

Order PROCELLARIIFORMES

A rather distinct group of some 80–100 species of pelagic seabirds, ranging in size from huge to tiny and in habits from aerial (feeding in flight) to aquatic (pursuit-diving for food), but otherwise with similar biology. About three-quarters of the species occur or have been recorded in our region. They are found throughout the oceans and most come ashore voluntarily only to breed. They are distinguished by their hooked bills, covered in horny plates with raised tubular nostrils (hence the name Tubinares). Their olfactory systems are unusually well developed (Bang 1966) and they have a distinctly musky odour, which suggest that they may locate one another and their breeding places by smell; they are attracted to biogenic oils at sea, also no doubt by smell. Probably they are most closely related to penguins and more remotely to other shorebirds and waterbirds such as Charadriiformes and Pelecaniiformes. Their diversity and abundance in the s. hemisphere suggest that the group originated there, though some important groups occurred in the northern hemisphere by middle Tertiary (Brodkorb 1963; Olson 1975).

Structurally, the wings may be long in aerial species and shorter in divers of the genera *Puffinus* and *Pelecanoides*, with 11 primaries, the outermost minute, and 10–40 secondaries in the Oceanitinae and great albatrosses respectively. The tail varies in length, being forked in *Oceanodroma*, forked to pointed in other forms, usually with 12 rectrices but up to 16 in fulmars. The tarsi are light and cylindrical in aerial forms; strong and laterally compressed with legs set far back in aquatic ones. The front toes are webbed; hind toe small or absent. The proventriculus is long and glandular; the gizzard small and twisted; and the small intestine often spiral in *Pterodroma*, presumably to aid absorption of the unusual lipids in their food. Chicks are helpless and covered in down, with two coats except in some Oceanitinae. Some larger species have a darker immature plumage, and the female is often darker than the male in the great albatrosses. The male is usually larger than the female, though smaller in the Oceanitinae and some other small species. Otherwise there is little difference in appearance with sex or age, except that young birds may have more pronounced pale or dark edges to the feathers. Many have simple counter-shaded markings that often appear to have given rise to uniformly dark or, less often, to pale derivatives; some species in most groups are dimorphic or polymorphic. The more complex groups have often developed distinctive markings of the extremities.

Breed more or less colonially on offshore islands, coastal cliffs, or on hills and deserts inland, where they perform complex vocal and aerial displays. The nest is a simple scrape or cup in a burrow or natural hole, sometimes under vegetation. The s. albatrosses build large cone-shaped nests in the open; may be lined with any debris available in the area. Smaller species visit it only at night, though larger ones and those breeding on remote islands may come to nests in the open by day. Parents incubate for spells of several days in turn and generally leave the chick alone soon after it hatches, only returning at long intervals to feed it by regurgitation. In consequence the chick is vulnerable to introduced predators and some species are now greatly reduced and at least two are now extinct. Some species also periodically liable to have unsuccessful breeding seasons. Many young or even old birds may be wrecked ashore and die when they meet bad weather or suffer shortage of food on migration or in the winter. Though it has been claimed that they are also vulnerable to all sorts of pollution, the evidence is weak (Bourne 1976). There is at present anxiety about the effect of some fishing methods, such as long-lining, which may be endangering species such as the great albatrosses.

All species feed at sea on a variety of fish, cephalopods and small marine invertebrates, either socially or alone; larger species may scavenge all sorts of offal or prey on other birds. Most, except perhaps *Pelecanoides*, can digest the complex lipids formed by some marine animals (Clarke & Prince 1976), and may eject them to soil the plumage of their enemies with lethal results (Swennen 1974). Some species can digest wax (Obst 1986). Many now take wastes from whaling and fishing operations (Fisher 1952). All have long life-cycles in proportion to their size; they disperse on fledging and then prospect for nest-sites for 2–12 years in their youth. They usually lay a single large white egg annually; though a successful breeding cycle may be completed in less than a year in at least one tropical species, *Puffinus lherminieri*, it may take 2 years in larger southern ones. Before laying, the birds court for weeks or months, then go to sea for feeding. Incubation lasts 6–8 weeks, and fledging 2–9 months. Once the fat chick fledges it fends for itself, even in species that immediately make a long migration, sometimes to the opposite hemisphere.

Tendency for failed breeders and non-breeders to begin moult before successful breeders. Five strategies of wing-moult in breeding adults: (1) In albatrosses, remiges replaced in staffelmauser interrupted while breeding; in nearly all other species, primaries moulted outwards; possibly simultaneously in some diving-petrels. (2) In most subantarctic and temperate species, moult begins soon after breeding and is completed shortly before next breeding season. (3) In most tropical species, moult aseasonal, between breeding attempts; resumption of breeding apparently depends on when moult completed. (4) In trans-equatorial migrants, wing-moult delayed until they reach non-breeding quarters, where it is completed; moult rapid but no satisfactory evidence for flightlessness. In

some species, body-moult also in winter quarters; in others, at breeding grounds. (5) In some species of high latitudes, rapid moult completed in summer when they breed; some begin moult long before breeding finished.

The history of the classification of the Order is very confused, as is seen by comparing Timmermann's (1965) discussion of their Mallophagan parasites with that by Klemm (1969) of their leg muscles and that by Harper (1978) of their proteins, but it is now widely agreed that the Order is best divided into four families: Diomedidae or large to huge aerial albatrosses; Procellariidae or medium-sized, mainly aerial but sometimes aquatic, petrels, shearwaters and prions; Hydrobatidae or small to tiny, aerial storm-petrels; and Pelecanoididae or small aquatic diving-petrels.

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Family 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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Pachyptila turtur Fairy Prion

COLOUR PLATE FACING PAGE 528

Procellaria turtur Kuhl, 1820, *Beitr. Zool. vergl. Anat. Abth* 1: 143. No locality. *Nomen conservandum*, based on an indeterminate drawing by Parkinson in Banks Library, British Museum Natural History, labelled 'Feb 1st. 1769, Lat 59°00'.

Specifically named for its likeness to a turtle-dove (*turtur* Latin).

OTHER ENGLISH NAMES Blue, Dove, Fairy Dove or Gould Petrel, Short-billed Prion, Whalebird, Narrow-billed Prion.

The epithet *Fairy* seems to prevail in modern literature.

POLYTYPIC Nominate *turtur* breeds on NZ offshore islands, from the Poor Knight Is to Foveaux Str., Chatham Is, islands in Bass Str. and Falkland Is; *subantarctica* Oliver, 1955, breeds Antipodes Is, Big South Cape, Snares Is, Macquarie I.

FIELD IDENTIFICATION Length 25 cm; wingspan 56 cm; weight 90–175 g. Small prion of low subantarctic and subtropical waters with small head, steep forehead and rounded crown; wings rounded; tail, fairly long and wedge-shaped. Generally indistinguishable at sea from Fulmar Prion *P. crassirostris*. Sexes alike. No seasonal variation. Juveniles inseparable.

DESCRIPTION ADULT. Forehead, crown and nape, blue-grey, uniform with hindneck and saddle; ill-defined dusky sub-orbital patch from in front of eye to behind ear-coverts; lores pale with dusky or blue mottling or wash; ill-defined white supercilium, from in front of eye to rear of ear-coverts. Blue-grey of hindneck extends onto sides of neck and upper breast, forming short pale-blue half-collar. Cap and ear-coverts darken with wear, contrasting with grey of hindneck and saddle. Upperparts, blue-grey except for prominent blackish M-mark from wing-tip to wing-tip (joining across rump); narrow white tips to scapulars; area behind M, especially remiges, appears paler than blue-grey of inner forewing; prominent broad black terminal tail-band. Underparts, wholly white except for blue-grey collar, faint blue barring on flanks and broad black central streak on centre of undertail and faint greyish trailing-edge to underwing. Sides of tail-coverts, barred pale-blue; rest of undertail, white. Underwing, white with grey trailing-edge to remiges. Bill, short and stubby, pale blue except blackish nostrils, culmicorn and sulcus. Iris, dark brown. Legs and feet, blue; webs, pale yellow or pinkish.

SIMILAR SPECIES **Fulmar Prion** closely similar and generally indistinguishable at sea: paler blue-grey, with more distinct M-mark, slightly broader tail band, paler facial pattern, largely bluish behind vent and slightly larger chunkier bill. **Slender-billed Prion** *P. belcheri* differs by very prominent supercilium and indistinct M-mark. **Broad-billed** *P. vittata*, **Salvin's** *P. salvini*, and **Antarctic** *P. desolata* have larger heads; flatter foreheads; longer, less stubby bills; more obvious supercilia; darker-headed appearance; less blue plumage; less distinct M-mark; much thinner tail-band; stripe though undertail rather than broad black band; larger. **Blue Petrel** *Halobaena caerulea* has black bill, white tail-tip and dark subterminal band, white undertail, white forehead, blackish cap and longer pointed wings.

Circumpolar, pelagic; in coastal waters and beyond shelf-break. Regularly feed in large flocks, sometimes with other

prions, shearwaters, albatrosses and petrels. Tend to fly close to the water, banking and weaving impetuously in strong winds; does not usually bank as high as other species of petrel and can change direction rapidly. Feed by dipping and surface-seizing, pattering or surface-plunging. At a distance from shore, prions can often be seen weaving in their thousands, the blue of their upperparts invisible against colour of sea and their white underbodies flickering as they bank close to the water. Rarely follow boats. Usually nocturnal at breeding colonies; at S. Georgia active ashore during day.

HABITAT Marine; in subtropical and subantarctic seas; abundant in se. Aust., NZ and Indian Ocean waters, but pelagic distribution poorly known (Harper 1980). At Iles Crozet, forage over continental shelf and slope (Jouventin *et al.* 1985); rarely come close inshore at breeding islands except in rough weather (Whero I.; Richdale 1965). Birds breeding on Poor Knights I., NZ, may feed in deep coastal waters off mainland (Harper 1976).

Breed on subtropical and subantarctic islands and rock stacks; burrowing in soil, or using crevices and caves in cliffs or rock falls; nest in scrub, herbland, tussock or pasture (Richdale 1965; Harper 1976; Walls 1978; Brothers 1984; Harris & Norman 1981), but avoid dense vegetation (Richdale 1965). At Poor Knights I., use artificial rock walls and terraces, and nest close to large boulders or trees used for take-off (Harper 1976). At Macquarie I., restricted to edges of suitable habitat in some areas by competition with Blue Petrels (Brothers 1984). In se. Aust. and NZ, some colonies among those of Short-tailed or Sooty Shearwaters (Walls 1978; White 1981).

Fly just above surface, from which they feed (Harper 1987).

On Macquarie I., population small and breeding only on offshore stacks, probably because Wekas *Gallirallus australis* and feral cats are major predators, especially in winter when food supply for introduced predators scarce (Brothers 1984).

DISTRIBUTION AND POPULATION Circumpolar, probably frequenting subtropical waters during non-breeding periods. Breed on subantarctic and subtropical islands in s. hemisphere (Bass Str. islands, Tas., NZ offshore islands, Macquarie I. and Iles Crozet, and Bird I., S. Georgia). Extraliminally: Falkland Is and Ile St Paul.

During non-breeding season, probably most abundant in subtropical Indian Ocean, off se. Aust. coast and round NZ (Harper 1980). NZ birds remain in NZ region throughout year (Powlesland 1989). Distribution after dispersal poorly known.

AUST. Often beachcast on se. coast; commonly seen offshore over continental shelf and in pelagic waters; less common WA and Qld. **Qld.** Moderately common winter visitor to se. regions (Roberts 1979); N to Wreck I. (Booth 1970) but possibly to n. Qld (HASB). No records during Atlas period. **NSW.** Common. Recorded June-Jan., but most numerous June-Aug. (Morris *et al.* 1981). Beachcasts along whole coast. **Vic.** Common along entire coast (Wheeler 1967) but most often W of Wilson's Prom. Commonest species of prion in Geelong region (Pescott 1983); sometimes in thousands offshore (Vic. Bird Reps 1981, 1985). **Tas.** Abundant visitor in all offshore waters throughout year (Tas. Bird Rep. 1985). Commonly beachcast (Green 1977). **SA.** Often beachcast between Adelaide and se. region; recorded most months. Regularly seen over continental shelf S of c. 36°50'S (Cox 1976; Parker *et al.* 1979). **WA.** Rarest prion (Serventy & Whittell 1976); during Atlas period, three winter records.

NZ Most abundant prion (Oliver). Common Tasman Sea in summer (Harper 1980), and remain in NZ region during non-breeding season (Powlesland 1989). **NI.** Most commonly collected from w. coast: nearly 90% were picked up on Auckland West and Wellington West beaches, at rates of 85.1 birds/100 km, and 84.6 birds/100 km respectively (Powlesland 1989). Less often on e. coast beaches. **SI.** Less common than on NI. Most often collected along Canterbury coasts, few from Westland, Otago and Southland beaches.

Extraliminally: single specimen from PNG, 1876 (Mayr 1941); at least five records from South Africa, from Muizenberg, SW Cape, to Durban and Zululand (Clancey 1955; Robinson 1962); also recorded from Namibia (Brooke & Sin-

clair 1978); fewer than six records for South American waters (Murphy; Falla 1940; Strange 1968).

BREEDING Known localities:

AUST. (References from *Seabird Islands Series, Corolla 3,4,5,7,8* unless stated). **Vic.:** Seal I.; Notch I.; Wattle I.; Anser I.; Kanowna I. (small numbers); McHugh I. (small numbers); Citadel I.; Dannevig I.; Shellback I.; Lawrence Rocks; Lady Julia Percy I. (1000 pairs; Harris & Norman 1981); Moncour I. (Harris & Norman 1981). **Tas.:** mainland at North Head (Tas. Bird Rep. 1981); Ile du Golfe (25 000 pairs); Flat Top I. (250 pairs); Round Top I. (1200-1400 pairs); Tasman I. (25 000 pairs); Flat Witch I. (10 000 pairs); Mewstone I. (300 pairs); Flat I. (2500 pairs); Green I. (thousands; Harris & Norman 1981); Woody I. (Milledge 1972); Albatross I. (large numbers); The Nuggets No. 3; Hippolyte Rocks (3000-5000 pairs); Big Caroline Rock (1000-2000 pairs); West Pyramid (1,000-2,000); East Pyramid (<250 pairs); Maatsuyker I. (600 pairs; Milledge & Brothers 1976); Grassy I. (100 pairs; McGarvie & Templeton 1974).

NZ > 1,000 000 birds. Poor Knights Is (Robertson & Bell 1984); Trio Is (Powlesland 1989); Stephens I. (Walls 1978); Brothers Is (Sutherland 1952); Motunau I.; Open Bay I. (Powlesland 1989); islets off Stewart I. (Richdale 1944); Akaroa and Otago (Powlesland 1989).

CHATHAM IS (Robertson & Bell 1984).

ANTIPODES IS (Imber 1983).

SNARES IS (Robertson & Bell 1984).

MACQUARIE I. (c.40 pairs; Brothers 1984);

HEARD I. (Imber 1983).

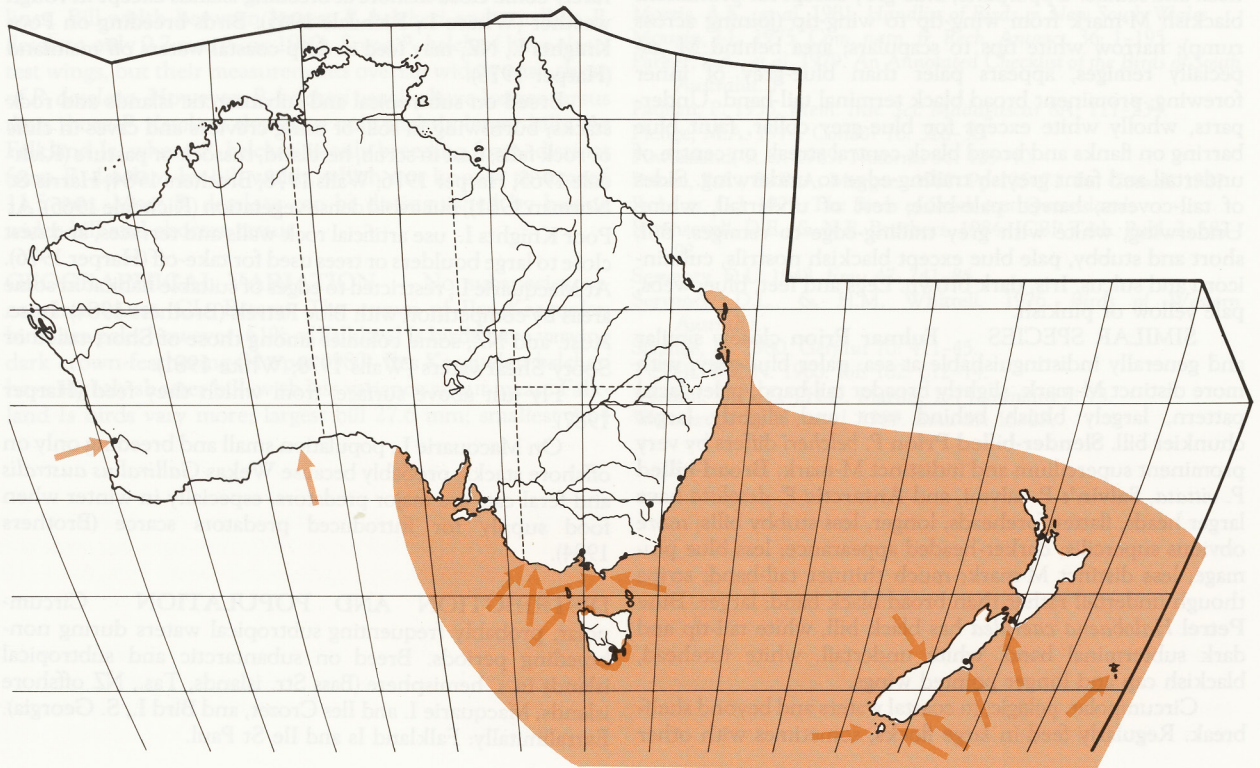
ILES KERGUELEN: 1000-10 000 pairs (Weimerskirch *et al.* 1989).

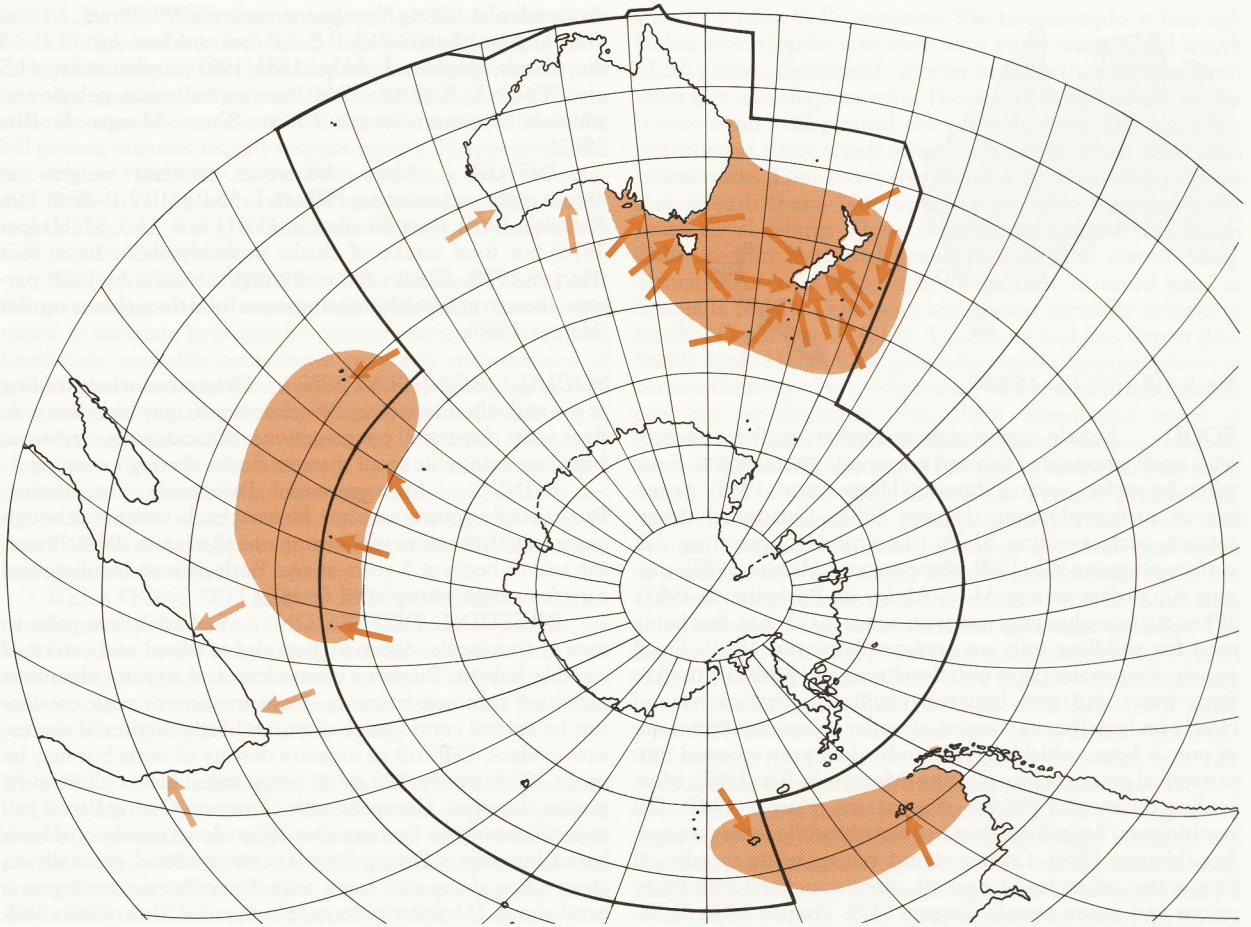
ILES CROZET (Jouventin *et al.* 1984)

Ile de l'Est: 10s of 1000s pairs.

Ile aux Cochons: 10s of 1000s pairs.

Iles des Pingouins: 100s pairs.





PRINCE EDWARD IS: 1000s pairs (Williams 1984).
Prince Edward I.; Marion I.

s. GEORGIA: 100s (Croxall *et al.* 1984).

Extraliminally breed on Falkland Is and Roche Quille (Ile St Paul).

Most Aust. colonies appear secure; Black Rats *Rattus norvegicus* may interfere with breeding on Macquarie I. On Grassy I., Bass Str., introduced cats and rats have almost destroyed colony (McGarvie & Templeton 1974). At some NZ colonies, predation by Wekas *Gallirallus australis*, Brown Rats *R. norvegicus* and Polynesian Rats *R. exulans*. Colonies on Beauchene I., Falkland Is, secure. Colonies on Ile aux Cochons and Marion I. suffer heavy predation by cats when birds arrive at dusk, but burrows too small for cats to enter. Colonies on Heard I., Ile de l'Est and Bird I. free of predators. Soil erosion on Lawrence Rocks, Vic., may have caused deterioration of formerly suitable nesting area resulting in decline (Pescott 1980). During breeding season, fires may seriously affect nesting colonies (White 1979; 1981).

MOVEMENTS Migratory or dispersive; poorly known but some populations apparently move N.

DEPARTURE Young fledge and adults depart Whero I., NZ, 19.8 Feb. (4.1 days; 16 Feb.–10 Mar.; Richdale 1965), most leave Poor Knights Is, 10 Jan. (3 Jan.–22 Jan.; Harper 1976), mean departure date S. Georgia, 15 Feb. (Croxall & Prince 1987) and fledge Iles Crozet, early Mar. (Jouven-

tin *et al.* 1985). Failed or non-breeders depart Poor Knights Is about 8 Dec. (Harper 1976).

NON-BREEDING Nominate *turtur* probably travel N to subtropical waters during winter with some birds banded Cook Str. recovered NSW (see Banding) and recorded June–Sept. off se. Qld (Smyth & Corben 1984) with peak numbers beachcast ne. NSW, June–July (Holmes 1977). Specimens of subspecies *antarctica* recovered from NZ suggest it may do same (Harper 1980). Most abundant Tas. waters, May–Sept. (D.W. Eades), which suggests influx of birds. Winter visitor to South African waters (Brooke & Sinclair 1978). However, birds seen at breeding colonies on Iles Crozet through winter (Jouventin *et al.* 1985). Of 1650 birds, of all age-classes, beachcast NZ, 60.6% male (Harper 1980). Frequently beachcast; particularly common NZ beaches late-Jan. to mid-Feb. after young fledge (Harper 1980; Powlesland 1989) and during inclement weather July–Nov. Often wrecked on Aust. and NZ coasts: Geelong region (Vic.): Aug. 1959, July 1961, July 1970, Aug. 1978, Jan. 1981, Aug. 1985 (Pescott 1983; Vic. Bird Rep. 1985). NSW: June, July 1975 (Holmes 1976); large wrecks in NZ, 1975–76, 1984–86 (Powlesland 1989).

RETURN Whero I., late Aug. (Richdale 1965) and Iles Crozet, late Sept. (Derenne & Mougin 1976).

BREEDING Foraging flights ≥ 320 km possible (Harper 1976).

BANDING Returns from n. SI, NZ (NZNBS) summarized Fig. 1.



Fig. 1. 41S 174E 2X2 NZNBS

FOOD Mostly euphausiids and other small crustaceans with small amounts of fish and pteropods. **BEHAVIOUR.** Food taken by surface-seizing, dipping (Harper *et al.* 1985), pattering or surface-plunging (Harper 1987). Quantified observations: surface-seizing 52.7%, dipping 44.2, pattering 2.8, surface-plunging 0.2 (1709 observations.; Harper 1987); dipping 67, surface-seizing 33 (3; Ainley & Boekelheide 1983). When surface-plunging, row with wings to 0.3–3 m, feet being used for paddling only on surface (Robinson 1961). Small pouch of interramal skin well developed and probably used to force water and prey between papillae in oral cavity and closely set lamellae on margins of upper palate; minimum size of prey is large, which suggests individual prey scooped into interramal pouch before filtering (Morgan & Ritz 1982). Most feeding during day (99.4% observations; Harper 1987). On reaching sea, fledgelings drink copiously while sitting on surface (Harper 1976). Gather round fishing boats to take oil from water; when feeding on oil, often associated with other prions and storm-petrels (Barton 1979; Harper 1980; D.W. Eades).

NON-BREEDING Recorded taking fish *Electrona risso* (6.0 cm, 1 bird, Cook Str.; Imber 1981), *Canthigaster* (1 bird, off se. Qld; Vernon 1978) and small white crustaceans (s. Vic.; Robinson 1961).

BREEDING Summarized Table 1. At **Poor Knights Is, NZ** (Harper 1976; P.C. Harper) crustaceans: euphausiids *Nyctiphanes australis*, other crustaceans crabs *Leptograpsus variegatus* nauplii; at **S. Georgia** (Prince & Morgan 1987; see

Table 1. Diet of Fairy Prion (% wt.).

	Poor Knights Is, NZ (Harper 1976, P.C. Harper)	Bird I., S. Georgia (Prince & Morgan 1987)
CRUSTACEANS	96.2	96.3
<i>Euphausiids</i>	94.2	78.9
Other	2.0	17.4
FISH	4.0	2.4
CEPHALOPODS		1.2
NO. SAMPLES	151	40

also Prince & Copestake 1990) crustaceans euphausiids *Euphausia superba*, other crustaceans barnacles *Lepas* cf. *australis* >0.1, copepods (*Calanoides acutus* 0.8, *Rhincalanus gigas* 2.8), amphipods 13.8% wt. (*Themisto gaudichaudii* 13.7, *Cylopus lucasii* <0.1). **Other records:** taking fish *Maurollicus muelleri* (50% wt., about 5.0 cm), pteropods (50, 3.0 cm; 1 bird,

Antipodes Is); taking *Nyctiphanes australis* (99.0% wt., 1.1–1.6 cm), *T. gaudichaudii* (0.3, 0.8–1.0 cm), unident. fish (0.7, 2.5 cm, 6 birds, Stephens I.; Imber 1981, 1983); euphausiids (≤ 1.5 cm, Whero I.; Richdale 1944); fish, cephalopods, pelagic amphipods (minimum length 0.3 cm, Tas., ; Morgan & Ritz 1982).

INTAKE Mean difference between weights of chicks night and morning: Whero I., 15.0 g (10.7, 0–56.0, 316; Richdale 1965), Poor Knights Is, 15.4 (1.4, 0–43.5, 57; Harper 1976) but food intake of chicks probably about twice that (Harper 1976). Chicks fed every night, usually by both parents, though at first adults bring more food than chicks can eat (Harper 1976).

SOCIAL ORGANIZATION Gregarious when feeding at sea and when breeding. At other times, may be solitary, in flocks or dispersed congregations. Occasionally arrive at breeding colony in small discrete flocks through evening.

BONDS Monogamous. Pair-bond, long-lasting. Pairs usually return to same burrow each season, although some may shift to a neighbouring one (Richdale 1944). Breeding said to begin at 5 years of age. Both parents incubate and care for single young until fledging.

BREEDING DISPERSION Colonial; few pairs to tens of thousands, depending on size of island and extent of suitable habitat. Burrows often close and nesting chambers may have common entrance. Nests in caves or rock crevices can be several centimetres apart, and little territorial aggression evident. Difficult to measure density of nests but may be up to 103 burrows/100 m² in some areas. Caves allow even greater densities. Compete with Common Diving-Petrel *pelicanoides urinatrix* for nest-sites; where large numbers of both breed, burrows of Diving-Petrels occur in a band, generally on steep slope above cliff faces, with Fairy Prions nesting in a band above. If habitat permits, Short-tailed Shearwaters *Puffinus tenuirostris* occupy an upper area. Also compete with Blue Petrels for nest sites. Both parents incubate and feed young.

ROOSTING In burrow when breeding; at sea other times.

SOCIAL BEHAVIOUR Reasonably well known from studies by Richdale (1944, 1965) and Harper (1976). Information supplied by N.P. Brothers. Visit breeding colony throughout year at Macquarie I.; fewest birds seen at and after fledging. No record of this behaviour at other locations. Numbers and noise level greatest during winter, when immatures probably courting and establishing nest sites. At S. Georgia, visit breeding sites at all times of day, alighting on rocks where they may sit before moving into rock crevices (Prince & Copestake 1990); elsewhere, entirely nocturnal, arriving at colony 1 to 3 h after nightfall and departing before daylight; Breeding birds not affected by stage of moon, but outside breeding season, numbers visiting colony less and arrival time later during bright moonlight. Tendency not to return each night during stormy weather outside breeding season; probably uneconomical expenditure of energy to fly between feeding and breeding grounds in such conditions. Stormy weather delays arrival times in breeding season. Highly vocal at colony throughout night, mostly at nest site but also elsewhere on ground and in air. Calls occasionally from nest during day. Silent at sea. Pairs and single birds stay ashore during the day in all seasons.

AGONISTIC BEHAVIOUR No detailed infor-

mation. Harper (1976) observed agonistic behaviour, in which birds on ground uttered rapid, high-pitched scolding calls, directed mostly at non-breeding birds seeking territory. If intruder persisted or entered territory unnoticed, resident advances towards intruder with wings held out from body and bill poised; intruder usually retreats rapidly. Harper (1976) did not observe FIGHTING. At Snares Is, two birds observed fighting: birds stood up with bills locked, balancing with wings, and calling; one, and probably both, birds gave female Harsh Call (A.J.D. Tennyson).

SEXUAL BEHAVIOUR No detailed information. **Allopreening**, mostly round neck with head turned and raised to facilitate preening by partner, occurs early in pair-formation; probably contributes to yearly maintenance of bonding between established pairs. Both birds engage in loud chorusing during allopreening. During **Mutual Nibbling** of crown, nape, back and area round eyes, both birds frequently close eyes or interrupt proceedings to call loudly; eyes closed probably to prevent or sublimate aggressiveness, or counter-act escape-drive which would be disadvantageous to pair-bond. Mates roost together at nest-site, each with bill tucked among feathers of partner's nape.

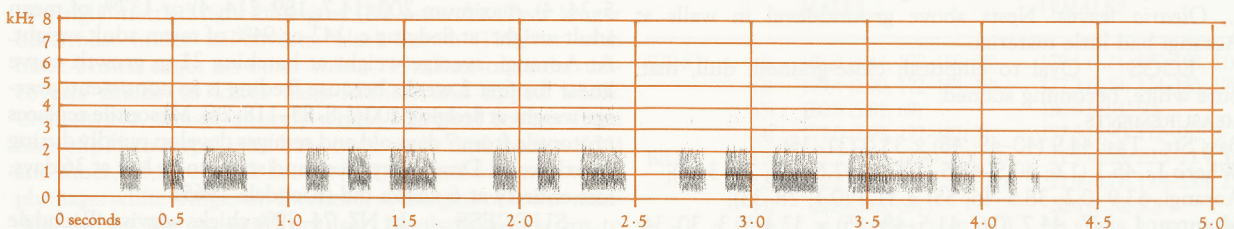
RELATIONS WITHIN FAMILY GROUP Chick usually guarded by one adult, occasionally by both parents, for first few days to 1 week; mostly unattended after this with adults returning for short periods to feed. Fledgelings active only at night, but some nestlings may leave nest for short periods during day just before fledging.

VOICE Detailed study by Tennyson (1989) on Mangere I., Chatham Is. Not known to call at sea; highly vocal on breeding grounds, at night. Common calls short harsh phrases of 2–3 syllables (Harsh Calls), usually repeated several times; described as *poor popper*, *popper*, *popper pop* (Richdale 1944, 1965), *kuk kuk coo-er* (Slater 1970) and *cup-a-curr* (Robertson & van Tets 1982); Mattingley's (1908) description, a faint *coo-ooo-ooo*, does not seem appropriate. Use of common calls changes seasonally: frequency of calling high from pre-breeding period until about start of hatching (mid-Dec.); from hatching onwards, calling virtually stopped. Birds rarely give aerial calls while rearing chicks. Some resurgence of calling in late Mar. after chicks have fledged. Distinct sexual differences in Harsh Calls; also males use Harsh Call more on ground than females, and females more in flight than males. Apparent individual differences in Harsh Calls but not studied in detail (A.J.D. Tennyson). Calls similar to other species of prion but harsh calls usually shorter with fewer syllables in usual phrase (A.J.D. Tennyson).

ADULT Harsh Call (sonagram A). Normally wide-band noises, sometimes extending to 10 kHz; however, often some purer tones and harmonics apparent; where pure tones present, call phrases all had fundamental frequencies between

0 and 1.3 kHz. Calls sometime rise to crescendo at final syllables, which louder and often with purer tones. Total length of call phrase, significantly shorter in males than females. Both sexes give sexually dimorphic Harsh Call in flight, from within burrows and from ground; call when duetting, fighting, when disturbed at nests, when other birds call or when other loud noises made. They often give Harsh Call while biting objects that disturb them. Non-breeders probably responsible for much aerial calling. These observations suggest that Harsh Calls used for territorial, sexual or individual identification. Sexual differences also apparent in calls of sexed pairs at Snares Is (A.J.D. Tennyson) and almost certainly present in birds at Open Bay Is (A.J.D. Tennyson) and Iles Crozet (J-C. Stahl). **Male Harsh Call**: generally rapidly repeated phrase of three syllables (n=26; c. 10 phrases/bird analysed) described as *poor pop per* (Richdale 1944, 1965). Mean total length of phrases 1.16 ± 0.03 s (SE). Phrases consisted of two relatively short syllables and one slightly longer syllable that had mean length 0.27 s (0.01 [SE]; 0.16–0.40). **Female Harsh Call**: usually a rapidly repeated, phrase of two syllables (n=22; c. 10 phrases/bird analysed) described as *errr err*. Mean total length of phrases 1.64 ± 0.03 s (SE). Phrases usually made up of one relatively long syllable and one shorter syllable; often very short syllables in gaps between the two main syllables. The longest syllable in each phrase had mean length of 0.54 s (0.01 [SE]; 0.43–0.68). **Rattle Call**. Very rapidly repeated *per-per-per...* that approaches a rattling sound. Syllables of 'rattle' were 0.03–0.08-s long and gaps between syllables were 0.01–0.07-s long (n=4); up to 30 syllables recorded per call. Frequencies concentrated in wide noise-bands from 0.5 to 2 kHz. Only heard a few times between 23–28 Oct.; given by apparently lone male and by several duetting birds; in one duetting pair, bird uttering Rattle Call was identified as male. May be copulation call, because only heard between 1 and 3.5 weeks before laying, from birds at nest. Not heard on Snares or Open Bay Is but observations were not made during pre-laying period (A.J.D. Tennyson). **Distress Call**. When birds of either sex handled, sometimes give rapidly repeated, more highly pitched call described as *pihihihi...* Fundamental frequency ranges from 0.2 to 3.7 kHz and sometimes shows strong harmonic between 4 and 6 kHz. Syllables have clear tones. Probably equivalent to 'canary-like call' given by birds that were being handled (Richdale 1944, 1965). Birds generally docile while giving this call and appeared to be in distress. Not heard under natural conditions on Mangere I.; on Snares and Open Bay Is, often utter call when handled (A.J.D. Tennyson). Also given when a Mottled Petrel approached an adult at its nest site on Snares Is (A.J.D. Tennyson).

YOUNG Beg with short whistle, while tapping adult's bill with their own (A.J.D. Tennyson); described as *staccato* squeaking (Harper 1976). Distress Call (see above) commonly given by chicks. Harsh Calls (of adults) also given



by chicks from 2 days after hatching and possibly before hatching. Maturation of calls involves lowering of pitch; calls of young chicks consist of purer tones but calls rapidly develop into wider band-noises like adult Harsh Calls.

BREEDING Well known. Based on studies on Whero I., NZ (Richdale 1944, 1965), on Aorangi, Poor Knights Is, NZ (Harper 1976), on S. Georgia (Prince & Copestake 1990) and observations at Chatham Is (A.J.D. Tennyson) and in Tas. (N.P. Brothers). Breed in simple pairs, colonially.

SEASON Broadly Sept.–early Mar. but early stages of cycle not well observed at most places. Return to colony: at Stephens I., NZ, (Walls 1978) in June; at S. Georgia, 12 Aug.: at Whero I., estimated as late Aug. and early Sept. Pair-formation and selection and excavation of burrows: at Stephens I., late July; at S. Georgia, peak in late Oct. Probable pre-laying exodus noted at Stephens I. Laying: at Aorangi, mid-Oct.: at Whero I., Chatham Is and S. Georgia, first half Nov., mostly estimated from observed dates of hatching: peak at Aorangi, 20–30 Nov.; at Whero I., 31 Dec.; at Chatham Is, 13–29 Dec.; at S. Georgia, 29 Dec. (2.8 days; 24 Dec.–1 Jan.; 7). Fledging: late Jan.–mid-Feb. except at Aorangi, where 3–10 Jan.; at S. Georgia, 15 Feb. (3.9 days; 11–15 Feb.; 7). Thus, season apparently almost 1 month earlier in n. than s. part of range.



(Whero I.)

SITE At Aorangi, almost entirely in crevices between rocks, in rock-walls or terraces built by Maori; near or under large boulders or tall trees, used as launching places. Prefer straight dark crevices, sometimes with two entrances; 20–80 cm long, entrance 10x10 cm at most. If no suitable nest-chamber at end of crevice, egg laid about three-quarters of length of crevice from entrance. In large caves several sites may be used. At S. Georgia, in crevices in screes at foot of steep cliffs. At Stephens I., mostly in burrows, straight or curved, averaging 120 cm (60–200) long, with nesting chamber offset to protect against light, wind and rain. At Whero I., also in burrows mostly in open areas of *Poa*. Burrows with single entrance may be shared by several pairs, usually where soil too shallow for burrowing competitors such as shearwaters; also more than 100 pairs recorded on floor of large cave with single entrance (North). Sites used year after year, though in caves exact site may change and occupying birds may change partners (Harper 1976). Bill and feet used in excavation.

NEST, MATERIALS Nest-chamber, well drained and dry, about 30 cm across, at end of burrow; in crevices usually large enough for only one adult; lined with fallen leaves of pohutukawa *Metrosideros excelsa* or tauputa *Coprosma repens* and sometimes twigs (Harper 1976); at Whero I., *Olearia* leaves. Nests above ground-level in walls at Aorangi had little material.

EGGS Oval to elliptical; close-grained, dull, mat; pure white, becoming stained.

MEASUREMENTS

Bass Str., Tas: 44.9 (40–49; 48) x 33.0 (31–35);
Whero I.: 45.1 (1.6; 40.5–48.5; 100) x 32.6 (1.0; 29–34.5);
Aorangi: 43.9 (0.2; 38.5–46; 55) x 31.4 (0.1; 28–33);
Motunau I., NZ: 44.7 (0.6; 41.5–48; 15) x 32.4 (0.3; 30–34) (Taylor 1967);
S. Georgia: 46.7 x 33.2, 46.5 x 33.5.

WEIGHTS:

Bass Str., s. Tas.: fresh 27.2 (20.2–32.2; 16);
Whero I.: 24.2 (2.6; 18.3–29.3; 56);
Aorangi: 22.2 (0.3; 18.5–25; 23).

CLUTCH-SIZE One. Single brooded. Replacement laying not recorded. One bird sometimes found with two eggs but always two females concerned.

LAYING Synchronized. At Mangere I., Chatham Is, 1–15 Nov.; at Snares Is, first half of Nov. (A.J.D. Tennyson).

INCUBATION By both adults in alternate shifts. At Aorangi, shifts of 2.4 days (1–5; 47) on average but incubating bird visited most nights by partner; change-over usually soon after dusk. Egg sometimes deserted for up to 3 days, which may be fatal; even though chick may still hatch, it dies later. At Whero I., shifts of 6–7 days, shortest complete shift being 6 days. At Mangere I., first incubation shift 1–7 days (A.J.D. Tennyson). Hatching at Aorangi, 21 Nov.–4 Dec.; at Mangere I., 20.3 Dec. (3.5; 13–29 Dec.; 28); at Snares Is, 18–31 Dec. (A.J.D. Tennyson). At least 2 days from pipping to emergence (Richdale 1965) or 24–36 h (Harper 1976). **INCUBATION PERIOD.** At Mangere I., 46.6 days (2.5; 44–54; 18) (A.J.D. Tennyson). Eggshells usually removed to entrance of burrow (Harper 1976).

NESTLING Semi-altricial, nidicolous. Hatched with light smoky-grey down, darker on head and wings, paler greyish-white below (North); medium violet-grey (Richdale 1965). Usually brooded by one parent for 1–5 days and then left alone during day; at Whero I., average length of brood-stage c. 36 h and in first few days chick sometimes fed by brooding parent during the day. Fed regularly each night by incomplete regurgitation; usually by cross-billed method but, when very small, chick may take food by pecking from inside parent's mandible and occasionally solid paste-like material quickly regurgitated directly into chick's open bill. Feeding at night often by both parents after first 8 days; meal takes about 2–9 min with 18–28 exchanges of food. Parents return to burrow between 10:15 and 12:30; most parents leave by 02:30 (Harper 1976). At S. Georgia fed on 52% of nights during nestling period. Frequency of feeding not affected by phase of moon; may lessen for few days before fledging but chicks not abandoned (N.P. Brothers); Richdale (1965) said that chicks may not be fed for some days just before flying, giving average of 1–8 days (1.3; 0.5; 59). Chicks do not eject stomach-oil. **NESTLING PERIOD:** at Whero I., 50 days (2.5; 43–56; 66); at Aorangi, average 45 days (n=72); at Mangere I., 48.2 days (1.7; 45–51; 17) (A.J.D. Tennyson). Leave at night: at Mangere I., 5.7 Feb. (3.6; 30 Jan.–13 Feb.; 21); at Snares Is, mainly during first half Feb. (A.J.D. Tennyson). Independent of parents at fledging.

GROWTH Weight at hatching: Whero I., 15–20 g, maximum 150–155 at 33–44 days old, fledging at 113 (0.9; 90–131). At S. Georgia, average weight at hatching 21 (2.0; 18–5–24; 4), maximum 200 (14.7; 189–214; 4) or 137% of mean adult weight, at fledging c. 142 or 94% of mean adult weight. At Aorangi, average weight at hatching 21 g; growth curve linear for first 2 weeks because feeding is so consistent; average weight at fledging 100 (1.8; 85–118; 26). Mesoptile replaces protoptile from 7 days old and remiges develop rapidly during fourth week. Down very loose and starts to be lost at 36 days; lost entirely at 6 weeks old (Richdale 1965).

SUCCESS In NZ, 74–79% chicks survive (Richdale 1965; Harper 1976). On Stephens I., Tuataras *Sphenodon punctatus* account for more than one-quarter of eggs and

chicks by predation and interference in nesting chamber (Walls 1978). No Aust. data but success varies greatly between colonies according to predation by cats and rats or to starvation.

PLUMAGES Based on birds from Macquarie I. attributed to nominate *turtur*.

ADULT Age of first breeding 4–5 years (Richdale 1965). In fresh plumage: **HEAD AND NECK.** Crown, grey (87); concealed bases of feathers, pale grey (86); rachis, dark brown (119A). Ear-coverts and hindneck, lighter grey (c87). Forehead, narrowly fringed white; fringes broader at lores and at margins of lower mandible. Suborbital patch narrow, dark grey (83); anterior margin grey-black (82). Narrow dull-white supercilium meets white lores; at hind end of supercilium, narrow subterminal blue-grey (c88) band on feathers. Facial pattern indistinct. Side of neck, dark blue-grey (88), forming incomplete collar. Rest of head and neck, white; demarcation at side of neck, sharp. Feathers at demarcation between malar area and collar, variously mottled light grey (85). Interramal space, bare. **UPPERPARTS.** Mantle, back and rump, blue-grey (c88); concealed bases of feathers, dull white; rachis, dark brown (121). Mantle, back and rump, fringed light grey (85). On lower back, fringes, dark blue-grey (78); distal tip of rachis, black-brown (119); feathers form central part of M-mark when wings spread. Scapulars, basally light grey (85), with broad sub-terminal black-brown (119) band; scapulars, broadly tipped white, particularly on outer web; innermost scapulars, largely dark brown (121); some very narrow white tips. Rachis of scapulars, basally brown-grey (80) merging to black-brown (119) distally. Longest upper tail-coverts, tipped dark brown (121). **TAIL,** dull light blue-grey (88); rachis, dark olive-brown (129); distal half of tail, black-brown (119). Black-brown (119) tip on t1–4 prominent; suffused on t5; slight on inner web of t6. **UPPERWING.** Marginal coverts at humeral joint, white. Marginal, lesser and tertial coverts, black-brown (119); feathers narrowly fringed grey (84); rachis, dark brown (121); feathers form part of M-mark when wing spread. Median and greater coverts, grey (87), fringed light grey (85). Greater coverts and secondaries tipped pale grey (86). Tertials similar, but outer web suffused dark brown (121) and basally dark grey (83). 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. P10–7, black-brown (119) on outer web; 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, tipped blue-grey (c88). Flanks, white, with variously mottled blue-grey (c88) tips. Lowermost flank-feathers, alongside abdomen, have broad light-grey (85) subterminal tips, narrowly tipped pale grey (86). Axillaries white, variously mottled light blue-grey (88) on webs. Two longer outermost under tail-coverts, black-brown (119), or with black-brown edges on outer webs (119). Rest of under tail-coverts similar to lower flank-feathers and tipped white. **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, at margins of lower mandible; white tips on primaries lost. Similarly, white tips to scapulars largely lost. With wear, plumage becomes darker; open M-mark remains despite wear (Harper 1980).

DOWNY YOUNG Protoptile, grey-brown, 15–20 mm long. Mesoptile, smoky-grey, 20–30 mm. Richdale (1944) states: protoptile, long, medium violet-grey, 20 mm long on body and 10 mm on head. Mesoptile appears at 7 days. At 13 days (9–15) egg-tooth lost. Down lost at c. 50 days. Richdale (1944) gives full details of plumage changes of chicks.

JUVENILE Similar to adult in fresh plumage; indistinguishable on plumage characters; distinguished on structural characters and bare parts (see Structure, Bare Parts). Fledgelings often distinguished by worn crown, wing-coverts and tail (Harper 1976, 1980).

BARE PARTS Based on photos in Lindsey (1986), NZRD and at NZDOC Library, except where stated.

ADULT, JUVENILE Iris, black-brown (119). Bill, including maxillary unguis, light blue-grey (88); culminicorn, nostrils and sulcus, grey-black (82). Tarsus and toes, light violet (170C); webs pink-brown (219D); light grey (NZRD). Harper (1980) states that webs of juveniles are darker grey than that of adults. Claws, pale grey (86), tipped grey-black (82).

DOWNY YOUNG Few data. Legs, dark blue; webs, faint reddish-violet (Richdale 1944).

MOULTS

ADULT POST-BREEDING Complete; in breeders: begins with body-moult before leaving breeding site, Jan.–Feb.; completed with renewal of primaries and rectrices by end of June in Tasman Sea. New plumage attained by most in July; slight wear evident in Aug. In subspecies *subantarctica*, wing-moult observed near Antipodes Is, 3 Jan. 1967 (Harper 1980). Primaries moult outwards; a few inner primaries lost simultaneously. Duration of moult requires study. Non-breeders presumably undergo early moult (Dec.) in mid-Pacific (Harper 1972, 1976). Birds in full moult rarely found on NZ beaches in winter; adult male in full tail-moult, 23 Mar. 1974 and sub-mature female in mid-Tasman Sea, 1 June 1963 (Harper 1972). Fairy Prions do not migrate as do other species of *Pachyptila* (Harper 1972; 1976).

POST-JUVENILE Few data; younger birds moult Dec.; assumed to occur with non-breeders but requires confirmation.

MEASUREMENTS (1) Main I., Snares Is, live birds; breeders; methods as in Baldwin *et al.* (1913) (A.J.D. Tennyson). (2) Mangere I., Chatham Is, live birds; breeders; methods as in Baldwin *et al.* 1913 (A.J.D. Tennyson). (3) Beachcast specimens, status unknown; (Harper 1980; [Note Harper's table incorrectly labelled males as females]). (4) Adult skins attributed to subspecies *subantarctica*; Mus. Hist. nat., Paris; methods unknown (J.A. Bartle).

		MALES	FEMALES
WING	(1)	181.0 (4.44; 170–189; 38)	179.1 (4.21; 170–188; 31)
	(2)	179.4 (2.90; 172–184; 19)	177.3 (2.34; 174–183; 19)
	(3)	180.8 (5.81; 69)	180.8 (4.94; 50)
	(4)	177.0 (2.92; 172–182; 7)	177.3 (3.90; 172–182; 8)
BILL	(1)	22.2 (0.82; 20.4–24.3; 39)	21.7 (0.78; 20.3–23.4; 31)
	(2)	22.2 (0.63; 21.2–23.5; 21)	21.4 (0.79; 19.4–23.4; 23)
	(3)	22.8 (0.83; 69)	22.6 (0.70; 50)
	(4)	22.1 (0.85; 21–24; 7)	21.2 (0.38; 20.5–21.8; 8)
BILL W	(3)	11.5 (5.81; 69)	11.2 (4.94; 50)
	(4)	9.7 (0.29; 9.2–10; 7)	9.6 (0.39; 9–10.3; 8)

TARSUS	(1)	33.3 (1.05; 31.4-36.5; 39)	33.1 (1.33; 30.8-37.9; 31)	(5)	136 (16; 13)
	(2)	31.4 (0.63; 30.4-33.1; 19)	31.4 (0.89; 29.5-33.3; 19)	(6)	140 (21; 110-175; 14)
	(4)	32.8 (0.95; 31.6-34.5; 7)	32.0 (0.90; 30.8-33.8; 8)	(7)	139 (17; 118-169; 21)
TAIL	(1)	89.1 (3.60; 79.7-96.7; 39)	87.9 (3.08; 82.5-94.5; 31)	(8)	132 (6; 122-148; 18)
	(2)	86.4 (3.52; 81.1-95.4; 18)	87.6 (3.01; 80.6-92.4; 19)	(9)	139.9 (20.4; 110-175; 17)
	(3)	88.9 (4.15; 69)	89.9 (4.24; 50)		
TOE	(1)	39.9 (1.32; 36.4-42.5; 39)	39.6 (1.20; 37.3-42.6; 31)		
	(2)	38.7 (1.29; 36.8-41.7; 19)	38.6 (1.47; 35.9-42.5; 19)		

Unsexed birds: (5) Macquarie I., live adults; minimum chord (Brothers 1984). (6) Iles Kerguelen, live birds, status unknown; methods unknown (Weimerskirch *et al.* 1989).

UNSEXED

WING	(5)	178.0 (3.67; 167-184; 24)
	(6)	180.6 (4.1; 174-189; 17)
BILL	(5)	22.0 (0.88; 21-23.9; 24)
	(6)	22.1 (1.2; 20-25; 17)
BILL W	(5)	11.2 (0.44; 10.6-12.1; 24)
	(6)	11.5 (1.2; 10.6-12.5; 17)
TARSUS	(5)	31.9 (0.97; 30.2-33.8; 24)
	(6)	33.1 (0.6; 32-34.5; 17)
TOE	(5)	41.5 (1.51; 38.3-44.2; 24)
TAIL	(5)	89.8 (2.84; 85-95; 24)

Contra Harper (1980), Tennyson (1989) found significant differences in lengths of bill of males and females (see 2 above). In immatures, width of bills shrinks c. 8.4%; 10.4% (9.3-11.5; 20); after drying, 9.5 (8-11; 20) (Harper 1980). Additional measurements in Condon (1944), Buddle (1941), Oliver, Richdale (1965), HASB, Despin *et al.* (1972), Mougin (1975), Bourne (1980), Harper (1980), Cox (1980), Prince & Croxall (1983), Jouventin *et al.* (1985) and Mougin (1985). Mougin (1985) summarizes measurements of recognizable forms.

WEIGHTS (1) Main I., Snares Is, live breeding birds; methods as in Baldwin *et al.* (1913) (A.J.D. Tennyson). (2) Mangere I., Chatham Is, live breeding birds; methods as in Baldwin *et al.* 1913 (A.J.D. Tennyson).

MALES

FEMALES

(1)	141.4 (15.67; 117-178; 31)	136.8 (14.77; 108-171; 26)
(2)	115.4 (11.68; 88-139.5; 19)	117.7 (15.13; 98.5-160; 19)

(1) Main I., Snares Is, live breeding birds; methods as in Baldwin *et al.* (1913) (A.J.D. Tennyson). (2) Mangere I., Chatham Is, live breeding birds; methods as in Baldwin *et al.* (1913) (A.J.D. Tennyson). (3) Whero I., live birds (Richdale 1965); (4) S. Georgia, live birds (Prince & Croxall 1983); (5) Falkland Is, live birds (Prince & Croxall 1983); (6) Iles Kerguelen, live birds (Mougin 1985); (7) Ile de l'Est, Iles Crozet, live birds (Mougin 1985); (8) Ile aux Cochons, Iles Crozet, live birds (Mougin 1985); (9) Iles Kerguelen, live birds (Weimerskirch *et al.* 1989).

UNSEXED

(1)	120.2 (11.61; 101-142; 23)
(2)	110.0 (14.55; 75.5-134; 19)
(3)	132 (14; 100-162; 100)
(4)	145 (14; 21)

Additional weights in Mougin (1975). Fledgelings leave breeding sites during first week in Jan. weighing average of 100.5 g (Harper 1976). Average weight of adults on arrival in evening is 134 g; average departure weight 111 g; after incubation shift or feeding of chick (Harper 1976). Richdale gives mean arrival weight 131.8 (92-162; 100). At Aoarangi I., Poor Knights Is, birds feeding older chicks 133.8 (1.3; 120-157). Usual departure weight of adults, 111 g; in emaciated beach-cast birds 65-97 g (n=105). Chicks reach a weight equal to that of adults at about 3 weeks after hatching; heaviest weight, of 170-188 g when 25-29 days old. Loss of 100 g, 10 days before departure (Harper 1976). Fledgelings leaving breeding site had average weight of 100.5 (85-118) g (Harper 1976); at Whero I., 112.7 (90-131) (Richdale 1965). Non-breeding birds have low weights similar to departure weights of breeding adults. Details of changes in chicks in Richdale (1944, 1965).

STRUCTURE Wing, short and narrow. Eleven primaries: p10 usually longest, p9 0-3, p8 6-7, p7 17-19, p6 28-31, p5 40-43, p4 51-57, p3 64-72, p2 75-83, p1 84-93, p11 minute. No emarginations. Twelve rectrices, t1 longest, t6 9-15 mm shorter. The small latericorns are usually straight sided, occasionally slightly convex; maxilla without lamellae. Inter-ramal space, bare; slightly distensible. Feet webbed. Outer and middle toes about equal, inner c.81% of middle, hind, claw only.

SEXING, AGEING Fleming (1941) stated that width and bulbosity of bills develop with age, but details are lacking on growth rates. Juveniles have weak bills that shrink on drying (Harper 1980). Cox (1980) showed that smaller-billed Fairy Prion have an angular culmen; rounded in adults. Both sexes have brood-patch during incubation (Harper 1976). Richdale (1944) provides a key to ageing chicks, based on plumage characters.

RECOGNITION Birds without egg or chick during breeding season, in Nov. have fresh plumage similar to brooding adults and bare brood-patches. Breeding birds distinguished from them by worn plumage (Harper 1976). Average length of bill, 20-25 mm, and width, 10-12 mm (Harper 1980); black tail-bar, 40 mm (35-45) wide on central rectrices, 25% broader than that of any other species. The distance between the nasal tubes and moderately developed unguis in Fairy Prion is 5.1 mm (4.2-6), shorter than in *P. belcheri* (8.3 mm); not so short as *P. crassirostris* (2-4 mm). Fairy Prion and *P. crassirostris* are the only two having long upper tail-coverts smudged with black (Harper 1980). In Falkland Is, *P. belcheri* vary; largest bill 27.6 mm, smallest 23.4; the smaller bill is like that of some *P. turtur* but distance between unguis and nasal tubes distinguish this species.

GEOGRAPHICAL VARIATION Taxonomic treatments vary: here treated as having two subspecies: *turtur* and *subantarctica*, following Harper (1980). Aust. CL and Peters treat Fairy Prion as monotypic, forming superspecies with *P. crassirostris*. Cox (1980) regarded Fairy Prion as having a number of subspecies, normally attributed to *P. crassirostris*.

Characters used to determine subspecific differences mainly based on form of bill (illustrated in Cox 1980).

Breeding populations fall into two discrete groups, a n., large-billed form and a s. stout-billed form. The difficulty has arisen in differentiating the s. stout-billed form from *P. crassirostris*. The validity of s. stout-billed form (*subantarctica*) has been questioned because Oliver based his description on a young bird (Cox 1980).

Imber (1981) states that colonies from Poor Knights Is to Snares and from Bass Str. to Chatham Is can be considered a unit. They breed in burrows, are nocturnal at nesting sites, and are longer-billed. Imber (1981) also states that the short-billed birds breed at the Falkland Is, Marion I., probably Prince Edward I., Ile aux Cochons and possibly Ile de l'Est, Iles Crozet (Mougin 1975), possibly on islands off Campbell and Antipodes Is.

Subspecific characters. In *P. turtur*, size of bill agrees with Allen's Rule (Harper 1980). Larger-billed populations have varying darkened crowns and smaller-billed birds of cooler waters are paler. Subspecies *subantarctica* has paler plumage than nominate *turtur*, lacks dark feathering on forehead and crown and is very pale about the face (closely resembling *P. crassirostris*). Harper (1980) states that the profiles of bills of the two are completely different, basing his statements on birds collected at Antipodes Is on 23 Nov. 1978. Cox (1980) found that birds from Falkland Is had bills similar to birds from Motunau I. in NZ and resembled some nominate *turtur* from Antipodes Is, Mangere Is, and Cook Str. and some *P. crassirostris* from Heard I. Variation in birds from Heard and Motunau Is indicates that all *P. crassirostris* and *P. turtur* may not be distinguishable. Some nominate *turtur* from Mangere I., Antipodes Is and Motunau I. resemble some birds from Heard and Auckland Is.

RMO

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Volume 1 (Part A), 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

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