

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 Tubinarae). 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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Pterodroma magentae Magenta Petrel

COLOUR PLATE FACING PAGE 432

Aestrelata magentae Giglioli & Salvadori, 1869, *Atti Soc. Ital. Sci. Nat.*, Milan, 11 (1868): 451 — 39°38'S, 125°58'W, Pacific Ocean.

Specifically named to commemorate the first Italian man-of-war to circumnavigate the globe — Giglioli & Salvadori 1869: *On some new Procellariidae collected during a voyage round the world in 1865-68 by H.I.M's S. Magenta.*

OTHER ENGLISH NAME Chatham Island Taiko.

MONOTYPIC A controversial and enigmatic species. After collection of the type-specimen in 1867 nothing was seen of this bird and even its name was lost in the synonymy of closely related forms (Bourne 1964) until it was rediscovered on Chatham I. in 1979 (Crockett 1979).

FIELD IDENTIFICATION Length 39, 42 cm; wing-span 102 cm; weight 420-560 g. Extremely rare medium-sized gadfly petrel, slightly smaller but similar in shape to Great-winged Petrel *P. macroptera* and with plumage pattern recalling Phoenix Petrel *P. alba* of tropical waters. Chunky black bill, large rounded head, thick neck and thickset body tapering to narrow gently wedged-shaped tail (usually held tightly folded and appearing pointed); wings, long and narrow, carpal

joints held well forward and outerwings swept back, tapering to fine points. Sexes alike; no seasonal variation. Juvenile undescribed.

DESCRIPTION ADULT. Upperparts, uniform sooty grey; may look blackish at sea, especially in strong light. Head, neck and upper breast, sooty grey, uniform with dorsum; generally appears as solid dark hood sharply demarcated from white lower breast and belly. Uniformity of hood re-



lieved by varying (usually small) white patch on chin and throat (difficult to discern at sea). Sooty grey of hood and dorsum wears browner. Lower breast, belly, and vent, white with dark of hood extending down flanks as solid dark band; under tail-coverts, white; blackish undersides of retrices form narrow dark rim round undertail. Underwing appears uniformly blackish in distant view or when backlit; in close view, marginal, lesser and median coverts blackish; greater coverts and remiges same but with glossy sheen, appearing strongly reflective in strong light, especially primaries, which flash silvery. Bill, black, often with horn-coloured patches on nails; chunky, with large, strongly hooked nail and tubed nostrils prominently raised over basal third of upper mandible. Legs and basal third of toes and webs, pinkish-flesh; rest of feet, black.

SIMILAR SPECIES Uniform sooty grey upperparts, wholly dark underwings and dark hood sharply contrasting with white belly and undertail form plumage pattern shared by no other Southern Ocean *Pterodroma*. However, in NZ waters, may be confused with superficially similar light-morph **Soft-plumaged Petrel** *P. mollis* which has dark underwing and can have hooded appearance in distant or receding view. Soft-plumaged much smaller, with less robust bill and lighter, less thickset jizz; upperparts paler (more bluish) grey and always marked with narrow open black M across upperwings and rump when fresh, or showing obvious contrast between brownish-black upperwings and grey saddle when worn (upperparts darker sooty grey and more uniform on Magenta, never with M-mark); head pattern also differs: clear white supercilium usually extends over eye, with obvious blackish patch beneath eye contrasting with grey cap; white chin- and throat-patch larger, extending to cheeks and lores and separated from white belly by narrow grey breast band giving collared appearance (Magenta appears hooded; head and neck, more uniform, dark sooty-grey with small white chin- and throat-patch, not extending onto cheeks or lores).

Underwing pattern also differs, Soft-plumaged showing small but distinct white triangle-shaped patch on inner leading edge, abutting body (underwing lining uniformly blackish on Magenta). For distinctions from superficially similar **Phoenix** and **Tahiti P.** *rostrata* **Petrels**, see those accounts.

Rarely reported at sea, even round Chatham Is. Avoid land except when breeding; never seen from breeding islands by day. Impetuous roller-coaster flight characteristic of genus. Solitary at sea. Ignore ships. Solitary or loosely colonial breeder, nesting on fern-covered slopes or forested ridges of main Chatham I.; strictly nocturnal at breeding grounds. Voice undescribed.

HABITAT Marine; pelagic distribution poorly known. Few reliable records at sea suggest birds prefer cool water and forage E of Chatham Is along Subtropical Convergence (Bourne 1964) or to S in subantarctic seas (M.J. Imber; see Movements). Breeding known only from Chatham Is; formerly nested on densely forested ridges and near sea-cliffs (Fleming 1939), but only recent evidence of breeding is in dense forest c. 5 km inland, on slopes or slightly elevated ground (M.J. Imber).

Very rare. Areas of native forest where birds bred cleared for pastoral development; few remaining stands deteriorating from damage by wind and grazing by introduced herbivores (possums, cattle, sheep, pigs). Introduced predators (cats, rats, wekas) common. Location of nest burrows and reservation of surroundings are priorities for conservation (King 1979).

DISTRIBUTION AND POPULATION Poorly known with few historical or recent records. Breed only Chatham Is. Highly pelagic, apparently restricted to s. Pacific Ocean. In winter, after breeding, thought to range E of Chatham Is in subtropical waters to 88°W, N to 26°S and S to Subtropical Convergence (Giglioli & Salvadori 1869; Bourne 1964; M.J. Imber); probably forage in subantarctic waters to S

of Chatham Is during breeding season (M.J. Imber). Only recent record at sea: one, probable, 400 km SE of Chatham Is, 28 Nov. 1970 (Rogers 1980).

Present estimate of population about 50 individuals and less than ten breeding pairs. Only six burrows have been found; in 1989, only three pairs and three of these burrows used (M.J. Imber).

MOVEMENTS Virtually unknown. In summer, recorded 400 km SE of Chatham Is in Nov., and radio-telemetry of ten birds (1987) showed they departed to S and SW and returned from SSE and SSW (M.J. Imber); thus foraging range of breeding birds probably subantarctic waters to S of Chatham Is. Earlier records, 4500 km, and farther, E of Chatham Is (Giglioli & Salvadori 1869) suggest post-breeding dispersal in subtropical waters of e. Pacific in winter (Bourne 1964).

FOOD No information.

SOCIAL ORGANIZATION AND BEHAVIOUR
No information; see breeding.

VOICE Never heard.

BREEDING Very poorly known; solitary or loosely colonial, only on Chatham Is. To 1990, only six burrows known, with three breeding pairs; in two groups, 5 km apart. Return to colonies, early Oct.; mating occurs about 15–25 Oct.; pre-laying exodus of about 4–5 weeks. Laying between 20 Nov. and early Dec. Incubation period unknown, probably c. 52 days. Chick-rearing, late Jan. to end Apr. Chicks depart, between c. 20 Apr. and 10 May. Success: from three nests over 2 years (1987–88, 1988–89), apparently three chicks fledged (50%).

PLUMAGES Plumage similar to Phoenix Petrel. Description here, based on photos (NZRD; M.J. Imber), and data presented in Bourne (1964).

ADULT HEAD AND NECK. Crown and hindneck, dark brown. Forehead, dark-brown, fringed white. When worn, fringes largely lost. Proximal lores, black, forming dark loreal patch; patch extends slightly below eye, as sub-orbital patch. In front of eye, above loreal patch, broader white fringed feathers. Side of head, rest of lores, round gape and proximal lower mandible, pale dark-brown. Chin and throat, extending marginally to malar region, white; merges into pale dark-brown foreneck. **UPPERPARTS**, black-brown; mantle, paler, and fringed paler brown. **TAIL**, dark brown. **UPPERWING.** Remiges, black-brown with dull white inner webs. Coverts, dark brown, fringed slightly paler. **UNDERPARTS**, almost entirely white; demarcation with foreneck, slightly convex, but quite sharp. Longest flank feathers, under tail-coverts, varying mottled dark brown; mottling reduced on lateral under tail-coverts. Axillaries, dark brown. **UNDERWING.** Inner webs of primaries, suffused with dull white. Greater primary and

greater coverts, brown-grey and glossy. Rest of coverts, dark brown and basally white.

DOWNY YOUNG, JUVENILE Undescribed.

BARE PARTS Based on photos in NZRD and unpublished (M.J. Imber).

ADULT Iris, dark brown (219). Bill, grey-black (82). Legs and feet, pink (7), to basal third of foot. Outer tarsus, outer toe, and rest of webs, grey-black (82).

DOWNY YOUNG, JUVENILE Undescribed.

MOULTS Few data. Based on field observations.

ADULT POST-BREEDING Five birds examined from 1 Dec.–1 Jan., in fresh plumage, though one bird still had outer primaries growing on 1 Jan. (NZRD).

POST-JUVENILE Undescribed.

MEASUREMENTS (1) Chatham Is, live birds; methods unknown (M.J. Imber); (2) Chatham Is, live birds (D.E. Crockett). (3) Tuku Valley, Chatham I., unsexed birds; maximum wing chord; exposed culmen (von Muller 1988).

UNSEXED

WING	(1) 306 (3.25; 302–312; 12) (3) 304.2 (298–308; 10)
TAIL	(1) 130 (3.76; 126–139; 15) (2) - (126–132; 5) (3) 128.9 (126–133; 10)
BILL	(1) 33.3 (1.42; 30.7–35.1; 15) (2) - (31.0–34.3; 5)
BILL D	(1) 15.8 (0.76; 14.3–17.2; 14) (2) - (14.6–16.5; 5)
BILL W	(1) 15.4 (0.60; 14.3–16.4; 14) (2) - (11.9–16.0; 5)
TARSUS	(1) 42.1 (1.09; 40.3–44.3; 15) (2) - (38.4–45.0; 5)

Measurements of type-specimen (held in Turin Museum) by Mathews & Hallstrom (1943) and re-measured by C. Jouanin were (respectively): Wing: 307, 304.5; Tail: 127, 125; Bill: 32.0, 32.5; Bill W: -, 16; Tarsus: 40, 39.

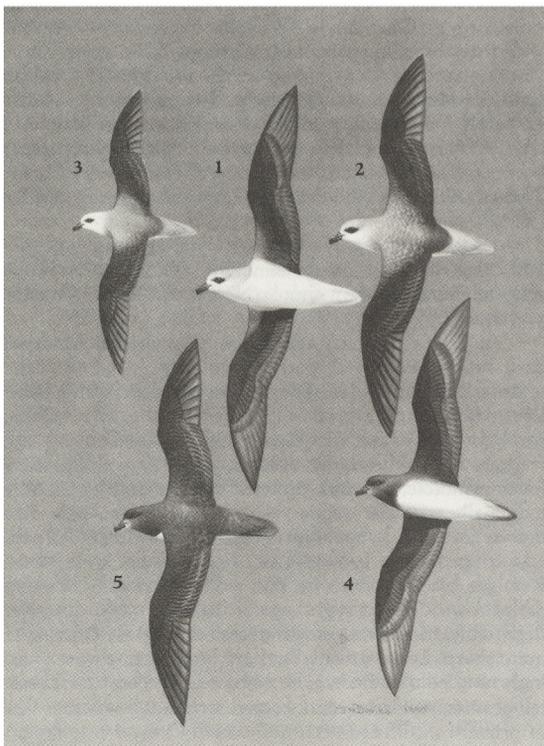
WEIGHTS Live birds, unsexed: 465 (21.6; 423–507; 17) (M.J. Imber); 415–560; 5 (n=5) (D.E. Crockett). At Tuku Valley, Chatham I., Oct.; unsexed birds: 468.3 (443–500; 10). No data on seasonal changes. RMO

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White-headed Petrel *Pterodroma lessonii*

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

Magenta Petrel *Pterodroma magentae*

- 4. Adult, ventral
- 5. Adult, dorsal

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