

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.

### References

- Bang, B.G. 1966. *Acta anat.* 65: 305-415.  
 Bourne, W.R.P. 1976. Pp 403-502. In: Johnston 1976.  
 Brodkorb, P. 1963. *Bull. Flor. St. Mus. biol. Sci.* 7: 179-293.  
 Clarke, A., & P.A. Prince. 1976. *J. Exp. mar. Biol. Ecol.* 23: 15-30.  
 Fisher, J. 1952. *The Fulmar*.  
 Harper, P.C. 1978. *NZ J. Zool.* 5: 509-549.  
 Johnston, R. (Ed.). 1976. *Marine Pollution*.  
 Klemm, R.D. 1969. *S. Ill. Univ. Monogr. Sci. Ser.* 2.  
 Obst, B.S. 1986. *Wilson Bull.* 98: 189-95.  
 Olson, S.L. 1975. *Smithson. Contr. Paleobiol.* 23.  
 Swennen, C. 1974. *Ardea* 62: 111-117.  
 Timmermann, G. 1965. *Abh. Verh. naturwiss. Vereins Hamburg NF 8, Suppl.* 1-249.

## 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.

## REFERENCES

- Brodkorb, P. 1963. *Bull. Flor. St. Mus. biol. Sci.* 7: 179-293.
- Cox, J.B. 1980. *Rec. S. Aust. Mus.* 10: 91-121.
- Fleming, C.A. 1941. *Emu* 41: 134-55.
- Harper, P.C. 1980. *Notornis* 27: 235-86.
- Imber, M.J. 1985. *Ibis* 127: 197-229.
- Kuroda, N. 1954. *On the classification and phylogeny of the order Tubinares, particularly the shearwaters (Puffinus), with special consideration on their osteology and habit differentiation.* Tokyo.
- Murphy, R.C., & J.M. Pennoyer. 1952. *Am. Mus. Novit.* 1580.
- Olson, S.L. 1975. *Smithson. Contr. Paleobiol.* 23.
- Voous, K.H. 1949. *Ardea* 37: 113-22.

*Pachyptila crassirostris* Fulmar Prion

*Pachyptila turtur crassirostris* Mathews, 1912, *Birds Aust* 2: 221 — Bounty Island.

The specific name refers to thick (*crassus* Latin) bill.

POLYTYPIC Nominate *crassirostris* breeds Chatham, Snares and Bounty Is; *eatonii* (Mathews, 1912), breeds Heard and Auckland Is.

**FIELD IDENTIFICATION** Length 28 cm; wingspan 60 cm. A rare prion; similar in size, proportions and appearance to more abundant Fairy Prion *P. turtur* from which indistinguishable at sea; see that account for details; differs in having more robust bill (see Plumages, Measurements). Sexes differ; females slightly smaller. Agile in flight, with distinctive looping flight. At Bounty Is and Western Chain of Snares Is, regularly land and depart from nest crevices in daylight; only prion known to do so. Hover, butterfly-like, near entrance to nest-sites; fly in from sea and circle several times past landing spot, hovering and dangling their legs, before alighting and disappearing into cracks. About 100 prions observed mobbing skuas and gulls in flight (Robertson & van Tets 1982).

**HABITAT** Marine; pelagic in subantarctic and Antarctic waters; pelagic range poorly known because specific identification is difficult to impossible at sea. Some birds remain near breeding grounds all year (Harper 1980). Feed close inshore at breeding islands (Fleming & Baker 1973), or in pelagic waters (Imber 1981); do not fly over land beyond outer cliffs and scree slopes where they nest (Downes *et al.* 1959).

Breed on islands extending just S of Antarctic Convergence at Heard I. Nest in rocky situations; on sea-facing cliffs and scree slopes at Heard I. but avoid inland cliffs and moraines (Downes *et al.* 1959); in screes, in crevices and under rock slabs on Snares, Bounty and Chatham Is (Fleming 1939; Fleming & Baker 1973; Sagar 1977; Robertson & van Tets 1982; Miskelly 1984). Occasionally burrow in soil at Chatham Is (M.J. Imber). Many breeding sites lack soil and vegetation.

**DISTRIBUTION AND POPULATION** Poorly understood. Breed on subantarctic islands in NZ region and Heard I. No acceptable Aust. records; uncommon in NZ. Range at sea unknown. Easternmost record: 1660 km ESE of

Chatham Is (50°S 156°W), May 1966 (P.C. Harper). Lack of records from Aust., NZ mainland and Tasman Sea indicates few wander NW from colonies (Harper 1980). No evidence to suggest visits to Antarctic waters. Single record claimed for South Africa: Cape of Good Hope, 1841 (Clancey 1980); far outside known distribution and confirmation needed.

**AUST.** No confirmed records. Record from Portland, Vic. (Learmonth 1957) is an incorrectly identified Fairy Prion (Cox 1980). Other Aust. specimens erroneous, suspect or unconfirmed (Vic. Atlas).

**NZ** Least common prion. Between 1970 and 1986, 101 beachcast specimens. **NI:** most often beachcast along w. coast, between Auckland West and Wellington South, mostly Wellington South (0.9 birds/100 km). Occasionally collected from Auckland East and Bay of Plenty, rarely elsewhere. **SI:** very rare. Since 1960, three beachcast specimens, all from e. coast: single, Canterbury North, 1984 (Powlesland 1986) and two, Canterbury South, 1985. Wreck of 63 birds in Aug.–Sept. 1985, after 2 days of gale-force winds, most beachcast Auckland West and Wellington South (Powlesland 1987, 1989).

**BREEDING** On islands from just south of Subantarctic Convergence to just north of Subtropical Convergence.

Reports of Fulmar Prions on The Sisters, Chatham Is (Dawson 1955) and Antipodes Is (Oliver; Harper 1980; Cox 1980) not confirmed; all specimens (NMNZ) collected on The Sisters are Fairy Prions (A.J.D. Tennyson) and only Fairy Prions confirmed at Antipodes Is (Imber 1983). Birds breeding Falkland Is almost certainly Fairy Prions (Strange 1965); Fairy Prion from Iles Kerguelen once erroneously described as *P.c. eatonii* (Weimerskirch *et al.* 1989). Total NZ population <90 000 pairs, with most at Bounty Is.

**MOVEMENTS** Largely sedentary. Adults recorded Heard I. every month of the year (Downes *et al.* 1959) and

Locality	Year of estimate	Estimate (pairs)	Reference
Heard I.		1000s	1
Auckland Is			
Rose, Ocean, Ewing Is		1–5x10 <sup>3</sup>	2,3,4
Western Chain, Snares Is			
Rima I.	1984	1–2x10 <sup>3</sup>	5,6
Toru I.	1984	3–4x10 <sup>3</sup>	5,6
Bounty Is	1978	76 000	7
Chatham Is		1–5x10 <sup>3</sup>	2
Pyramid, Forty-four, Murumurus			8,9,10

(1) Downes *et al.* (1959); (2) Robertson & Bell (1984); (3) Yaldwyn (1975); (4) A.J.D. Tennyson; (5) Miskelly (1984); (6) Sagar (1977); (7) Robertson & van Tets (1982); (8) Fleming (1939); (9) Falla (1940); (10) C.M. Miskelly.



thought to be sedentary throughout range (Harper 1980). Most juveniles appear to leave Heard I., mid-Feb (Downes *et al.* 1959), and similar date postulated for Snares Is (Miskelly 1984). Some movement W from Chatham Is (P.C. Harper) but, from dearth of beachcast birds on w. coast of NZ, few probably enter Tasman Sea (though 63 beachcast July–Aug. 1985; Powlesland 1987). Probably feed close to shore (Ealey 1954; Fleming & Baker 1973; Sagar 1977; P.C. Harper).

**FOOD** Diet varies with locality but probably mostly crustaceans. **BEHAVIOUR.** Take food from sea surface by surface-seizing or shallow-diving (Robertson & van Tets 1982; Harper *et al.* 1985); small pouch of interramal skin well-developed and, though the bill does not have lamellae as in larger-billed prions, latericorns have some small serrations and birds probably filter some food from water (P.C. Harper). Males have longer more robust bill than females (Harper 1980), which suggests possible differences in diet. Seen feeding in association with Cape Petrels *Daption capense* at Bounty Is (Robertson & van Tets 1982). Most feeding during day; at Heard I., birds return to nesting burrows at dusk and leave at dawn (Downes *et al.* 1959); at Bounty and Snares Is active on land during day and also seen feeding close to shore during day (Fleming & Baker 1973; Sagar 1977; Robertson & van Tets 1982; Miskelly 1984); at Chatham Is, possibly feed on barnacles by day (Imber 1981).

**BREEDING** At Heard I. (38 stomachs; Ealey 1954) gastropods *Clio sulcata* and crustaceans amphipods *Hyperietta antarctica*, *Themisto antarctica*, in large numbers, also mys-

daceans *Boreomysis rostrata*, amphipods *Hyperia galba*, *H. spinigera*, *Vibilia armata*, *Tryphosella barbatipes*, and remains of fish at least once. Characteristically red faeces at Heard I. (Downes *et al.* 1959) probably indicates diet also contains euphausiids. At Chatham Is (16 regurgitations; Imber 1981) mostly remains of barnacles *Lepas* with some pteropods, cephalopods *Histioteuthis atlantica*, salps *Pyrosoma* and fish. Birds from Snares Is take mostly euphausiids (probably *Nyctiphanes australis*) and amphipods Hyperiididae (C.A. Fleming to P.C. Harper).

**SOCIAL ORGANIZATION** Little known. Based mainly on Downes *et al.* (1959) and information supplied by P.C. Harper and A.J.D. Tennyson. Unusual in being largely diurnal ashore at Snares and Bounty Is (Fleming & Baker 1973; Sagar 1977; Miskelly 1984; Robertson & van Tets 1982); largely nocturnal ashore at Heard I., though hundreds seen coming ashore there on foggy afternoons and reported at nests during day (Downes *et al.* 1959; E.J. Woehler).

**BONDS** Said to be sustained monogamous (P.C. Harper).

**BREEDING DISPERSION** Colonial.

**ROOSTING** At Heard I., in crevices, caves and among rocks near or at nest-site (Downes *et al.* 1959).

**SOCIAL BEHAVIOUR** Virtually unknown because of inaccessibility of nest-sites. A little information from Downes *et al.* (1959). Squabbles with growling calls reported as birds passed neighbours when arriving at nest-sites. **ALLO-**

**PREENING.** Billing and necking observed between members of pairs at entrance to crevices. Courting took place in open throughout day with peak at midday (Robertson & van Tets 1982). **COURTSHIP.** One observation of sitting bird vigorously moving bill backwards and forwards with vicious sideways motion against the other's bill; lower bird uttered soft, wheezy squeak in time with the other bird's movements; copulation not recorded during 20-min watch (Downes *et al.* 1959). Re-surgence of courting behaviour, as judged by calling birds, may occur after chicks fledged (Miskelly 1984). No further information.

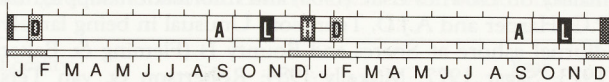
**VOICE** No detailed studies; information from Heard I. (Downes *et al.* 1959) and Bounty Is (Robertson & van Tets 1982). Range of cooing, gurgling, growling and squeaking noises reported. Colonies noisy when many birds present, especially late-Oct. to Nov. On Bounty Is, calling confined to daytime; at Heard I., mostly at night. Calls differ from those of Fairy Prion (Robertson & van Tets 1982; A.J.D. Tennyson). Pairs duet (A.J.D. Tennyson).

**ADULT** At Bounty Is, calls of assumed males were four-syllabled with emphasis on first or second syllable; sounding like following phrases in clipped Oxford accent: *what-not-to-do*, *not-pro-fit-able*, *not-poss-si-ble*. Response by assumed female was a somewhat slurred cooing call with equal emphasis on three syllables *coore-corr-corr* and *co-ver-up*. Wheezy squeaking reported from courting bird (Downes *et al.* 1959).

**YOUNG** Two large downy young gave harsh slurred calls, similar to calls of assumed adult female (A.J.D. Tennyson).

**BREEDING** Very poorly known. No detailed information because nesting islands remote and rarely visited and because nest-sites usually inaccessible. Information supplied by P.C. Harper and A.J.D. Tennyson. Breed in dense to loose concentrations on rocky slopes and cliffs; at Chatham and Bounty Is associated with albatrosses *Diomedea* spp.

**SEASON** Broadly from Nov. to Feb. At Heard I., numbers visiting colonies increase in Sept.; laying estimated early Nov. and eggs found 23 Nov.-20 Dec. (Downes *et al.* 1959). At Snares, Bounty and Chatham Is, eggs found 19 Nov. to 16 Dec. (Fleming 1939; Sagar 1977; Robertson & van Tets 1982; A.J.D. Tennyson). Estimated hatching at Heard I., late Dec.-early Jan. (Downes *et al.* 1959); at Snares Is, hatching c. 15 Dec. and departure before 11 Feb. in four nests (C.M. Miskelly).



**SITE** Under rock slabs, in crevices in cliffs, among scree and rock-falls, in caves and under overhangs (Downes *et al.* 1959; Robertson & van Tets 1982; Miskelly 1984). On Pyramid, Chatham Is, Fleming (1939) found nests in shallow holes under nests of Shy Albatross *D. cauta* with sitting birds visible, but A.J.D. Tennyson found nests (seven) only among rocks. Nests may be in crevices 2+ m long and winding so that birds cannot be reached or detected (Downes *et al.* 1959) and as little as 30 cm apart (Robertson & van Tets 1982).

**NEST, MATERIALS** Mere scrape or hollow in rock debris ('small dried pellets of mud'), sometimes lined with penguin or albatross feathers (Sagar 1977; Robertson &

van Tets 1982).

**EGGS** Ovoid; smooth-shelled, not glossy; white.

**MEASUREMENTS:**

Snares Is: 46.1 (1.14; 44.2-48.6; 13) x 32.9 (1.04; 30.7-34.0) (Sagar 1977);

Bounty Is: 46 (2; 31) x 33 (1; 31) (Robertson & van Tets 1982);

Chatham Is: 46 (2; 30) x 33 (1; 30) (C.J.R. Robertson).

**CLUTCH-SIZE** One.

**LAYING, INCUBATION** No detailed knowledge.

**NESTLING** Two large downy chicks on 19 Jan. at Snares Is had remiges and rectrices showing through grey down on most of body, whitish on belly (A.J.D. Tennyson).

**FLEDGING TO MATURITY** At Heard I., fledglings seen leaving from 17 Feb. for 1 week.

**SUCCESS** No information. Some predation by skuas *Catharacta* reported on breeding grounds by many authors.

**PLUMAGES** Subspecies *eatoni* from Heard I.

**ADULT** Definitive basic. Age of first breeding unknown. **HEAD AND NECK.** Crown, light grey (light 87), darker with wear; feathers, pale grey (86) with dark grey (83) to grey (84) subterminal band and light grey (c86) tips, which are lost with wear. Forehead and forecrown, mottled white and grey; feathers, grey (84) with white fringes, which are lost with wear. Narrow supercilium, white, extending about one eye-width in front of eye and three eye-widths behind eye. Indistinct narrow grey-black (82) suborbital stripe, about half width of eye, from lores, petering out at ear-coverts. Ear-coverts, hindneck, and hindcrown, light grey (light 87). Lores, chin and throat, white. **UPPERPARTS,** light bluish-grey (c87); feathers, light bluish-grey (c87) with grey-black rachis and concealed white bases. Narrow dark-grey (83) band across rump, indistinct in some birds. Longest scapulars, grey-black (c82) towards tip; tips, white, c. 3 mm wide; rest, light grey (85) merging to white at base. Longest upper tail-coverts have dark grey (83) tips. **TAIL.** Most feathers, light grey (85) with grey-black (82) tips c. 40-50 mm long in central rectrices; narrower outwards; on t4, c. 25 mm; on t5, tip varying smudged dark grey (83), sometimes none. Rachis, grey-black (82), merging to concealed brownish grey (119B) bases; t6, light grey above and below. **UPPERWING.** Tertiaries, secondaries, secondary coverts and inner six primaries, grey (c84), merging to light grey (c85) toward tip; tips, white, lost with wear. Outer four primaries, grey-black (c82); inner web mostly light grey (c85), merging to white at inner edge. Tip, grey-black (c82). Alula, primary and lesser coverts, grey-black (82), with bluish-grey (light 87) fringes, wider on lesser coverts. **UNDERPARTS,** mostly white. Lower breast and belly sometimes have pale bluish-grey wash; feathers have varying wash near tip. Sides of breast, flanks and under tail-coverts, pale blue-grey (c86); feathers have dark grey (83) rachis and concealed white bases. Axillaries, white with pale blue-grey (c86) mottling near tip. **UNDERWING,** mostly white. Remiges have grey (84) wash near end, appearing paler when reflecting direct light; outer four primaries have dark grey (83) outer edge. Innermost greater secondary coverts have fine light-grey speckling at tip; narrow grey-black (c82) leading-edge between carpal joint and p10. Outermost primary lesser coverts, median coverts and greater coverts and p10 have grey-black (82) outer webs.

**DOWNY YOUNG** No information.

**JUVENILE** In recently fledged birds, forehead, white; unknown when this character lost with wear.

**BARE PARTS** Based on labels (NMNZ) and photos in Lindsey (1986) and NZRD.

**ADULT, JUVENILE** Iris, black-brown (c119). Bill, pale grey (c86) to light bluish-grey (c88), with grey-black (82) culminicorn, naricorn, sulcus and junction between latericorn and maxillary unguis. Tarsus and toes, light blue (66-88); webs, grey (-) to light brown-grey (44), sometimes with pinkish tinge. Claws, pale grey (c86) with grey-black (82) tips; dusky brown also recorded (Harper 1980).

**DOWNY YOUNG** No information.

**MOULTS**

**ADULT POST-BREEDING** Pre-basic. At Ewing I., Auckland Is, 23 Feb, four subadults (aged on gonads) had recently completed primary moult; in one of these p10 was still growing. All were moulting tails. An adult collected at same time was in heavy body-moult (NMNZ). No other direct information. Large series collected at Heard I., June and Nov. (MV) and at Chatham Is, Sept. to Nov. (NMNZ) were not moulting. Beachcast birds suggest moult begins just before, or on, completion of breeding (P.C. Harper).

**POST-JUVENILE** No information. Molt of non-breeders recorded in Nov. (NZRD), in submatures in July (P.C. Harper).

**MEASUREMENTS** Subspecies *eatonii*: (1) Heard I. skins, juveniles excluded; UNGUIS = maximum width of maxillary unguis. C'CORN = length of culminicorn, from base of maxillary unguis to midpoint of line drawn between lateral walls of nostrils; bird with width of maxillary unguis, 3.0, excluded (MV). (2) Auckland Is, methods unknown (Harper 1980). (3) Heard I., adults, live; bill-depth measured at junction of nares and feathers, bill-width at junction of lower latericorn and feathers (E.J. Woehler).

	MALES	FEMALES
WING	(1) 184.5 (4.58; 174-190; 11) (2) 180.0 (4.65; 175-187; 6)	182.8 (3.09; 177-182; 13) 179.5 (0.52; 179-180; 3)
8TH P	(1) 124.0 (4.00; 115-129; 10)	122.7 (3.00; 117-127; 13)
TAIL	(1) 93.6 (4.60; 87-105; 11) (2) 91.2 (2.46; 90.4-94.5; 5)	93.5 (1.22; 92-95; 13) 91.3 (0.52; 91-92; 3)
BILL	(1) 21.8 (0.74; 20.9-23.4; 11) (2) 20.8 (0.49; 20.4-21.6; 6)	21.4 (0.69; 20.1-22.7; 13) 19.8 (0.69; 19-20.3; 3)
UNGUIS	(1) 4.46 (0.35; 4.0-5.2; 11) (2) 5.06 (1.22; 10.5-10.8; 6)	4.32 (0.29; 3.8-4.9; 12) 4.76 (0.16; 4.6-4.9; 3)
C'CORN	(1) 4.04 (0.61; 2.7-5.0; 11)	4.11 (0.51; 3.4-5.0; 13)
BILL W	(1) 10.7 (0.12; 10.5-10.8; 6)	10.2 (0.23; 9.9-10.3; 3)
TARSUS	(1) 33.3 (0.89; 32.2-34.8; 11)	33.4 (1.23; 31.7-35.8; 13)
TOE	(1) 42.5 (1.60; 40.6-44.5; 3)	42.0 (1.82; 39.7-44.6; 6)
<b>UNSEXED</b>		
WING	(3) 174.0 (6.69; 156-184; 25)	
TAIL	(3) 87.3 (4.53; 76.0-97.0; 25)	
BILL	(3) 22.1 (0.84; 20.8-23.5; 25)	
UNGUIS	(3) 4.65 (0.27; 3.9-5.0; 25)	
BILL D	(3) 9.77 (0.42; 9.0-10.8; 6)	
BILL W	(3) 10.18 (0.60; 9.1-11.4; 25)	
TARSUS	(3) 33.3 (1.08; 31.0-35.2; 25)	

Nominate *crassirostris*: (1) Bounty Is, recently dead, juveniles excluded (NMNZ). (2) Bounty Is; methods unknown (Harper 1980).

	MALES	FEMALES
WING	(1) 188.1 (3.76; 180-192; 9) (2) 185.8 (5.20; 12)	190.0 (2.50; 187-193; 3) 184.8 (2.98; 11)
TAIL	(1) 95.4 (4.19; 89-101; 9) (2) 88.9 (3.39; 8)	98.5 (3.21; 95.6-103; 3) 90.7 (4.2; 9)
BILL	(1) 23.4 (0.63; 22.4-24.2; 9) (2) 22.9 (0.69; 12)	22.6 (0.33; 22.2-23; 3) 22.2 (0.99; 11)
UNGUIS	(2) 5.02 (0.30; 18)	4.86 (0.25; 17)
BILL W	(2) 11.4 (0.35; 12)	11.4 (0.32; 10)
TARSUS	(1) 35.2 (0.81; 34.1-36.3; 8)	34.7 (0.78; 33.7-35.6; 3)
TOE	(1) 43.1 (3.0; 39-46.5; 9)	41.9 (0.85; 40.7-42.7; 3)

(1) Chatham Is, breeders, recently dead (NMNZ). (2) Chatham Is; methods unknown (Harper 1980).

	MALES	FEMALES
WING	(1) 194.5 (5.26; 187-203; 9) (2) 192.9 (4.64; 11)	192.9 (3.60; 186-197; 8) 192.6 (6.32; 10)
TAIL	(1) 98.8 (3.65; 94.5-106.5; 9) (2) 97.7 (2.32; 11)	98.1 (1.79; 96-101; 7) 97.7 (5.69; 10)
BILL	(1) 23.9 (0.99; 22.4-25.5; 9) (2) 23.5 (0.99; 11)	23.1 (0.79; 21.9-24.2; 8) 22.5 (1.26; 10)
UNGUIS	(2) 5.47 (0.19; 10)	5.31 (0.25; 10)
BILL W	(1) 12.8 (0.24; 12.5-13.2; 9) (2) 12.6 (0.66; 11)	13.0 (0.54; 12.2-13.6; 8) 12.2 (0.32; 10)
TARSUS	(1) 34.5 (0.99; 32.8-36.2; 9)	34.3 (0.99; 33.0-36.1; 8)
TOE	(1) 41.6 (1.59; 39.2-45.3; 9)	41.1 (2.05; 38.3-44.1; 8)

**WEIGHTS**

Subspecies *eatonii*. Adults, unknown status, at Heard I., 125.8 (10.07; 102-144; 25) (E.J. Woehler); between 11 and 19 June, 166.4 (10.39; 150-185; 14) (MV); difference significant. At Ewing I., Auckland Is, 23 Feb 1973, subadults and adults, 126.6 (8.0; 118.6-140.6; 6) (NMNZ).

Nominate *crassirostris* at Bounty Is, birds of unknown status with some to no fat between Sept. and Nov., 146.9 (7.81; 130-160; 12) (NMNZ). Beachcast, NZ with no fat, 98.6 (9.30; 85.1-117; 11) (NMNZ). At Chatham Is, breeding adults between 6 and 20 Nov.: males 148.7 (11.94; 133.7-171.6; 9), females 140.6 (14.38; 110-157; 8), some very fat varying to some with no fat (NMNZ).

**STRUCTURE** Subspecies *eatonii*. Eleven primaries; p9 longest, p10 0-5, p8 5-7, p7 15-20, p6 25-31, p5 37-44, p4 49-58, p3 62-71, p2 73-83, p1 86-94. Bill, short and rather heavy, no lamellae, bill plates rigid. Nasal tubes about one-quarter length of bill; nostrils round, pointing forwards and slightly inwards. Maxillary unguis, large, hooked, raised well above level of culminicorn; maximum width usually exceeds length of short culminicorn. Mandibular unguis has recess for hook of upper mandible. Base of maxillary unguis projects further ventrally than tip. Tarsus scutellate, laterally compressed. Middle and outer toes longest, inner c. 80%.

**AGEING** Culminicorn of recently fledged juveniles rigid; unknown when rounded profile of adult attained.

**RECOGNITION** Closely similar to *P. turtur*; *P. crassi-*



*rostris* slightly larger with different bill-shape. Maxillary unguis of *crassirostris*, broad, looks rounded in dorsal view; maxillary unguis 4.6–5.7 mm wide (3.3–4.4 mm in *P. turtur*) and considered reliable character for separation of *crassirostris* and *turtur* (Harper 1980). However, width of unguis of *crassirostris* from Heard I. overlaps with that of *P. turtur*; birds with unguis between 3.8 and 4.4 mm wide cannot be identified on this character. Further, little information on width of unguis in juvenile *crassirostris*. In most prions, bill of juvenile considerably smaller than in adult. Also, length of culminicorn usually shorter in *crassirostris*: 2.0–4.0 mm long (4.2–6.0 mm in *P. turtur*) (Harper 1980); however, on basis of Heard I. measurements, prions with culminicorn between 4.2 and 5.0 mm long cannot be identified.

Mandibular unguis of both *P. turtur* and *P. crassirostris* decurved. In *P. turtur*, tip of mandibular unguis usually curves to, or below, level of base of unguis. In *P. crassirostris*, tip of maxillary unguis usually above level of base. These characters apply to 30 of 31 *eatonii* skins from Heard I. and to 34 of 35 *P. turtur* skins from Bass Str. (MV).

According to Harper (1980),  $t_5$  of *P. crassirostris* has considerably more black on outer web than *P. turtur*. This does not apply to Heard I. birds (see Plumages); Harper probably based this character on skins from other localities, suggesting tail-pattern affected by geographical variation.

**GEOGRAPHICAL VARIATION** Two subspecies: *crassirostris* and *eatonii*. Subspecies *eatonii* (described above) smaller than *crassirostris*, with markedly smaller maxillary unguis; tail-pattern may also differ (see Recognition). Peters recognised *pyramidalis* Fleming, 1939, as a third subspecies;

when first described, believed to be larger than *crassirostris* of Bounty Is (Fleming 1939). However, larger series have shown little difference in size and plumage between *pyramidalis* and *crassirostris* (only greater width of bill; see Measurements).

DIR

## REFERENCES

- Clancey, P.A. 1980. SAOS Checklist of South African Birds.  
 Cox, J.B. 1980. *Rec. S. Aust. Mus.* 10: 91–121.  
 Dawson, E.W. 1955. *Notornis* 6: 78–82.  
 Downes, M.C., et al. 1959. ANARE Rep. Ser. B, II: 1–135.  
 Ealey, E.H.M. 1954. *Emu* 54: 204–209.  
 Falla, R.A. 1940. *Emu* 40: 218–36.  
 Fleming, C.A. 1939. *Emu* 38: 380–413.  
 Fleming, C.A., & A.N. Baker. 1973. *Notornis* 20: 37–45.  
 Harper, P.C. 1980. *Notornis* 27: 235–86.  
 Harper, P.C., et al. 1985. *BIOMASS Handbook* 24.  
 Imber, M.J. 1981. *Proc. Symp. Birds Sea Shore*: 63–88.  
 Imber, M.J. 1983. *Notornis* 30: 283–98.  
 Learmonth, N.F. 1957. *Emu* 57: 57–9.  
 Lindsey, T.R. 1986. *The Seabirds of Australia*.  
 Miskelly, C.M. 1984. *Notornis* 31: 209–23.  
 Powlesland, R.G. 1986. *Notornis* 33: 171–84.  
 Powlesland, R.G. 1987. *Notornis* 34: 237–52.  
 Powlesland, R.G. 1989. *Notornis* 36: 125–40.  
 Robertson, C.J.R., & B.D. Bell. 1984. *ICBP Tech. Publ.* 2: 573–86.  
 Robertson, C.J.R., & G.F. van Tets. 1982. *Notornis* 29: 311–36.  
 Sagar, P.M. 1977. *Notornis* 24: 178–83.  
 Strange, I.J. 1965. *Ibis* 110: 358–9.  
 Weimerskirch, H., et al. 1989. *Emu* 89: 15–29.  
 Yaldwyn, J.C. 1975. *Preliminary Results of the Auckland Islands Expedition 1972–1975*. Dept. Lands & Survey.



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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

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