

Order **PROCELLARIIFORMES**

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

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

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

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

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

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

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

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Family PROCELLARIIDAE fulmars, petrels, prions, shearwaters

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

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

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

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

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

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

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

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

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

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Calonectris diomedea Cory's Shearwater

COLOUR PLATE FACING PAGE 593

Procellaria diomedea Scopoli, 1769, *Annus I Hist. Nat.*: 74 — no locality; Tremiti Is, Adriatic Sea, designated by Committee on Nomenclature, Br. Orn. Union, 1946, *Ibis* 88: 534.

Generic name compounded of *καλός* (beautiful, fair, good) and *νηκτρών* (to swim) = good swimmer. Specific name probably in reference to islands in the Adriatic Sea called in classical times 'Diomedea Insulae' (now Tremiti), named after Diomedes, bravest of the Greeks at Troy after Achilles.

OTHER ENGLISH NAMES North Atlantic, Atlantic, Mediterranean Shearwater.

English name honours C.B. Cory, 1857–1921, founder member of AOU, American millionaire, Curator of Birds at Field Museum, Chicago, champion golfer, billiards player and pistol-shot, who amassed a huge collection of skins, especially from Gulf of Mexico and Caribbean (Mearns & Mearns, *Biogr. Birdwatch.*, 1988).

POLYTYPIC Nominate *diomedea* breeds Mediterranean; *borealis* (Cory, 1881) in Berlengas, off Portugal, Madeira, Desertas, Porto Santo, Salvages, Canaries, Azores; *edwardsii* (Oustalet, 1883) in C. Verde Is.

FIELD IDENTIFICATION Length 45–46 cm; wingspan 100–125 cm. Large heavy-bodied and pale-billed shearwater. Greyish brown above and white below, with rather featureless plumage lacking contrasting patterns. Sexes similar; males slightly larger and heavier-billed. No seasonal variation.

DESCRIPTION ADULT. Head and hindneck, grey-brown, faintly mottled. Rest of upperparts, greyish-brown with paler edges to feathers; longest upper tail-coverts tipped whitish, occasionally forming pale horseshoe mark over tail. Tail, dark brown to blackish grey. Upperwing, greyish brown with faint paler edges to feathers; secondaries and primaries, blackish brown, latter with brownish white inner webs. Underwing, white merging into dusky brown on leading- and trailing-edges and wing-tip. Sides of neck and breast, mottled grey-brown merging into faintly grey chin and throat, and into white underparts, without obvious demarcation. Rest of underparts, white except for faint brown-grey barring on flanks and sides of under tail-coverts. Bill, yellow-horn with dusky marks behind nail. Iris, brown. Inner part of tarsus and inner toes, pale flesh; outer surface of tarsus, outer toe and web, dusky.

SIMILAR SPECIES Only nominate race and *bor-*

ealis found outside Atlantic. Both subspecies distinguished from **Grey Petrel** *Procellaria cinerea* by white underwing; from **Great Shearwater** *Puffinus gravis* by pale bill, ill-defined dark cap, entirely white belly and vent, absence of dark diagonal bar on underwing, heavier jizz more reminiscent of *Procellaria* petrels than of shearwaters; from **Buller's Shearwater** *Puffinus bulleri* by pale bill and absence of dark W-mark across upperwings and rump; from **Barau's Pterodroma barau**, **Juan Fernandez Pterodroma externa** and **White-necked Pterodroma cervicalis Petrels** by larger size, pale bill, grey-brown (not white) forehead and absence of dark diagonal bar on underwing; from **Streaked Shearwater** *C. leucomelas* by fairly uniform grey-brown crown and forehead; from **Pink-footed Puffinus creatopus** and light-phase **Wedge-tailed Puffinus pacificus Shearwaters** by absence of dark diagonal bar and mottling on underwing.

In light winds, flight languid, consisting of several deep wing-beats followed by long glide low over water; broad wings usually flexed, with distinct bow from carpal to wing-tip. In strong winds, prolonged gliding and banking with wings bowed, occasionally soaring. In wintering areas of s. hemisphere, usually gregarious in flocks of up to 100 birds (Bierman & Voous 1950; J.A. Bartle; J-C. Stahl), occasionally

joining mixed-species flocks off e. South America (Cooke & Mills 1972; Brown *et al.* 1975a). Occasionally follow ships; attend fishing boats (J.A. Bartle; J-C. Stahl).

HABITAT Marine, pelagic; in temperate and subtropical waters. Found in pelagic, offshore and inshore waters (BWP). Off e. South America, pelagic, mainly where sea surface-temperature $> 16^{\circ}\text{C}$; greatest densities over waters of 20°C over edge of continental shelf (Brown *et al.* 1975a). Off Namibia and South Africa, pelagic over waters of $18\text{--}20^{\circ}\text{C}$ (Bierman & Voous 1950). In sw. Indian Ocean, pelagic over waters of $16\text{--}21^{\circ}\text{C}$; mainly in zone where subtropical waters interspersed with cold-water eddies, N of Subtropical Convergence (J.A. Bartle; J-C. Stahl); observed S of Subtropical Convergence round Prince Edward Is (Williams & Burger 1978; Griffiths & Sinclair 1982). Juveniles of all races and *C.d. edwardsii* of all ages may winter in Tropical waters (Bourne & Curtis 1985; Mougouin *et al.* 1988). Concentrate to feed at coastal upwellings and along thermal fronts at boundaries of warm currents or water-masses (Cooke & Mills 1972; Brown *et al.* 1975b; Haney & McGillivray 1985).

Breed extraliminally in ne. Atlantic and Mediterranean; on islands or in mountainous terrain up to 30 km or more from coast; nest in burrows, in caves, among rocks, cliffs or scree, under bushes or in artificial nest-holes (BWP).

In flight rise higher than many other shearwater species on upwind tack; alight on water, often forming rafts (BWP). When feeding, may plunge briefly below water surface, but do not dive deeply (Brown *et al.* 1978).

DISTRIBUTION Extralimital during breeding season (Mar.-Nov.), breeding on islands and coasts of ne. Atlantic and Mediterranean; outside breeding season, in s. Atlantic and sw. Indian Oceans. Vagrant to A'asia.

Present in s. hemisphere mostly Nov.-May. In sw. Atlantic, in waters off Brazil, Uruguay and Argentina; usually S to 39°S but recorded to 48°S ; most common near Rio de la Plata (Cooke & Mills 1972; Brown *et al.* 1975a; Orlog 1979;

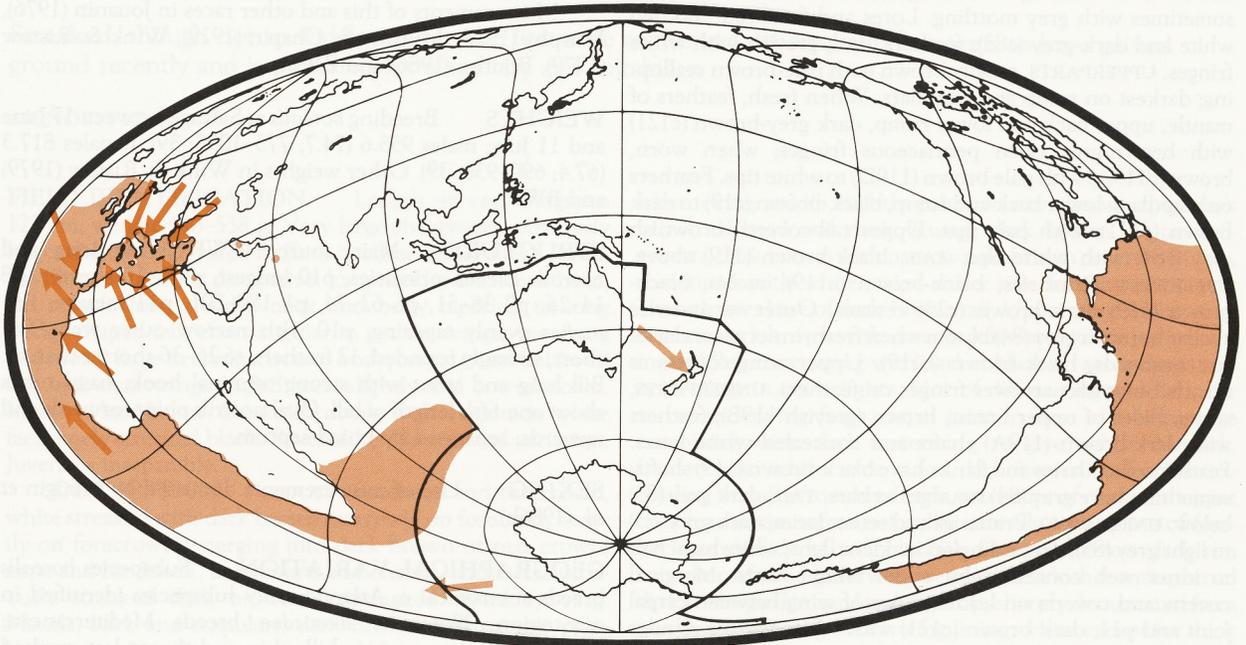
Thurston 1982; Bourne & Curtis 1985; Sick 1985). In central South Atlantic, abundant along Equatorial Countercurrent (Bourne & Curtis 1985), but apparently absent further S; accidental Gough I. (Richardson 1984). In se. Atlantic, in waters off Namibia and South Africa between 24°S and 40°S , W to c. 8°E (Bierman & Voous 1950; van Oordt & Kruijff 1953; Harris & Batchelor 1980; Voisin 1980; Griffiths & Sinclair 1982). In sw. Indian Ocean from E. Cape and Natal (Brooke & Sinclair 1978; Griffiths & Sinclair 1982) E to at least Iles Amsterdam and St Paul, c. $77^{\circ}35'\text{E}$ (Roux & Martinez 1987); mostly between $34\text{--}42^{\circ}\text{S}$ (Harrison 1978; Stahl 1987; Bourne 1989; J.A. Bartle; J-C. Stahl); further S, occasionally seen in numbers off Prince Edward Is (Griffiths & Sinclair 1982). *Contra* Mougouin *et al.* (1988), numbers entering Indian Ocean far from insignificant: population E of 30°E in order of 250 000 during summer (J.A. Bartle; J-C. Stahl). Nominate race predominant South Africa (Brooke & Sinclair 1978); *borealis* off e. North America (Powers 1983), South America (Mougouin *et al.* 1988) and probably sw. Indian Ocean (J.A. Bartle; J-C. Stahl).

NZ One record of *borealis*, beachcast, Foxton, sw. coast of NI, Jan. 1934 (Oliver 1934). Reported sighting of about four off Canterbury Bight, 1979, was misidentification of Pink-footed Shearwaters *Puffinus creatopus* (Tunnickliffe 1982, 1984).

BREEDING Nominate race breeds Mediterranean islands (total population 26 460+ pairs; James 1984). Subspecies *borealis* breeds Azores (estimated population 500 000 pairs; Le Grand *et al.* 1984), Madeira and offshore islands, Salvages (6800 pairs; Mougouin *et al.* 1984), Canary Is (1000s of pairs; Le Grand *et al.* 1984) and Berleuguas Is off Portugal. Subspecies *edwardsii* breeds C. Verde Is.

MOVEMENTS Transequatorial migrant from breeding grounds in n. Atlantic and Mediterranean to s. Atlantic and Indian Oceans.

DEPARTURE Birds leave breeding grounds in Mediterranean, Oct.-Nov., through Straits of Gibraltar



(Telleria 1980). Rapid trans-equatorial passage to South African waters, probably main wintering area, as species abundant and nominate race predominant (Brooke & Sinclair 1978). Non-breeders migrate earlier in autumn (BWP). Birds from Azores, Madeira and Canary leave similarly; observed and collected Cuba (May, Nov.; Garrido & Moutana 1975), Trinidad (Feb., Apr. and June; Collins 1969) and Guyana (Oct.; Snyder 1966). Specimens also from w. Sahara and Augda (Mougin *et al.* 1988), e. C. Province (Feb.; Courtenay-Latimer 1961) and Natal (April, one adult female; Clancey 1965).

NON-BREEDING Mediterranean birds off South Africa, Nov.–May (Griffith & Sinclair 1982); largest numbers off C. Province between 30–40°S and 10–20°E (BWP). First-year birds may winter in tropical Atlantic off w. Africa: fledglings from Corsica recovered Ghana in Feb. and May (Mougin *et al.* 1988). Non-breeding area of birds from Atlantic islands unknown.

Birds occur in sw. Indian Ocean, Dec.–Mar., all being massive with heavy bills characteristic of subspecies *borealis* and in wing-moult in Jan., corresponding with probable moult schedule of adults; moult of young birds almost certainly much later (J.A. Bartle; J.-C. Stahl). Single specimen of *borealis* found on sw. coast of NI, NZ, in Jan. (Oliver 1934). Immatures apparently restricted to w. Atlantic coasts of North and South America (Powers 1983; Thurston 1982; Sick 1985; Olrog 1979).

RETURN For Mediterranean, main return movement up e. side of Atlantic in late Jan.–Mar.; peak of passage through Straits of Gibraltar in Mar. (Garcia 1971). Non-breeders return May–June (BWP). For Atlantic islands, first return to Salvages in Aug.–Oct. when 3–4 years old (Mougin *et al.* 1988).

PLUMAGES

Subspecies *borealis*.

ADULT, JUVENILE Age of first breeding 7–13 years, half breeding by ninth year (Mougin *et al.* 1986a). **HEAD AND NECK.** Top of head, grey-brown (grey 119A). Hindneck and sides of neck, light brown-grey; chin and throat, white, sometimes with grey mottling. Lores and forehead, mottled white and dark grey (c83); feathers, dark greyish with white fringes. **UPPERPARTS,** mostly brown with pale-brown scalloping; darkest on rump and scapulars. When fresh, feathers of mantle, upper back and lower rump, dark grey-brown (c121) with brown-grey open pennaceous fringes; when worn, brown (c119A) with pale brown (119D) to white tips. Feathers on scapulars, lower back and rump, black-brown (c19) to dark brown (c121), with pale tips. Upper tail-coverts, brownish grey (c84) with white tips. **TAIL,** black-brown (119) above. **UPPERWING.** Primaries, black-brown (c119); rachis, black-brown (119) with brown (c23) centres. Outer secondaries similar but with grey (84) bloom when fresh; inner secondaries and humerals, black-brown (c119). Upper wing-coverts as mantle but with narrower fringes on feathers. **UNDERPARTS,** white. Sides of upper breast, brown (greyish 119B); feathers with dark-brown (119A) shafts and concealed white bases. Feathers of axillaries and flanks have black-brown (119) shafts; sometimes have grey (84) smudges or bars. **TAIL,** dark grey (83) below. **UNDERWING.** Primaries and secondaries, dark grey (83) to light grey (85), depending on incident light; white basal half to inner web concealed by under wing-coverts. Marginal coverts and coverts on leading edge of wing between carpal joint and p11, dark brown (c121) with white fringes. Under wing-coverts, white; most have black-brown (c119A) shafts, at

least at tip. Near base of wing, under wing-coverts have grey-brown (c119B) shaft-streaks.

BARE PARTS Based on BWP and photos from Harrison (1987) and unpublished (J.-C. Stahl).

ADULT, JUVENILE Iris, dark brown. Bill, cream-yellow (54) to yellowish buff (c124) with black-brown band across base of unguis; bill sometimes has pinkish tinge. Inner toes and inner surface of tarsus, pale flesh (-); outer side of tarsus and outer toe and web, dusky (-).

MOULTS

ADULT POST-BREEDING Complete, primaries outwards. Some birds of unknown status in moult in Sept., when majority not started (Mayaud 1949–50). Birds collected at breeding sites in Mar. have new wing feathers; some *edwardsii* have not completed growth of p10. Moult of body feathers, July–Mar., starting when eggs hatch (Jouanin 1964). Body moult slow; feathers replaced first are worn by the time that last ones grow.

POST-JUVENILE, SUBSEQUENT MOULTS No information.

MEASUREMENTS *C.d. borealis*. (1) Skins (BWP). (2) Grand Salvage I., breeding pairs, live; minimum chord (Robertson & James 1988).

		MALES	FEMALES	
WING	(1)	361, 367	358 (4.50; 347–363; 11)	
	(2)	371.1 (6.0; 357–380; 39)	363.0 (7.1; 343–363; 39)	**
TAIL	(1)	138, 145	136 (3.01; 131–141; 11)	
	(2)	55.5 (1.73; 51–59; 52)	52.8 (1.85; 49–57; 60)	**
BILL	(1)	58.8 (1.98; 54.4–61.7; 39)	55.7 (1.91; 52.0–59.9; 39)	**
	(2)	22.6 (0.77; 21.0–24.1; 39)	20.4 (0.57; 19.3–21.6; 39)	**
BILL D	(1)	57.0 (1.24; 54–59; 52)	54.6 (1.32; 51–57; 61)	**
	(2)	60.3 (1.19; 57.6–62.7; 39)	58.1 (1.40; 54.7–61.1; 39)	**
TARSUS	(1)	71.5 (1.92; 67–74; 52)	68.8 (1.92; 64–73; 61)	**
	(2)			

Measurements of this and other races in Jouanin (1976), Murphy (1924), Murphy & Chapin (1929), Wink & Ristow (1979), Bourne (1986) and BWP.

WEIGHTS Breeding *borealis* at Salvage between 17 June and 11 July; males 955.6 (74.7; 775–1095; 39), females 817.3 (67.4; 690–930; 39). Other weights in Wink & Ristow (1979) and BWP.

STRUCTURE Main source: BWP. Wing long and narrow. Eleven primaries; p10 longest, p9 1–10 shorter, p8 14–26, p7 38–51, p6 62–74, p1 180–201, p11 minute. Primaries evenly tapering, p10 with narrow outer web. Tail short, strongly rounded; 12 feathers: t6 26–36 shorter than t1. Bill long and stout with strong terminal hook, nasal tubes about one-fifth length of bill. Oval nostrils point forwards and upwards, separated by broad septum.

SEXING Use of measurements discussed by Mougin *et al.* (1986b).

GEOGRAPHICAL VARIATION Subspecies *borealis* breeds subtropical e. Atlantic; only subspecies identified in our region. Nominate *diomedea* breeds Mediterranean; smaller, with less massive bill; chin and throat less marked

grey; prominent white wedge on inner web of primaries, projecting well beyond under wing-coverts. Subspecies *edwardsii* breeds C. Verde Is; much smaller, with longer tail; bill black; upperparts darker; no white on distal half of primaries. Further information in Palmer (1962), Bourne (1955, 1986), BWP.

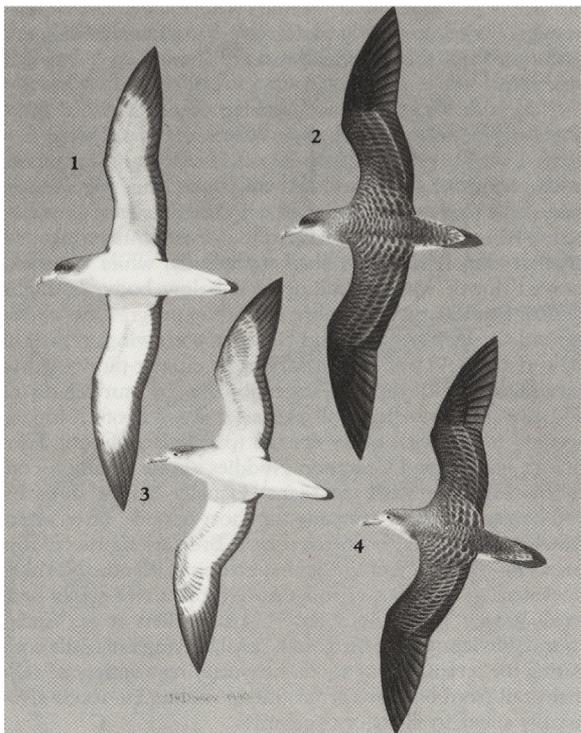
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Cory's Shearwater *Calonectris diomedea* Subspecies *borealis*

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

Streaked Shearwater *Calonectris leucomelas*

- 3. Adult, ventral
- 4. Adult, dorsal

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