean and A'asian birds, lores mostly white narrowly separated from well-defined white supercilium by grey bar extending from eye to forehead; in South Atlantic and Heard I. birds, sub-orbital patch bolder and darker, and some have lores freckled black and supercilium reduced, giving more sombre facial pattern (recalling that of Broad-billed Prion *P. vittata*). Blue-grey of hindneck extends down sides of neck and upperbreast, forming conspicuous half-collar; collar appears richer blue on bottom half. Forehead and crown darker with wear, contrasting more with hindneck and saddle. Upperparts, rich blue-grey except for: moderately broad well-defined black open M-marking across wings (joining across rump); thin white trailing-edge to secondaries; scapulars, narrowly tipped white; narrow black terminal tail-band, not extending onto outer (or outer two) rectrices. On upperwing, area behind M-marking, especially remiges, appears paler than blue-grey of inner forewing and translucent when backlit; M-marking becomes noticeably browner with wear. Underparts, wholly white except for blue-grey half-collar, blackish streak on centre of undertail (formed by blackish central rectrices and central under tail-coverts), and faint greyish trailing-edge to underwing. Bill, chunky, deep at base in profile; pale blue except for blackish nostrils, culminicorn and sulcus. Iris, dark brown. Feet, lavender-blue; webs, creamy-yellow.

SIMILAR SPECIES **Salvin's Prions** very similar and inseparable at sea (see Recognition; Harper 1980). For differences from **Broad-billed Prion** *P. vittata*, see that account. **Slender-billed Prions** *P. belcheri* closely similar, with overlap in pattern of plumage (especially in s. Indian Ocean and A'asian waters) and jizz; separation difficult and should be based on combination of following typical characters: Slender-billed slightly smaller and slimmer-bodied, with proportionately smaller head and slimmer neck; bill, more slender, delicate, not so deep at base; in flight, head not tucked into body, wings usually held straighter, and projection of body about equal in front of and behind wings, giving generally more compact appearance (on Antarctic, head usually tucked into body, giving thick-necked and deep-chested appearance, and carpal joints usually held well forward, giving greater projection of body behind wings than in front); mostly white lores and long broad white supercilium form striking pale face; M-marking, less distinct; tail-band, narrower; flight, dainty, often with much aerobatics; in calm weather often faster and more manoeuvrable. For distinctions from **Fairy** *P. turtur* and **Fulmar** *P. crassirostris* **Prions**, see those texts.



Widespread in s. oceans (rare in central South Pacific); in wide range of marine habitats. Pelagic, ranging into shelf-break and continental shelf waters but usually seen from land only during onshore gales, except round breeding sites. Flight, fast, buoyant and erratic with twisting glides broken by short bursts of crisp shallow wing-beats; often arc high above sea; in calm weather, flight, slower more laboured with peculiar 'flopping' action. From head on, carpals raised slightly and outerwing bowed down. Feed during day by surface-seizing, hydroplaning, dipping, surface-diving and surface-filtering; when hydroplaning, scurry forward using feet, with breast on water, wings outstretched and head or bill submerged; strain plankton from water with lamellae of bill. Highly gregarious, often in flocks of thousands, especially when feeding. Sometimes follow or circle ships for short periods. Breed colonially on subantarctic and Antarctic islands. Nocturnal at breeding colonies, occasionally arriving at dusk in stormy or overcast conditions. Utter repeated staccato notes and throaty cooing at breeding sites.

HABITAT Marine, pelagic; in Antarctic and subantarctic waters, mainly in Indian, Southern and Atlantic Oceans. In Ross Sea, occur S to -0.5 °C isotherm, penetrating to higher latitudes in late summer than in spring; prefer open cold waters N of zone of icebergs and pack-ice (Ainley *et al.* 1984). Avoid pack-ice (Zink 1981; Ainley *et al.* 1984), but may penetrate a short distance in open water of leads and pools (Cline *et al.* 1969). Particular prey taken round each breeding island may determine feeding areas used (Tickell 1962). On Heard I., feed inshore in bays, at base of cliffs and off glaciers; from surf zone to a few kilometres offshore (Falla 1937; Downes *et al.* 1959). Large flocks observed 6–16 km offshore from Auckland I. (Harper 1972). But on Signy I., birds do not feed in bays or inshore waters, and flocks observed 16–160 km offshore; when island surrounded by pack-ice, birds feed >16 km from ice-edge (Tickell 1962).

Breed on subantarctic and Antarctic islands that are free of pack-ice in summer; one record of breeding on Antarctic continent, at C. Denison (Falla 1937), but breeding not widespread there, probably because persistent pack-ice limits feeding areas (Tickell 1962).

Predators and other animals introduced by humans have probably affected breeding on some islands: Wekas *Gallirallus australis* and cats on Macquarie I.; rabbits on Iles Kerguelen (Falla 1937; Brothers 1984).

DISTRIBUTION AND POPULATION S. Indian and Atlantic Oceans; breed Antarctic and subantarctic islands; when breeding, between about 50°S and limit of pack-ice; shift N in non-breeding periods. Common visitor in winter and spring to NZ and s. Aust.

Remain S of 50°S during breeding season, with pack-ice representing s. limit (Murphy). In non-breeding season, disperse N to subantarctic and subtropical regions; abundant in South Atlantic and s. Indian Oceans; rare in central South Pacific (Harper 1972). Non-breeding visitor to s. African coast, from Walvis Bay to Durban (McLachlan & Liversidge 1978). In South America, irregular off Chile (Johnson 1964) and regular seasonal visitor to Peru (to 12°S) (Plenge 1974). In Atlantic, N to 24°S off s. Brazil (de Schauensee 1970).

AUST. Often beachcast in s. Aust., fewest on e. coast. **Qld**. One, Burleigh Heads, 30 May 1955 (QM 0.5439; Robertson 1956); one, One Tree I., July 1974 (Chilvers 1975). **NSW**. Beachcast specimens from entire coastline; between 1970 and 1976, 250 recovered: 18%, N of 29°S; 22% between 29–30°S; 1%, 30–31°; <1%, 31–32°; 10%, 32–33°; 25%, 33–34°; 10%, 34–35°; >1%, 35–36° (Morris 1972, 1973, 1974; Morris & Sawyer 1973; Holmes 1976, 1977; Holmes & Morris 1975). **Vic**. Beachcast w. and central coasts, from Nelson to Wilson's Promontory (Cooper 1970; Vic. Bird Reps 1982–86). **Tas**. Commonly beachcast during winter (Sharland 1958; Green 1977). Beachcast, King and Flinders Is and ne., s. and w. coasts. **SA**. Commonly beachcast between May and Oct. (Condon 1969; Cox 1976). **WA**. Commonly beachcast in SW (Serventy & Whittell 1976); most frequently beachcast prion in Swan R. district (Serventy 1948). Wrecks occurred in NSW in 1954 and 1973 (Morris 1974) when almost all beachcast birds (203 of 250) found. Large numbers of prions seen at sea off se. NSW (Marchant 1977) and in Bass Str. (D.W. Eades) probably included many Antarctic Prions.

NZ Common in waters S of NZ; less common coastally (Oliver). Usually beachcast. **NI**. Beachcast specimens found all coasts but most frequently on w. coast between Auckland West, Taranaki and Wellington West. Nearly 90% of all beachcast Antarctic Prions found on Auckland West

Plate 39

Blue Petrel *Halobaena caerulea*
1. Adult, ventral
2. Adult, dorsal

Slender-billed Prion *Pachyptila belcheri*
3. Adult, ventral
4. Adult, dorsal, fresh
5. Adult, dorsal, worn
6. Adult, head

Fairy Prion *Pachyptila turtur*
7. Adult, ventral
8. Adult, dorsal
9. Adult, head

Fulmar Prion *Pachyptila crassirostris*
10. Adult, dorsal
11. Adult, head

beaches at a rate of 17.8 birds/100 km. Less common on ne. coast and uncommon on se. coast (Powlesland 1989). **SI.** Uncommonly beachcast, mainly on e. coast between Canterbury North and Otago. Between 1960 and 1976, only one recovery on w. coast. Wrecks June–July 1974, 1975, 1986 (Powlesland 1989).

BREEDING Antarctic and subantarctic islands in s. Indian, Southern and South Atlantic Oceans.

Possibly breed Bouvetøya and Balleny I. (Murphy; Tickell 1962).

Long-term survival may be affected by harvesting of krill, its major food (Croxall *et al.* 1984). On S. Georgia, nesting now restricted to areas not yet inhabited by Brown Rats *Rattus norvegicus*. Feral cats prey on prions on Iles Kerguelen and Macquarie I. (Jones 1977). Pigs affect nesting on Auckland I. (Robertson & Bell 1984), cattle trample burrows on Iles Kerguelen (Jouventin *et al.* 1984). Wekas kill prions on Macquarie I. (Falla 1937). Of 36 beachcast Antarctic Prions examined, 13.8% of immatures' and 16.7% of adults' gizzards contained plastic pellets (Harper & Fowler 1987).

Locality	Year	Population (pairs)	Ref.
Iles Crozet	1981–82	100s	1
Ile de l'Est		10s	1
Ile des Pingouins		10s	1
Iles Kerguelen	1984–87	$2–3x10^6$	2
Heard I.			3,4
Macquarie I.	1973–76	*c.* 49 000	5,6
Scott I.	1966–67	<200?	4,7
Auckland I.	1984	$1x10^5–1x10^6$	8
		$3.5–7.5 \times 10^5$	9
S. Georgia		$22x10^6$	10
S. Sandwich Is		1000–10 000	10
S. Orkney Is		$5–10x10^4$	10
S. Shetland Is		1000–10 000	10
Elephant I.		440	10,11
King George V Land			
C. Denison	1913 (prob. no longer)		4,12

References: (1) Jouventin *et al.* (1984); (2) Weimerskirch *et al.* (1989); (3) Downes *et al.* (1959); (4) Harper (1980); (5) Jones (1980); (6) Rounsevell & Brothers (1984); (7) Harper *et al.* (1984); (8) Robertson & Bell (1984); (9) P.C. Harper; (10) Croxall *et al.* (1984); (11) Tickell (1962); (12) Falla (1937).

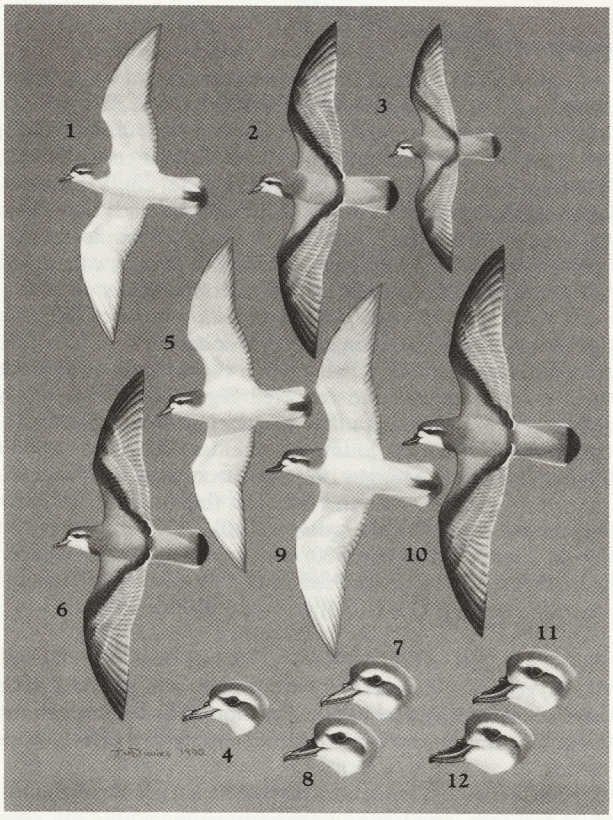


Plate 40

Antarctic Prion *Pachyptila desolata*
1. Adult, ventral
2. Adult, dorsal, fresh
3. Adult, dorsal, worn
4. Adult, head

Salvin's Prion *Pachyptila salvini*
5. Adult, ventral
6. Adult, dorsal
7. Adult, head, light bill
8. Adult, head, dark bill

Broad-billed Prion *Pachyptila vittata*
9. Adult, ventral
10. Adult, dorsal
11. Adult, head, light bill
12. Adult, head, dark bill

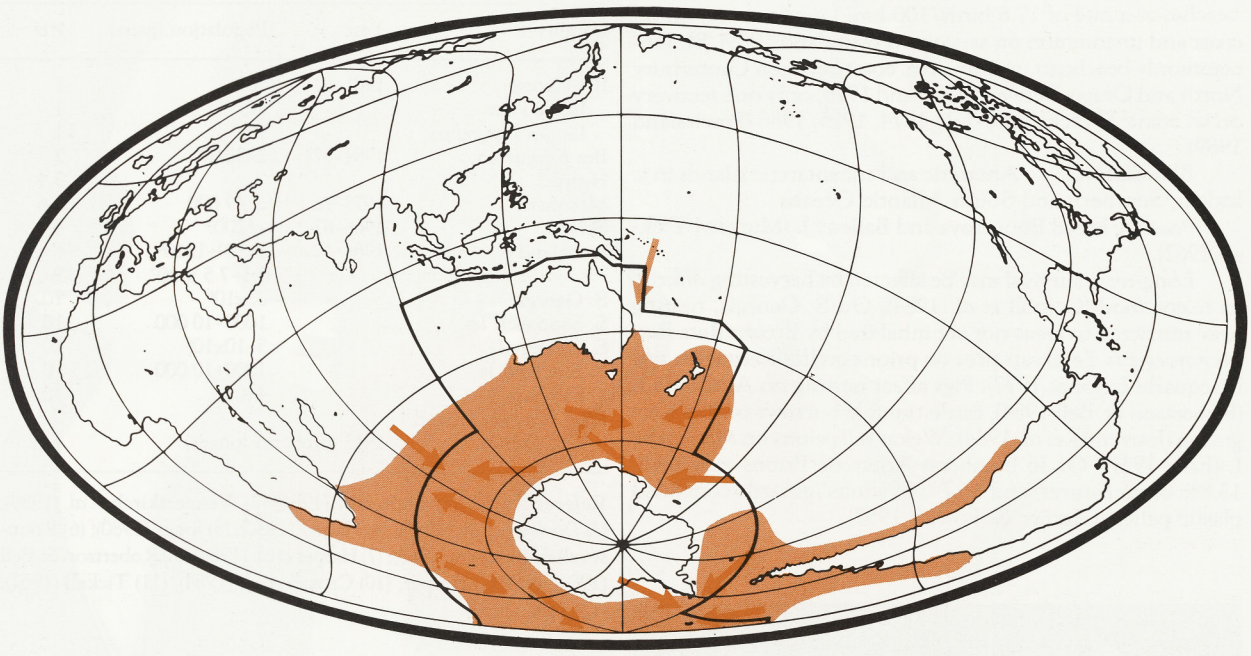
MOVEMENTS Dispersive or migratory; all age groups leave breeding grounds after breeding (Falla 1937; Downes *et al.* 1959; Tickell 1962), most probably moving N, extent of longitudinal movement being largely unknown.

DEPARTURE Fledgelings leave Iles Crozet, early Mar. (Jouventin *et al.* 1985); Bird I., S. Georgia, 20 Mar. (1 day; 6–30 Mar.) (Hunter *et al.* 1982); Signy I., over four seasons, 25 Mar. (6.2 days; 12 Mar.–7 Apr.; 54 birds) (Tickell 1962; Beck 1970) with occasional records of adults from later in Apr. (Tickell 1962). Latest record Heard I., 7 May but most depart by mid-Apr. (Downes *et al.* 1959).

NON-BREEDING Exact winter feeding grounds unknown but no evidence of circumpolar migration by any population. No supporting evidence for movements of banded birds but, judged from morphological characters of beachcast birds and specimens, probably birds from Macquarie and Auckland Is move N; immatures regularly beachcast on s. coasts Aust. and NZ, late Mar.–Aug.; earliest record NZ, mid-Mar. (Harper 1972). Iles Kerguelen birds move E and regularly wrecked WA, May–Sept. but uncommon SA and Vic. and rare NZ (Harper 1972, 1980). Heard I. birds recorded occasionally NZ but rare Aust. Immatures range widely into subantarctic waters after fledging. Some birds seen E of Chatham Is, Sept. (Harper 1972); seen irregularly off Chilean coast and commonest prion off s. Africa, where chiefly winter visitor (Brooke & Sinclair 1978).

RETURN First returns Iles Crozet, late Sept. (Jouventin *et al.* 1985), Signy I., 27 Oct. (7.5; 11 Oct.–10 Nov.; 18 seasons) (Rootes 1988), S. Georgia, 25 Oct. (Croxall & Prince 1987), Heard I. (Downes *et al.* 1959) and Macquarie I. (Brothers 1984), late Oct.–early Nov. but do not reoccupy burrows until early Nov. by which time bulk of population present.

BREEDING During breeding season large concentrations of prions noted feeding only few kilometres from Heard I. (Downes *et al.* 1959) but, on basis of homing experiments from Signy I., can probably travel >320 km/day giving foraging range of 640 km between incubation shifts and 160 km while feeding chicks (Tickell 1962). From flight speed and feeding frequency foraging range estimated 244–300 km from



S. Georgia (Croxall & Prince 1980, 1987). Regularly beachcast NZ where peak mortality usually Aug. of birds driven N by s. or sw. gales (Powlesland 1989).

FOOD Largely euphausiid crustaceans but including other mysidaceans, amphipods and copepods, with smaller amounts of fish, cephalopods and gastropods. BEHAVIOUR. Most prey obtained from surface by surface-seizing, also uses surface-filtering, hydroplaning, dipping and surface-diving (Murphy; Prince 1980; Harper 1987) with wings half spread (Downes *et al.* 1959); surface-seizing 71.2% observations, hydroplaning 17.0%, dipping about 7.3% (two small flocks totalling about 41 birds), surface-diving 3.7%, surface-filtering 0.9% (565 observations; Harper 1987). Sieve minute food items from water using lamellae inside upper mandible: one 16-g sample contained >40 000 copepods (Prince 1980). Birds disturbed by boats at sea seen flying off with adult euphausiids held crosswise in bills (Harper 1972). Seen feeding only during daytime (Harper 1987), sometimes in association with Southern Fulmar *Fulmarus glacialoides* and White-headed Petrel *Pterodroma lessonii* (Ainley & Boekelheide 1983).

NON-BREEDING Crustaceans *Euphausia superba* only food in samples Ross Sea (three stomachs, 0.9 cm [0.3; 15]; Ainley *et al.* 1984) and s. Atlantic (three stomachs, 1.22 cm [0.79–1.97; 171]; Harper 1987). At Heard I., seen catching long white or pale-pink worm-like creatures (Downes *et al.* 1959). One collected South Atlantic contained remains of fish and crustaceans incl. mysidaceans, euphausiids (Murphy), another contained euphausiids and cephalopod beaks (Bierman & Voous 1950).

BREEDING At **Bird I., S. Georgia** (90 regurgitated samples; Prince 1980) oil 19.5% wt., unident. food 32.5, identified 48. Of identifiable solids crustaceans 97.6% wt., 98.9% no., 99.8% freq.; fish 1.8, 4.4, 0.1 (possible maximum 11.5% wt including unidentified material); cephalopods 0.6, 8.9, 0.1 (*Alluroteuthis antarctica*). Of identified crustaceans (10 796), copepods: 32.3% wt., 78.5% no., 36.7% freq.: *Rhincalanus gigas* 0.88 cm (0.08, 35), *Calanoides acutus* 0.44 cm (0.08; 19); mysidaceans 0.8, 0.3, 10.0: *Antarctomysis maxima* 1.53 cm (0.70; 14); amphipods 8.2% wt.: *Hyperia macrocephala* 0.1, 0.1, 8.9, 0.66 cm (0.22; 13), *Hyperiella antarctica* 1.7, 4.8, 30.0, 0.54 cm (0.12; 23), *Hyperoche medusarum* 0.4, 0.4, 14.4, 0.95 cm (0.53; 9), *Themisto gaudichaudii* 4.6, 3.3, 46.7, 1.15 cm (0.38; 38), *Cyllopus lucasii* 0.9, 1.3, 35.6, 1.10 cm (0.31; 23), *Vibilia antarctica* 0.5, 0.4, 17.8, 0.83 cm (0.23; 5); euphausiids *Euphausia superba* 58.4, 9.8, 86.7, 4.10 cm (1.75; 51), *Thysanoessa macrura* 0.3, 1.1, 8.9, 1.15 cm (0.20; 5). One sample, containing 41 188 *Calanoides acutus*, excluded from analysis.

At **Heard I.**, amphipods *Hyperiella antarctica, Hyperia spinigera, Themisto antarctica*; gastropods *Clio sulcata* (five stomachs nesting adults; Ealey 1954); euphausiids, amphipods and a whole cephalopod reported **Signy I., S. Orkney Is** (Tickell 1962), one bird at **Iles Kerguelen** reported with stomach full of *Themisto antarctica* (Paulian 1953) and another had cephalopods (Mougin 1975); one from **Auckland Is**, contained *T. gaudichaudii* and two fish (Imber 1981) and stomachs collected **Iles Kerguelen** (Falla 1937) and beachcast birds from **NZ** (Harper 1980) contained cephalopod beaks.

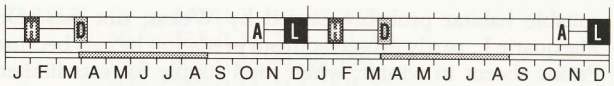
INTAKE Chicks fed at S. Georgia on 83% nights (n=326), gaining 11.6 g (5.4) per meal (Prince 1980).

SOCIAL ORGANIZATION Based mainly on Tickell (1962) and P.C. Harper. Gregarious at sea while seeking food and when feeding. Flocks of many thousands not uncommon near breeding grounds. No detailed description of behaviour at sea.

BONDS Little information on length of pair-bonds, but probably long lasting because breeding adults use same burrow each year. If eggs neglected, addled or lost, pairs may split up and keep company with strange birds in own territory or in other nests nearby. Nests deserted by experienced breeders early in season may be taken over and defended by other birds, but early return of experienced breeders in following season will usually prevent late comers from regaining it. Both parents incubate and tend young until fledging.

BREEDING DISPERSION Colonial. Burrows densely spaced: at S. Georgia, 1400 burrows/1000 m^2 (Croxall & Prince 1980).

ROOSTING At nest-sites early in breeding season, on snow banks and on sea at other times; details not known.



SOCIAL BEHAVIOUR Not well known; based on Tickell (1962) and information supplied by P.C. Harper. Silent at sea, but noisy in burrows and when in flight at breeding grounds. Usually return to nesting burrows after nightfall; occasionally arrive before dusk during stormy weather. Rarely visit land by day.

AGONISTIC BEHAVIOUR Pair strongly defend nest territory against large numbers of non-breeders within colonies. FIGHTS frequently fierce, sometimes wounding, with pecking, biting and tearing directed at opponent's head, back or bill. Prions lack ability to eject stomach oil as means of defence, although can dribble oil when severely alarmed.

SEXUAL BEHAVIOUR On arrival at colony, pair-formation and courtship begin without delay; pairs face off, or sit head to tail, frequently with billing and rubbing, sometimes pecking if aggressive levels still high. Female utters high-pitched piping whistle during coition (Tickell 1962). No post-copulatory displays. Females spend 2 weeks at sea before laying. Males and unemployed birds continue visiting breeding grounds during females' absence. Burrow maintained by digging through snow; claws sometimes worn back to webs when digging in frozen gravel.

RELATIONS WITHIN FAMILY GROUP Experienced birds share incubation equally, each spending total of 22–23 days on egg. Change-overs quick, normally complete 2 h or less after sunset. If mate fails to return, birds will sit up to 6 days and nights awaiting relief. Eggs in snow regions rarely deserted; hatching successful after 1–2 days of neglect and sometimes up to 6 days (Tickell 1962). Chicks brooded 3–5 days after hatching, thereafter deserted during day.

VOICE No detailed studies. Generally silent at sea; noisy in burrows and in flight at breeding colonies. Rapid twittering (Buller 1873). The noise of thousands of birds described as low continuous murmur like the sound of distant street traffic in large town (Eaton, in Sharp 1879). Loud, shrill *squarks* and squeals uttered in defence of territory and during fights (Tickell 1962). No other information.

ADULT Most frequent call, throaty cooing . . .*uc coo uc coo u-u-u-u-uc cuc coo o-o-o-o*. Resembles call of turtle-doves *Streptopelia* spp (Will 1884). Flight call described as *u-u u-u u-u* (Eaton, in Sharp 1879).

YOUNG No information.

BREEDING Not well known. Only comprehensive study at Signy I. by Tickell (1962). Information supplied by P.C. Harper. Breed in dense colonies, e.g. 1400 burrows/1000 m^2 at S. Georgia (Croxall & Prince 1980).

SEASON Broadly from mid Oct. to early Apr., through range, with first eggs in first week, and last in last week of Dec. Variations in different parts of range or caused by weather not known. At Signy I., birds returned in mid Oct., colony fully occupied early Nov. Testes well developed, ovaries little developed in Oct.; free sperm not available till mid Nov.; largest follicle (5.5 mm diam.) in copulating female 20 Dec., (Tickell 1962). Pre-laying exodus for about two weeks in late Nov.–early Dec. Adults and young leave about same time (12 Mar.–7 Apr.), Signy I.; all gone by mid-Apr.

SITE Nest in burrows or rock crevices; in coastal and inland slopes, plateaux, gullies, screes and cliffs. At low latitudes, most birds burrow among low vegetation (*Azorella*, *Acaena*, grass) on sheltered slopes; a few in exposed, high-altitude sites among sparse vegetation (Falla 1937; Downes *et al.* 1959; Brothers 1984); at high latitudes, where soil and dense vegetation absent, nest in ice-free rocky sites; simply under mats of moss in S. Orkney Is (Falla 1937; Tickell 1962; Harper 1972). Burrows used by same breeding birds in successive years. Males keep burrows clear of snow immediately before females return for laying. No further details of excavation of burrows.

NEST, MATERIALS Burrows 0.23–1.0 m in length, depending on depth of soil, at Signy I. (Croxall & Prince 1980); 2.6 m long, Macquarie I. (Falla 1937; P.C. Harper). Nest chamber 20–30 cm below surface. Sometimes more than one entrance. Material varies from nothing to accumulation of loose rocks, sticks, mosses and lichens. Eggs are sometimes immersed in water or embedded in ice.

EGGS Large, sub-elliptical; smooth, matt; white when laid, becoming stained; thin-shelled, eight empty shells averaged 3.8 g (2.5–5.0) (Tickell 1962).

MEASUREMENTS: Signy I.: 47.1 (44–52; 42) x 34.6 (31–36.5) (Tickell 1962); Macquarie I.: 50.0 x 35.0, 50.2 x 36.0 (n=2; Falla 1937).

WEIGHTS: Signy I.: 32.8 (29–36; 23) (Tickell 1962). Egg-mass 20.8% of mean adult mass (Mougin 1975).

CLUTCH-SIZE One. No replacement laying.

LAYING Synchronized; usually laid on night of female's return. At Signy I., 1955 and 1956, mean dates of laying 20 Dec. (7–31 Dec.) and 19 Dec. (5–27 Dec.) (Tickell 1962); at Macquarie I., fresh eggs plentiful, 13–14 Dec. (Falla 1937).

INCUBATION By both adults in average shifts of 3 days (1–5; 103) during which not visited by partner. INCUBATION PERIOD: 44.8 days (0.56; 44–46; 10) (Tickell 1962).

NESTLING Semi-altricial, nidicolous. Brooded (guarded) by both adults for 1–5 days, then left alone in burrows. Fed by both adults by incomplete regurgitation; after one week old, at night only. NESTLING PERIOD: at Signy I., (four seasons): mean date of hatching 2 Feb. (22 Jan.–23 Feb.; 48); mean date of departure 25 Mar. (0.84 days; 12 Mar.–7 Apr.; 54); thus period about 51 days. All birds gone by mid-Apr., later or delayed young trapped in burrows by snow and gales. Most young leave on dark nights with *c.* 15 kt winds; able to fly immediately on leaving burrows (Tickell 1962). At Macquarie I., chipping eggs and small chicks 24 Jan. (Warham 1969).

GROWTH At hatching, 21–25 g; at departure, maximum 247 g or 165% of mean adult mass (150 g). Protoptile, smoky blue-grey, lighter on belly; egg-tooth remains for about 6 days, gone by 10 days old. Mesoptile paler than protoptile. See Tickell (1962) for growth curves of bill, wings, tail and replacement of down by feathers.

SUCCESS Little information. Skuas *Catharacta* spp main predator of young, whose direct pattern of flight makes them an easy prey, and of some adults; may also try to dig out birds calling from shallow burrows. On Iles Kerguelen, breeding restricted to islets and steep slopes where rabbits absent (Falla 1937). Previously bred in abundance on coastal tussock slopes on Macquarie I., but Wekas in these areas damaged burrows (Falla 1937); now breed mainly on plateau where Wekas absent. Therefore, abandonment of

suitable habitat probably caused by Wekas, not cats. On Macquarie I., partly protected from predation by cats because Prions absent in winter, when food supply for cats limited (Brothers 1984). At S. Georgia, introduced rats *Rattus* spp seriously reduce numbers. Giant-Petrels *Macronectes* spp occasionally take prions at sea (Hunter 1985; P.C. Harper).

PLUMAGES Based on Heard I. birds. Age of first breeding unknown.

ADULT HEAD AND NECK. Crown to hindneck, grey (78); concealed bases of feathers, pale grey (86); rachis, dark brown (119A). Feathers of forehead with narrow white fringes, which are broader at lores and margins of lower mandible. Sub-orbital patch, dark grey (83); anterior margin, grey-black (82). White supercilium connects with lores, terminating above ear-coverts; at posterior margin, narrow subterminal blue-grey (88) band on feathers. Sides of neck, grey (87), forming incomplete collar. Rest of head and neck, white; demarcation at side of neck, sharp. Feathers at demarcation from malar to collar, varyingly mottled light grey (85). Interramal space, bare. UPPERPARTS. Mantle, back and rump, grey (87); concealed bases of feathers, dull white; rachis, grey-brown (91). Mantle, back and rump, with light-grey (85) fringes. On lower back, fringes, dark grey (78); distal tip of rachis, black-brown (119); feathers form central part of M-marking when wings spread. Scapulars, light grey (85) at base with broad subterminal black-brown (119) band; broadly tipped white, especially outer web; innermost scapulars, mostly dark brown (119); very narrow white tips. Rachis of scapulars, brown-grey (80) at base merging to black-brown (119). TAIL, dull blue-grey (88); rachis, dark olive-brown (129); tip of tail, black-brown (119). Black-brown (119) tip on t1 and t2 prominent; suffused on t3; slight on inner web of t4; t5–6, light grey (85). UPPERWING. Marginal coverts at humeral joint, white. Marginal, lesser and tertial coverts, dark brown (121); feathers, narrowly fringed grey (84); rachis, dark brown (121); feathers form part of M-marking when wing spread. Median and greater coverts, grey (87), with light-grey (85) fringes. Greater coverts and secondaries tipped pale grey (86). Tertials similar, but outer web suffused dark brown (121). Alula, marginal coverts near alula, and greater primary coverts, dark brown (121); marginal coverts near alula narrowly fringed grey (84); greater primary coverts have narrow white tips. Outer web p10–7, black-brown (119); inner web, mottled grey (84), merging to white; rachis, grey-black (82). P6–1, grey (87); rachis, basally grey-brown (91), merging to grey-black (82) distally. All primaries narrowly tipped white. UNDERPARTS, almost entirely white. Feathers on outer breast with grey (87) tips. Flanks, white, with varyingly mottled light-grey (85) tips. Lowermost flank-feathers, next to abdomen, have broad light-grey (85) subterminal tips and narrow pale-grey (86) tips. Axillaries, white, varyingly mottled light blue-grey (88) on webs. Two longer outermost under tail-coverts, tipped black-brown (119); next innermost, varyingly mottled grey (84) and white; rachis, white. Rest of under tail-coverts similar to feathers of lower flanks. UNDERWING, almost entirely white. Marginal coverts from base of p11 to carpal joint, have outer webs dark brown (121) and inner, white, or dark brown (121), fringed white. In worn plumage, white fringes on forehead and at margins of lower mandible, and white tips on primaries lost. Similarly, white tips to scapulars mostly lost. With wear, plumage becomes darker (Harper 1980).

DOWNY YOUNG Protoptile, smoky blue-grey, lighter on belly. Egg-tooth present at 6 days old. Protoptile, 20–25 mm long at 8 days old. Mesoptile begins to appear on underparts at 8 days; slightly lighter in colour. Egg-tooth lost by 10 days old. Mesoptile 3–5 mm long at 12 days old. At 16 days, primaries sprout; thick mat of whitish down covers belly. At 40 days, face free of down, white supercilium prominent. At 45 days, wing and tail full length and, with head, free of down. Fledging *c.* 54 days (42.5–54.0; 22) (Tickell 1962). Full details of plumage changes in chicks in Tickell (1962).

JUVENILE Indistinguishable from adult in fresh plumage; structural characters differ (see Sexing, Ageing).

BARE PARTS Based on photos in Lindsey (1986) and at NZDOC library.

ADULT, JUVENILE Iris, dark brown (219). Bill, light blue-grey (88); culminicorn, grey-black (82). Interramal space, blue or violet-grey (Bierman & Voous 1950). Tarsus and toes, light blue (88); webs, grey (85). Claws, pale grey (86), tipped grey-black (82).

DOWNY YOUNG Few data. Tickell (1962) states: at 12 days, legs brighter blue and bill darkens. At 22 days, pink fleshy webs of feet darken slightly; edge of lower mandible, smooth and rounded although lamellae in maxilla only slightly developed and space at gape not yet visible.

MOULTS

ADULT POST-BREEDING Complete; occurs last weeks of breeding season. Body moult, late Mar.; remiges replaced Apr.–May at sea. (Tickell 1962; Harper 1980). Remiges moult outwards; replacement rate unknown. Non-breeders moult mid-winter.

POST-JUVENILE Not known.

MEASUREMENTS (1) Adults, skins (Mus. Hist. nat., Paris; J.A. Bartle). (2) Signy I., S. Orkney Is, adults, live (Tickell 1962). (3) Mostly s. Aust., beachcasts, status unknown; methods unknown (Condon 1944).

		MALES	FEMALES
WING	(1)	184 (3.64; 181–193; 8)	186 (2.34; 182–189; 8)
	(2)	193 (182–209; 19)	192 (185–200; 12)
	(3)	187 (7.46; 174–198; 13)	188 (8.89; 168–203; 16)
TAIL	(2)	102.0 (97–111; 19)	101.0 (95–107; 12)
	(3)	101.9 (6.65; 88–110; 13)	102.0 (3.43; 96–110; 16)
BILL	(1)	26.5 (0.92; 24.5–27.4; 8)	26.1 (0.79; 25.2–27.7; 8)
	(2)	28.0 (26.5–31; 19)	27.7 (26–30; 12)
BILL W	(1)	12.6 (0.49; 12–13.7; 8)	12.3 (0.64; 11.2–13.3; 8)
	(2)	14.9 (14.5–15.5; 19)	14.5 (14–15.5; 12)
	(3)	12.4 (0.58; 11.5–13.5; 13)	12.3 (0.83; 11–14; 16)
BILL D	(3)	6.8 (0.62; 6–8; 13)	6.6 (0.37; 6–7.5; 16)
TARSUS	(1)	33.0 (0.84; 31.6–34.7; 8)	33.9 (0.75; 32.5–34.8; 8)
	(2)	32.5 (29.5–35.5; 19)	32.1 (29–34; 12)
TOE	(1)	37.0 (1.09; 35–38.6; 8)	37.8 (1.71; 35.3–41.3; 8)
	(2)	36.4 (34.5–38; 19)	36.3 (34.5–38.5; 12)
	(3)	37.9 (1.70; 35–40; 13)	38.2 (1.59; 35–42; 16)

Unsexed birds. (1) Adults, skins; method of wing measurement unknown (Tickell 1962). (2) Adults, not specified whether skins or live birds; methods unknown (Harper 1980). (3) Iles Kerguelen; methods unknown (Weimerskirch *et al.* 1989). (4) Heard I., live birds, 1987–88, sexes combined; methods as in Cox (1981); BILL D = depth at base; BILL W = width at base; THL = Total Head Length (E.J. Woehler). (5) Signy I., freshly dead adults; as above (Tickell 1962). (6) Heard I., fresh birds; as above (Tickell 1962). (7) S. Orkney Is, fresh

birds; as above (Tickell 1962). (8) S. Georgia, fresh birds; as above (Tickell 1962). (9) Heard I., adult skins; as above (Tickell 1962). (10) S. Orkney Is, adult skins; as above (Tickell 1962). (11) Locality unspecified, adult skins (Harper 1980). (12) Scotia Sea, adult skins (Harper 1980). (13) Macquarie I., live adults; minimum chord (Brothers 1984). (14) Auckland I., adult skins; as above (Tickell 1962). (15) Macquarie I., adult skins; as above (Tickell 1962). (16) Auckland I., adult skins (Harper 1980). (17) Macquarie I., adult skins (Harper 1980).

UNSEXED

WING	(1)	188 (1.03; 180–199; 31)
	(2)	185 (4.42; 179–197; 40)
	(3)	186 (3.8; 176–195; 118)
	(4)	193 (4.67; 182–204; 40)
	(6)	193 (3.34; 187–197; 19)
	(7)	192 (5.22; 173–209; 125)
	(8)	194 (4.80; 184–208; 69)
	(9)	191 (4.64; 178–201; 27)
	(10)	190 (1.47; 179–198; 27)
	(11)	189 (3.75; 182–195; 22)
	(12)	191 (3.81; 185–199; 18)
	(13)	189 (5.17; 180–202; 77)
	(14)	180 (3.25; 171–191; 34)
	(15)	187 (4.75; 177–199; 17)
	(16)	181 (4.48; 171–197; 41)
	(17)	187 (5.09; 177–200; 26)
TAIL	(1)	93.8 (2.53; 89–100; 31)
	(2)	89.4 (5.05; 82.7–100; 40)
	(4)	93.1 (4.82; 77–103; 40)
	(6)	94.8 (3.34; 86–99; 19)
	(7)	99.9 (4.68; 77–113; 125)
	(8)	97.5 (3.94; 91–107; 24)
	(9)	94.4 (5.08; 86–104; 27)
	(10)	97.7 (6.15; 89–102; 27)
	(11)	91.5 (4.22; 87–100; 22)
	(12)	92.2 (3.81; 85–98.4; 18)
	(13)	84.4 (4.38; 72–97; 77)
	(14)	79.0 (5.74; 72–93; 34)
	(15)	84.4 (6.96; 73–96; 17)
	(16)	86.0 (3.84; 79–92; 41)
	(17)	89.6 (4.58; 82–96; 26)
BILL	(2)	27 (1.26; 25–29; 40)
	(3)	26.9 (1.0; 24.7–29.3; 118)
	(4)	28.6 (0.89; 27.0–30.1; 40)
	(11)	27.7 (0.93; 26.7–29.8; 22)
	(12)	27.4 (0.84; 26.4–28.8; 18)
	(13)	27.4 (1.05; 25.5–29.5; 77)
	(16)	26.8 (0.64; 25.0–28.7; 41)
	(17)	27.2 (1.01; 25.6–28.5; 26)
BILL D	(4)	13.4 (0.69; 12.2–14.9; 40)
BILL W	(1)	13.1 (0.15; 12.0–14.5; 31)
	(2)	13.1 (0.63; 12.0–14.5; 40)
	(3)	13.5 (0.5; 12.1–14.6; 118)
	(4)	14.7 (0.67; 13.3–16.4; 40)
	(6)	15.2 (0.24; 14.0–16.5; 19)
	(7)	14.8 (0.06; 13.5–16.5; 125)
	(8)	14.9 (0.63; 13.5–16.0; 69)
	(9)	14.4 (0.24; 13.5–16.0; 27)
	(10)	13.9 (0.27; 13.0–15.0; 27)
	(11)	14.3 (0.46; 13.4–15.2; 22)
	(12)	14.0 (0.84; 13.3–15.7; 18)
	(13)	14.4 (1.66; 13.1–15.9; 77)
	(14)	13.9 (0.08; 11.5–15.5; 34)
	(15)	13.8 (0.15; 12.5–15.0; 17)
	(16)	14.1 (0.64; 13.3–16.0; 41)
	(17)	14.0 (2.54; 12.7–14.8; 26)
THL	(4)	64.2 (1.54; 60.4–66.8; 40)
TARSUS	(3)	34.1 (1.2; 31.5–37; 118)
	(4)	33.3 (1.36; 29.7–36.1; 40)
	(5)	30.4 (1.66; 27–35; 125)
	(13)	33.3 (1.14; 31.1–35.9; 77)

Bill shrinkage of combined adults and immatures, 6.0% (1.6; 4–10; 18) (Kinsky & Harper 1968); further details in Harper (1980). Additional measurements in Falla (1937; note that Falla's measurements are 10–12 mm short [Harper 1980]), HASB, Mougin (1985), Jouventin *et al.* (1985) and Cox (1981).

WEIGHTS Birds from Iles Kerguelen, unsexed: 146.6 (14.1; 115–183; 118) (Weimerskirch *et al.* (1989); Ile de Croy, 145 (10; 120–169; 53); Golfe de Morbihan, 120 (17; 95–130; 4) (Mougin 1985). Birds from S. Orkney Is, adult males 160.0 (138–182; 18), adult females 153.0 (118–176; 12); Signy I., 158.6 (11.50; 116–199; 124) (Tickell 1962). Final weights before departure of young, 175, 224, 168, 150, 186. Full details of weight changes in chicks in Tickell (1962).

STRUCTURE Wing, short and narrow. Eleven primaries, p10 usually longest, p9 0–4 mm shorter, p8 6–10, p7 17–23, p6 29–38, p5 42–52, p4 55–65, p3 69–81, p2 83–93, p1 91–105, p11 minute. No emarginations. Eighteen secondaries, four of tertial form. Twelve rectrices, t1 longest, t6 14–23 mm shorter. Latericorns, straight-sided, except birds from Auckland Is. Maxillary unguis, large and rounded. Closed mandibles conceal small palatal lamellae; small lamellae visible in Scotia Sea populations; latericorns slope upwards proximally. For full details on bill structure see Tickell (1962) and Prince (1980). Bill often soiled with dirt when excavating burrow; claws can become very worn from digging in frozen gravel (Tickell 1962). Outer toe *c.* 107% of middle, inner *c.* 85%, hind, claw only.

SEXING, AGEING Adults sexed on cloaca and distension of abdomen in females during breeding season (Tickell 1962). Juveniles have high culmen, greater bill depth and soft latericorn, which distinguishes them from adults (Harper 1980).

RECOGNITION Discussed fully by Harper (1980). Average bill-length 26.5 mm, bill-width 14 mm; 'immatures' have weaker bill. Sides of latericorn straight when viewed from above, except Auckland I. birds which are bowed (resembling Salvin's Prion); bill of Iles Kerguelen birds like those of adult Slender-billed Prions; however skins (adult and juvenile) when dry, differ. Also differ from Slender-billed Prions by more pronounced tail-band.

GEOGRAPHICAL VARIATION Monotypic, following Harper (1980). Three subspecies have been recognised (*desolata, macquariensis* and *banksi*) (e.g. Tickell 1962; Peters); separated on bill-width, wing-length and tail-length (Tickell 1962). Cline in wing- and tail-lengths: long wings and tails at S. Georgia; short wings and tails at Auckland Is; corresponds to Bergmann's Rule. Bill lamellae of birds from S. Georgia and S. Orkney Is usually exposed at gape, more so than birds from other localities. Harper (1980) describes A'asian birds as having paler heads and more distinctive and contrasting facial pattern; birds from Iles Kerguelen, intermediate facial pattern; birds from Scotia Sea have dark feathering at gape, not present

in other populations and (with Heard I. birds) darkest plumage.

RMO

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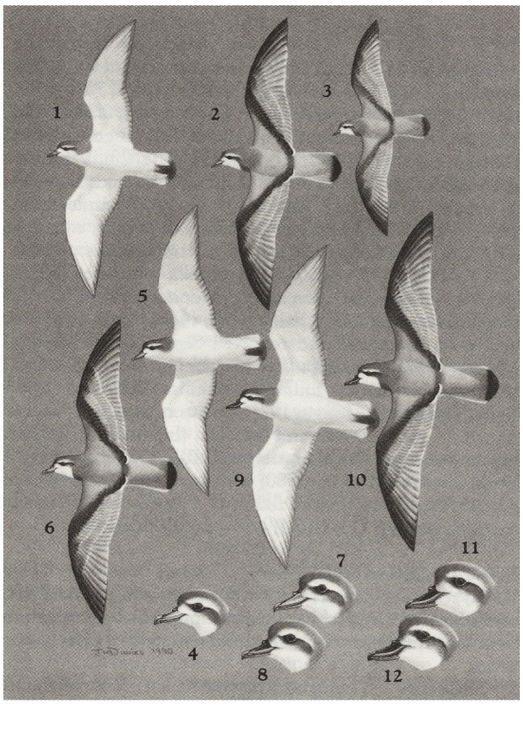

Volume 1 (Part A), Plate 40

Antarctic Prion *Pachyptila desolata*
1. Adult, ventral
2. Adult, dorsal, fresh
3. Adult, dorsal, worn
4. Adult, head

Salvin's Prion *Pachyptila salvini*
5. Adult, ventral
6. Adult, dorsal
7. Adult, head, light bill
8. Adult, head, dark bill

Broad-billed Prion *Pachyptila vittata*
9. Adult, ventral
10. Adult, dorsal
11. Adult, head, light bill
12. Adult, head, dark bill