

## Order CHARADRIIFORMES

A large, diverse assemblage of small to medium-large (12–75 cm long) limicoline, pratincoline, aquatic or terrestrial birds. Cosmopolitan from Arctic to Antarctic regions; in all sorts of maritime, freshwater and open terrestrial habitats (including deserts) with a few (woodcocks and snipes) even using dense forests. Once known as Limicolae or Laro-limicolae (e.g. Mayr & Amadon 1951); colloquially, the assemblage (excluding alcids, skuas, gulls, terns and skimmers) is often referred to as waders (especially in Britain) or shorebirds (especially in North America).

About 350 species in 19 families, though taxonomic treatments vary. Following families recognized (mostly based on recent reviews of Order [Sibley *et al.* 1988; Sibley & Ahlquist 1990; Sibley & Monroe 1990]):

Thinocoridae	seedsnipes; four species, S. America.
Pedionomidae	Plains-wanderer; monotypic, Aust.
Scolopacidae	sandpipers, snipes and allies; c. 85 species, cosmopolitan.
Rostratulidae	painted snipes; two species, s. America and Old World.
Jacanidae	jacanas; seven species, pantropical.
Chionididae	sheathbills; two species, Antarctica and subantarctic islands.
Burhinidae	thick-knees, stone-curlews; nine species, widespread in Old World and two in Neotropics.
Haematopodidae	oystercatchers; c. 11 species, worldwide in tropics and temperate regions.
Recurvirostridae	avocets and stilts; about seven species, worldwide in tropical and temperate regions.
Ibidiorhynchidae	Ibisbill; monotypic, central Asia.
Charadriidae	plovers and lapwings; c. 60 species, cosmopolitan.
Pluvianellidae	Magellanic Plover; monotypic, S. America.
Dromadidae	Crab Plover; monotypic, Arabian region.
Glareolidae	pratinoles, coursers, and Egyptian Plover; c. 15 species, widespread in Old World.
Stercorariidae	skuas and jaegers; about seven species, mostly in Arctic and Antarctic regions.
Rhynchopidae	skimmers; three species, pantropical.
Laridae	gulls; c. 47 species, cosmopolitan.
Sternidae	terns; c. 42 species, cosmopolitan.
Alcidae	auks; c. 20 species, Arctic and temperate regions of n. hemisphere.

Apparently monophyletic. Pteroclididae (sandgrouse) probably sister-group of Charadriiformes (e.g. Fjeldså 1976, 1977; Sibley & Ahlquist 1990; BWP), though whether best placed within Charadriiformes or in separate order is debated. Flamingoes (Phoenicopteridae) and divers (Gaviidae) have also been treated as Charadriiformes (Olson & Feduccia 1981; Fjeldså 1976, 1977) but DNA–DNA hybridization studies (Sibley & Ahlquist 1990) inconsistent with these theories. Affinities to other orders still controversial; DNA–DNA hybridization has suggested closest links are to large waterbirds, such as storks, herons and allies, Pelicaniformes, Procellariiformes, penguins, grebes, divers (Gaviidae) and also Falconiformes. All these were combined in huge order Ciconiiformes by Sibley & Ahlquist (1990).

Taxonomy and relationships reviewed in Sibley & Ahlquist (1990), Christian *et al.* (1992) and BWP (and references therein). Recent reviews have included: patterning of downy young (Jehl 1968; Fjeldså 1976, 1977), osteology (Strauch 1978; Mickevitch & Parenti 1980; Olson & Steadman 1981), DNA–DNA hybridization (Sibley *et al.* 1988, Sibley & Ahlquist 1990) and electrophoresis of tissue proteins (Christian *et al.* 1992). The studies of allozymes, DNA–DNA hybridization and the most recent osteological study of the entire order (Strauch 1978) have agreed in finding two or three well-knit, monophyletic assemblages within the Charadriiformes: scolopacids and allies (Thinocoridae, Pedionomidae, Scolopacidae, Rostratulidae, Jacanidae) and charadriids and allies (Chionididae, Burhinidae, Haematopodidae, Recurvirostridae, Ibidiorhynchidae, Charadriidae, Pluvianellidae, Dromadidae, Glareolidae, Stercorariidae, Rhynchopidae, Laridae, Sternidae, Alcidae); Strauch (1978) treated Alcidae as separate lineage, but skeletons may be so highly modified for foot-propelled diving that they do not reflect relations well (Sibley & Ahlquist 1990); gulls and allies have also been regarded as a separate lineage (Christian *et al.* 1992) or as allied to charadriids (e.g. Sibley & Ahlquist 1990). Further relationships within the Order discussed in introductions to families.

Because the Order comprises so many species and adaptations are so diverse, few characters shared by all species; those that are shared are mostly anatomical features of the skull, e.g. most or all have schizorhinal nostrils, schizognathous palates, well-developed vomer, lachrymals fused with ectethemoid and pre-frontal bones, well-developed supra-orbital grooves; see Olson & Steadman (1981) for more information on osteological characters. Wings usually have 11 primaries, with p10 longest and p11 minute; 15–24 secondaries; diastataxic except in *Scolopax minor*, as far as is known. Usually 12 tail-feathers. Necks usually rather long with 15–16 cervical vertebrae. Oil-gland bilobed and tufted. Syrinx, tracheo-bronchial; two carotids (type A-1 of Glenny 1955); caeca present. Legs usually rather long; hind toe small or lacking in most but all toes greatly elongated in Jacanidae. Feathers with small thin afterfeathers. Normally two moults annually: complete post-

breeding and partial pre-breeding; some jacanas and alcids have flightless periods when moulting remiges. Young, downy, usually with intricate cryptic patterns on upperparts of three chief types: pebbly, spotted and striped, matching characters of habitat (Fjeldså 1976, 1977): precocial, nidifugous usually, self-feeding or not depending greatly on parents.

Thirteen families recorded in HANZAB region, with 54 species breeding, 41 occurring as regular non-breeding migrants and c. 38 as accidentals or probable accidentals. Scolopacidae, Stercorariidae, Laridae and Sternidae will be dealt with in Volume 3 of HANZAB.

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## Family LARIDAE skuas, jaegers, gulls and terns

A large assemblage of small to very large charadriiform seabirds. We recognize four subfamilies within the Laridae following Mayr & Amadon (1951), AOU (1983).<sup>1</sup>

**Stercorariinae** Skuas and jaegers; about six species; cosmopolitan.

**Larinae** Gulls; c. 47 species; cosmopolitan.

**Sterninae** Terns; c. 42 species; cosmopolitan.

**Rynchopinae** Skimmers; three extralimital species, pan-tropical.

Taxonomic rank given to above groups varies greatly. Considered four families within suborder Lari (e.g. Campbell & Lack 1985; BWP), or four tribes within subfamily Larinae (e.g. Sibley *et al.* 1988; Sibley & Ahlquist 1990; Sibley & Monroe 1990). Others have divided Lari into three families (Stercorariidae, Laridae and Rynchopidae) with gulls and terns usually considered subfamilies within Laridae (e.g. Wetmore 1960; Judin 1965; Hackett 1989; Peters). Moynihan (1959) divided the group into two subfamilies, Stercorariinae, containing the skuas, and Larinae, containing gulls, terns and skimmers in three tribes. Study of skeletal and external morphology of suborder 'Lari' (our Laridae) was mostly unable to cluster gulls and terns satisfactorily and found group surprisingly uniform (Schnell 1970a,b). Despite lack of agreement on taxonomic ranking of above groups, monophyly of Laridae is not in doubt. Studies of biochemistry (Christian *et al.* 1992), DNA–DNA hybridization (Sibley & Ahlquist 1990), downy young (Fjeldså 1977) and skeletal morphology (Strauch 1978; Mickevich & Parenti 1980; Chu 1995) generally agree in finding close relation with Glareolidae (pratincoles) and Dromadidae (Crab Plover *Dromas ardeola*). DNA–DNA hybridization suggests Alcidae (auks) also closely related (Sibley & Ahlquist 1990), though this contradicted by studies of skeletal morphology (e.g. Strauch 1978; Chu 1995).

Body-form varies greatly, from small and slender in some gulls and terns, to robust and thickset in skuas, jaegers, some gulls and a few terns. Differences in size between sexes slight; males usually larger but females larger than males in Stercorariinae. Wings usually long, narrow and pointed, but broader and more rounded in some; 11 primaries; p10 longest, p11 minute; 17–24 secondaries. Tail has 12 rectrices; shape varies: in Stercorariinae, central rectrices project beyond rest of tail and greatly elongated in adult breeding plumages of *Stercorarius*; in most Sterninae and Rynchopinae, outer rectrices elongated and tail forked; in Larinae, usually square. Bill, varies, though usually rather short and stout, with prominent gonydeal angle; rather fine in some Larinae and Sterninae; tip pointed in Sterninae, decurved in strong hook in Stercorariinae. Bill highly modified for unique foraging methods in Rynchopinae (Zusi 1962). Lack cere, except in Stercorariinae. Nostrils schizorhinal and perforate, with no median septum. Legs, short and stout; attached near centre of body; tibiae partly bare; tarsi, short and typically scutellate in front. Four toes; hindtoe, short, raised, sometimes rudimentary or absent; front toes, fully webbed (webs somewhat incised in some). Claws, moderately long, strong, laterally compressed. Caeca ranges from large (Stercorariinae) to poorly developed (Rynchopinae, Sterninae). Supra-orbital salt-glands well developed.

Plumages mainly browns, black, white and greys. Colours of bare parts often striking and often showing marked variation with both season and age. Adults moult twice annually: (1) a post-breeding (pre-basic) moult to non-breeding plumage, which is complete (with apparent exception of *Larus sabini*); and (2) a pre-breeding (pre-alternate) moult to breeding plumage, which is almost always partial (but see *Larus pipixcan* and *L. sabini*); some terns also undergo one or two pre-supplemental moults of inner primaries. Primaries moult outwards.

Hatch in natal down, which is replaced by juvenile plumage; downy young precocial but more dependent on

<sup>1</sup> This treatment differs from the arrangement presented in the introduction to the Charadriiformes in Volume 2 of HANZAB (p. 648), where these four subfamilies were listed as families. Recent major studies in avian classification (particularly by Sibley and co-workers) and the publication of a revised species list of Aust. birds (Christidis & Boles 1994) since the preparation and publication of Volume 2, have brought much rearrangement. In this and subsequent volumes of HANZAB, taxonomy, nomenclature and arrangements of species follow Christidis & Boles (1994) (though they do not present subfamilial taxonomy). Their sequence of families of Charadriiformes occurring in HANZAB region is: Pedionomidae, Scolopacidae, Rostratulidae, Jacanidae, Chionidae, Burhinidae, Haematopodidae, Recurvirostridae, Charadriidae, Glareolidae and

Laridae. However, work on Volume 2 was too advanced to follow their sequence and taxonomy fully. The Scolopacidae are out of place in the arrangement of subfamilies in Volumes 2 and 3; other families follow the order of Christidis & Boles (1994).

### Plate 23

Oriental Pratincole *Glareola maldivarum* (page 366)

1 Adult breeding; 2 Adult non-breeding; 3 Juvenile;  
4, 5 Adult

Australian Pratincole *Stiltia isabella* (page 373)

6 Adult; 7 Downy young; 8 Juvenile;  
9 First immature non-breeding;  
10, 11 Adult

parental feeding than other Charadriiformes. Post-juvenile (first pre-basic) moult complete or partial, varying within and between families; moults of subadults complicated and vary between subfamilies (see subfamily accounts). Generally slow to mature, attaining adult plumage when 2–4 years old and first breeding at 2–4 years (smaller gulls and terns) to 4–9 years (many skuas and larger gulls and terns); some may breed in first year (e.g. *Sterna albifrons*).

Inhabit wide range of marine and freshwater habitats from Tropics to polar regions; many species strongly migratory, especially those breeding at high latitudes, e.g. South Polar Skua *Catharacta maccormicki* and Arctic Tern *Sterna paradisaea*, which migrate between polar regions. Most nest in terrestrial colonies near water (see subfamily accounts); some species highly pelagic in non-breeding season. Use wide range of foraging methods (see subfamilies; for discussion of feeding methods, see General Introduction).

See subfamily accounts for summaries of social organization and breeding.

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## Subfamily STERNINAE terns and noddies

Cosmopolitan group of seabirds, with narrow pointed wings and long pointed bills, ranging in size from Little *Sterna albifrons* (20–28 cm) to Caspian Terns *Sterna caspia* (up to 55 cm). Mostly smaller, slimmer and longer-tailed than gulls (Larinae) and more aerial. About 42 species in six genera.

GENUS	NUMBER OF SPECIES
<i>Sterna</i>	Sea terns (including commic terns); c. 32 species; 17 in HANZAB region (15 breeding, 2 non-breeding migrants; 1 species not acceptably recorded)
<i>Chlidonias</i>	Marsh terns; 3 species; all recorded HANZAB region (1 breeding, 1 non-breeding, 1 accidental)
<i>Phaetusa</i>	Monotypic; Large-billed Tern <i>P. simplex</i> ; extralimital in South America; often combined in <i>Sterna</i>
<i>Anous</i>	Dark noddies; 3 species; all breed HANZAB region
<i>Procelsterna</i>	1 (possibly 2) species; Grey Ternlet <i>P. albivitta</i> breeds HANZAB region (second taxa extralimital)
<i>Gygis</i>	Monotypic; White Tern <i>G. alba</i> ; breed HANZAB region
<i>Larosterna</i>	Monotypic; Inca Tern <i>L. inca</i> ; extralimital in South America

Studies of osteology (Strauch 1978; Mickevich & Parenti 1980; Chu 1995), behaviour (Moynihan 1959), DNA–DNA hybridization (Sibley & Ahlquist 1990) and allozymes (Christian *et al.* 1992) have generally suggested that terns more closely related to gulls than to other Laridae; monophyly of the Sterninae appears not to be in doubt, and sometimes considered a full family (e.g. BWP).

Number of genera recognized varies. Moynihan (1959) recognized only three: *Sterna* (including *Chlidonias* and *Phaetusa*), *Larosterna*, and *Anous* (including *Procelsterna* and *Gygis*). Others have recognized as many as ten (e.g. Peters) or 12 (e.g. Wolters 1975) genera. Gull-billed Tern *S. nilotica* often placed in monotypic genus *Gelochelidon*; large terns with erectile crests (e.g. *S. bergii*, *S. bengalensis*) sometimes placed in *Thalasseus*; Caspian Tern *S. caspia* sometimes placed in monotypic genus *Hydroprogne*, or in *Thalasseus*. *Anous*, *Procelsterna* and *Gygis* sometimes treated as tribe Anousini (noddies). Our arrangement follows Christidis & Boles (1994) and Sibley & Monroe (1990), except that Black-fronted Tern *S. albostrata* placed in *Sterna* rather than *Chlidonias* (following Mees 1977; Lalas & Heather 1980; NZCL; see that account). Monophyly of genus *Sterna* as recognized here has been challenged by electrophoretic study of Hackett (1989).

Body-form gull-like, but slimmer and more elongate than gulls except in largest species. Males usually slightly larger than females, especially in length and depth of bill. Necks short. Wings, long and pointed, narrower than in gulls; when wing folded, primaries project well beyond tertials (tips of 5–6 outer primaries usually exposed) and often beyond tip of tail. About 18–24 secondaries; ulnar part of wing shorter than in gulls. Flight musculature differs from gulls by lack of expansor secundarium (except in *Anous*). Tail, long in most species, with 12 rectrices: most have deeply forked tail, with t6 often elongated as tail-streamer; *Chlidonias* has short tail, only shallowly forked; tail of noddies forked, but with t3 or t4 longest in *Anous* and t5 longest in *Procelsterna* and *Gygis*. Bill, straight, with simple rhamphotheca and no cere; slender and rather long in most species, heavier in larger species, especially *Phaetusa*, short and thick in *S. nilotica*; tip pointed, not hooked. Legs, short or very short; tarsi rather weak; scutellate. Three front toes fully webbed, though webs deeply incised in *Chlidonias*; hindtoe reduced or vestigial, raised. Swim less readily than gulls, and have less well developed oil-gland (vestigial in *S. fuscata*). Supra-orbital salt-glands well developed. Down occurs on both pterygiae and apteria.

Sexes similar in plumage. Adult *Sterna* and *Phaetusa* usually uniform light grey above and white or pale grey below (with evanescent pink flush in some species), usually with contrasting black markings on head (often in form of cap) and tip of wing; some browner above (e.g. *S. fuscata*, *S. anaethetus*). *Chlidonias*, *Larosterna* and *Anous* mostly dark grey, dark brown or black above and below; *Procelsterna*, uniform ash-grey; *Gygis*, all white. Irides normally dark brown. Bill, legs and feet of most, yellow, orange, red or black. *Phaetusa*, *Chlidonias* and most *Sterna* show seasonal change in plumage: in non-breeding plumage, black caps reduced or flecked with white, many develop dark cubital bars, fork of tail usually less deep (and tail often slightly darker), underparts of grey-bellied species become paler, and bill and feet often become darker; *Chlidonias* also develop paler upperparts. No seasonal change in appearance of noddies. Adults typically have two moults per cycle: a complete post-breeding (pre-basic) moult to non-breeding plumage; and a partial pre-breeding (pre-alternate) moult to breeding plumage (which involves at least head, neck and some of body, and often all of body, tail and varying number of inner primaries). Primaries moult outwards. Moult of remiges, especially primaries, protracted in most; post-breeding (pre-basic) moult of primaries continues long after moult of body finished, and often overlaps with start of pre-breeding (pre-alternate) moult. Species moulting inner primaries in pre-breeding (pre-alternate) moult can thus have two concurrently active waves of moult in primaries. In some species (e.g. *S. albifrons* and some *Chlidonias*) there is often a third wave, as innermost primaries replaced a third time in a pre-supplemental moult. In two small pale tropical species (*Gygis alba* and *Sterna*

*sumatrana*), primaries replaced in staffelmauser, which is interrupted only when breeding; pre-alternate moults possibly lost in these species. Breeding and moult seldom overlap, except for some pre-basic moult of feathers of head when raising chicks (usually in larger or migratory species); in migratory species, most or all moult of remiges occurs in non-breeding areas and post-breeding moult (if started) is suspended during migration. In several species of oceanic terns nesting in Tropics, annual cycles last for less than 1 year, with duration between breeding events possibly dependent on time needed to complete moult (e.g. Ashmole 1962, 1963, 1968).

Downy young, precocial or semi-precocial; semi-nidifugous in most; nidicolous in *Gygis*, *Anous*. Natal down, ramose and woolly in most species, but long, straight, silky and very soft in *Chlidonias* (perhaps an adaptation to rather wet nesting sites). In some *Sterna* (e.g. *S. dougallii*), terminal barbs of down cling together to cause spiny appearance, especially on upperparts; down also very short in some (e.g. *S. albifrons*, *S. nereis*). Ground-colour of down ranges from white to grey or buff (rich orange-buff in *Chlidonias*), though dark, like adults, in some *Anous*. Dark markings on upperparts complex and diffuse: *Chlidonias* have bold black blotches; others varyingly streaked or speckled dark brown or black above, without distinct pattern except for three radiating lines on crown in many. Some species virtually unmarked above (e.g. *S. caspia*, *S. nilotica*). Some variation in colour and patterning of down (especially ground-colour) appears to be geographical (e.g. down of tropical populations of *S. dougallii* usually paler than in temperate populations) but also much individual variation, and siblings from the same clutch often look totally different (see Fjeldså 1977 for more information on downy young). Juvenile plumages typically differ from non-breeding adults in having buff or blackish tips or bars on much of upperparts and upperwing; tail generally darker than in adult, often with dark subterminal markings; many species have much individual variation in upperparts, and darkness of ground-colour and width of dark barring usually correlated. Juvenile plumages rather unusual in *S. virgata*, *S. vittata* and *S. fuscata*; see species accounts for details. In *Anous*, *Gygis* and *Procelsterna*, juvenile plumage similar to adult.

Sequence of moults from juvenile to adult plumage, complex. When recognizable traces of juvenile plumage have been lost, distinction of immatures from adults depends mainly on moult and wear of primaries. However, this of little use for ageing species in which timing of breeding and moulting vary (a frequent occurrence in Tropics) and subadult moults of such species (including all noddies) poorly known. Following generalizations based on species of *Sterna* and *Chlidonias* with regular cycles. **POST-JUVENILE (FIRST PRE-BASIC) MOULT** usually complete, with head and body finished several months before last outer primaries; in some species, birds can arrest moult when a few very worn outer primaries remain. In several species of medium-sized *Sterna* from s. hemisphere (*striata*, *albostrata*, *vittata* and *virgata*), post-juvenile moult appears to be partial, moulting almost no remiges or rectrices (though interpretation complicated because, unlike most juvenile terns, first post-breeding [second pre-basic] moult of head and body coincides with first moult of primaries, much as in typical gulls [D.J. James]); these species (and possibly *S. hirundinacea*) have several other unusual features in common, including heavily marked juvenile plumages, little sexual dimorphism in length of wing, and only one moult of primaries and (apparently) rectrices per cycle. They may represent a radiation from a single s. hemisphere ancestor (D.J. James). Whether first pre-basic moult partial or complete, most terns superficially resemble adult non-breeding when 3–7 months old, except for retained juvenile remiges (which are still moulting). When 9–12 months old, at least some perform partial **FIRST PRE-BREEDING (FIRST PRE-ALTERNATE) MOULT**, often starting before post-juvenile moult finished; some attain traces of breeding plumage (especially on crown and cubital bar) but in most there is probably no change in appearance. Resultant first immature non-breeding (first alternate) plumage superficially like adult non-breeding and, in species with regular cycles, held when adults in full breeding plumage.<sup>1</sup> When c. 1 year old, complete **FIRST IMMATURE POST-BREEDING (SECOND PRE-BASIC) MOULT** brings on plumage almost identical to adult non-breeding; this retained for much of second year, so most immatures retain non-breeding appearance from c. 5 months to c. 21 months old. Partial **SECOND PRE-BREEDING (SECOND PRE-ALTERNATE) MOULT** near end of second year is first moult to bring on extensive breeding plumage. In many species, second immature breeding plumage may differ from adult breeding in having a few non-breeding-like feathers in crown, cubital bar, tail or underparts; however, reliability of these ageing characters undermined in some species by similar variation in very small number of adults. Subsequent moults, as adults.

Mostly marine, inshore; some frequent both littoral and freshwater habitats; some markedly pelagic. Carnivorous; some only or mainly take fish (e.g. Black-naped Tern *S. sumatrana*, White-fronted Tern *S. striata*); other HANZAB species take mixture of fish, molluscs, crustaceans and insects; some freshwater species also take small vertebrates, such as mice or frogs (e.g. Whiskered Tern *C. hybridus* and Gull-billed Tern *S. nilotica*). Mostly diurnal but some nocturnal or crepuscular. Forage singly, in small groups or in mixed species feeding flocks, usually with other terns or seabirds, such as shearwaters. Feed mainly by surface plunging, occasionally shallow plunging; and by dipping (contact and non-contact). Also feed by hawking for insects over land and water; gleaning food while walking on ground or in shallow water; and kleptoparasitism.

<sup>1</sup> In Arctic Terns, the first alternate plumage was once mistaken as a separate species and named *Sterna portlandica* (Ridgway 1874), and the second alternate plumage was mistaken as another, *Sterna pikei* (Lawrence 1853). These taxonomic treatments have long since been discarded, but the terms 'portlandica plumage' and 'pikei plumage' still confusingly and incorrectly used for homologous plumages in many terns.

Highly gregarious when feeding, roosting and breeding, and will mob predators at colonies. Monogamous, with pair-bonds tending to persist from year to year. Birds may breed as early as 1 year old, but usually not till 3–4 and even older. Can live for many years. Normally breed in colonies, which can number up to tens of thousands. Nesting densities vary with species and habitat, and in large colonies of some *Sterna*, distances between nests can be a body-length. Nesting territories used for courtship and pair-formation, courtship feeding, copulation, and nesting. Fidelity to nesting site between years high in some species, though other species move between colonies or shift site of colonies altogether (Campbell & Lack 1985). At colonies, social flights, called MASS FLIGHTS, DREADS, PANICS, or UPFLIGHTS, common. In these displays, some or all members of a colony take flight and fly round in dense flock. Many authors use the terms interchangeably. Others distinguish between Mass Flights and Dreads: In Dreads, birds take off and fly low over colony for some distance without calling, then fly upwards calling loudly; Dreads an escape response but may also be used to help synchronize breeding. In Mass Flights, all birds take off and fly upwards, calling loudly from outset; Mass Flights most common before laying and are used to help synchronize breeding cycles of individuals; resurgence of Mass Flights occurs when chicks being fed, mostly by non-breeding birds visiting colony, at least some of which are preparing to breed in the next breeding season (K. Hulsman). The distinction is often not clear in published descriptions of flock behaviour. Vocal at breeding colonies; calls raucous.

In *Sterna* and allied genera, displays usually elaborate and similar between species. Aerial flights and some ground displays persist after laying. In GROUND DISPLAYS, which often involve more than two birds, birds drop wings, raise tails and stretch necks upwards. Aerial displays occur in and round colonies. In HIGH FLIGHTS, several birds ascend rapidly to 100 m or more, with some birds displaying as they descend. Zigzagging flights common and especially spectacular in Crested Tern, even after nesting has finished (Gibson 1956). A male carrying a fish will execute noisy LOW FLIGHT through colony, which often stimulates others to join in. FISH-OFFERING CEREMONIES involve one bird flying round, calling loudly, usually with fish held crosswise in bill; usually, another joins it, flying in front of first. Fish not transferred on wing, but may be passed on ground, accompanied by strutting.

Noddies (*Anous*, *Procelsterna* and *Gygis*) have different displays to sea terns. Similarities include ground displays before and during incubation, which involve birds dropping wings so that tips on or close to ground. In courtship display at nest-site, male bobs head slightly and caresses head and neck of female with bill; male courtship-feeds female, and birds call and touch bills. In aggressive territorial displays, male raises feathers of crown slightly, gives rattling call, then thrusts stiffened neck forward and bows. In all displays, orange tongue, pale crown and markings round eyes prominent (Woodward 1972).

Within Sterninae, both sexes share nest duties. Chicks semi-precocial and, if undisturbed, semi-nidifugous (most species) or nidicolous (*Anous*, *Gygis*); older chicks occasionally form crèches in some *Sterna*. Food given in bill (most species) or by regurgitation (e.g. *S. fuscata*, *Anous*). Parental feeding continues after fledging, sometimes for several months and, sometimes, after dispersal from colonies (Campbell & Lack 1985; BWP).

Breeding seasonal, though some tropical terns, notably Bridled *S. anaethetus* and Sooty *S. fuscata* Terns, breed at sub-annual intervals depending on local conditions; at some sites, breeding of population may be continuous (King & Buckley 1985; King *et al.* 1992; BWP). Usually breed in colonies on offshore islands or on headlands; also on or round terrestrial wetlands or in coastal habitats, such as sand dunes, beaches and on islands and sandspits in estuaries; some species nest on cliffs (e.g. Grey Ternlet *P. albigitta*); Black-fronted Terns nest in shingle beds in streams; Whiskered Terns in vegetation in freshwater swamps; occasionally nest on man-made structures, such as jetties and wrecked ships (HASB; Aust. NRS). Will nest with other species of terns. Ground-nesting birds make unlined or poorly lined scrape in sand or gravel, sometimes under vegetation or in crevice of rock; most noddies nest in trees and bushes, and build bulky nests out of plant material, though many Common Noddies *A. stolidus* nest on ground; Whiskered Terns build mounds or platforms of vegetation; White Terns make no nest, laying egg on bare branch or leaf of a tree (Fjeldså 1977; HASB; Aust. NRS). Ground-colour of eggs varies from cream or stone-grey to greenish stone, buff or light brown, with markings of black or dark brown, occasionally dark purple (HASB). Clutch-size, 1–3; most species breeding temperate zones average two eggs per clutch, most in tropical areas only one. Incubation period ranges from 19 to 36 days; species that lay 2–3 eggs per clutch incubate for shorter periods, mostly between 19 and 23 days, while those that usually lay one egg incubate for longer, from 28 to 36 days. Both sexes incubate. Adults defecate away from nest. Both sexes feed young, mostly bill to bill or by dropping item beside chick, though noddies, *Procelsterna* and some tropical *Sterna* fed by regurgitation. Young of ground-nesting species leave nest within 1 week of hatching but may remain near nest for a few more days; usually seek shelter in nearby cover, though some species form crèches (Hulsman 1977; HASB); young of tree-nesting species usually remain in nest till able to fly (but see *Gygis alba*). Most species dependent on parents for food for up to 4 months after fledging. Age of first breeding, usually 3–4 years, some species at 2 years (BWP).

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*Procelsterna cerulea* Grey Ternlet

COLOUR PLATES FACING PAGES 800 & 801

*Sterna Cerulea* F.D. Bennett, 1840, *Narr. Whaling Voy.* 2: 248 — Christmas Island, Pacific Ocean.

One of the many generic combinations beloved of French ornithologists over a century ago, *Procelsterna* is compounded of the generic name *Procellaria*, here used in the older sense of 'storm-petrel', and *Sterna*, tern, and alludes to the birds' habit of pattering with their feet on the surface of the sea, in the manner of storm-petrels. The specific name is from Latin *caeruleus*, cerulean, azure-blue.

**OTHER ENGLISH NAMES** Grey, Gray, Blue-grey, Blue-gray or Blue Noddy; Blue-grey or Little Grey Tern; Blue Ternlet; Blue-gray Fairy-Tern; Blue-gray Fairy Ternlet; Necker Island Tern; San Ambrosio Grey Ternlet; Little Blue Petrel; Blue Billy; Patro.

**POLYTYPIC** Subspecies *albivitta* Bonaparte, 1856, breeds Lord Howe, Norfolk and Kermadec Is, and Three Kings and Bay of Plenty, NI, NZ. Extralimitally: Nominate *cerulea* breeds Christmas I. (Pac.); subspecies *saxatilis* Fisher 1903, breeds Hawaiian Is; subspecies *teretirostris* (Lafresnaye, 1841) breeds Society, Marquesas and Tuamotu Is; subspecies *nebouxii* Mathews, 1912, breeds Phoenix, Ellice and Samoan Is; subspecies *murphyi* Mougin & de Naurois, 1981, breeds Gambier Is; subspecies *skottsbergii* Lönnberg, 1921, breeds Henderson and Easter Is; subspecies *imitatrix* Mathews, 1912, breeds San Ambrosio and San Felix off Chile.

**FIELD IDENTIFICATION** Length 25–30 cm; wingspan 46–61 cm; weight c. 70 g. Small, delicate tern, with slender black bill and moderately forked tail; resembles Black Noddy *Anous minutus* in shape and proportions, but much smaller and more compact, with much shorter bill, and shorter more deeply forked tail; much smaller than White Tern *Gygis alba*. Distinctive, with typical noddy jizz; blue-grey above, with greyish-white head, underbody and underwing-coverts. Sexes alike. No seasonal variation. Juvenile separable when close.

**Description Adult** Head, neck and underbody, greyish white, with faintly paler cap, thin white eye-ring behind eye, and small black patch in front of eye, which, with dark eye, gives big-eyed appearance. Rest of upperparts, pale blue-grey, slightly darker on wing-tips, with thin white trailing-edge to secondaries; when worn, show slight contrast between grey remiges and paler coverts. Underwing-coverts, greyish white, as underbody, contrasting strongly with dark-grey undersides of remiges. Bill and iris, black. Legs and feet, black, with dirty-pink webs. **Juvenile** Differs from adult by: slightly smaller black patch in front of eye; brown-grey streaking on chin and throat; faint brown tinge on saddle and inner upperwing-coverts; and darker grey upperside of remiges, forming dark trailing-edge, contrasting with paler-grey coverts.

**Similar species** None. In bright light at distance, can appear paler and could be confused with **White Tern** (q.v.). At distance, **White-winged Black Tern** *Chlidonias leucopterus* in non-breeding plumages best distinguished by: slightly larger size and more compact appearance, with proportionately shorter tail, appearing almost square-cut or only gently notched at tip; upperwing-pattern often more contrasting, and usually have obvious contrast between whitish rump and uppertail-coverts and greyer rest of upperparts; and whiter head, neck and underbody, always with some black on crown and ear-coverts.

In HANZAB region, breed only on oceanic and offshore islands in warm subtropical seas. Gregarious; flocks seen in waters surrounding breeding islands throughout year, though singles and small groups occasionally seen in open ocean. Vagrants sometimes seen in shelf-break and inshore waters; occasionally seen from land away from breeding islands, mainly during storms. Often seen with other terns and noddies, especially when feeding. Tame and inquisitive. Flight, graceful, buoyant and direct, with steady wing-beats and slight bouncing action; look small-headed, with distended breast in profile; often appear rather broad-winged in some flight attitudes. Typically forage in flocks; hover and flutter just above surface of water, often pattering with feet in manner of storm-petrels; repeatedly dip down to glean minute items with bill; occasionally settle on sea. Generally rather silent; at breeding colonies, utter low purring *cror-r-r*.

**HABITAT** Mainly isolated tropical or subtropical islands, on associated islets or rock stacks with cliffs, and in surrounding nearshore waters. Though prefer inshore seas, occasionally recorded in pelagic zone (Wood 1991; Brandis *et al.* 1992; CSN 20). Usually forage from surface of sea, in inshore waters (Hogg 1963; Edgar *et al.* 1965; Falla 1970; Seddon & Seddon 1979), sometimes in calm waters in lee of cliffs (Jenkins 1971). Once recorded feeding at sea round upwelling current (CSN 19). Vagrant off South Solitary I., NSW, fed in shallow (<10 cm) surf, and on damp littoral sands (Holmes 1976). Roost or loaf on ledges in cavities or crevices of precipitous cliffs and other rock faces of islands and offshore islets and stacks (Cheeseman 1890; Wakelin 1968; Falla 1970; Seddon & Seddon 1979; Tarburton 1981; Hutton 1991); sometimes just

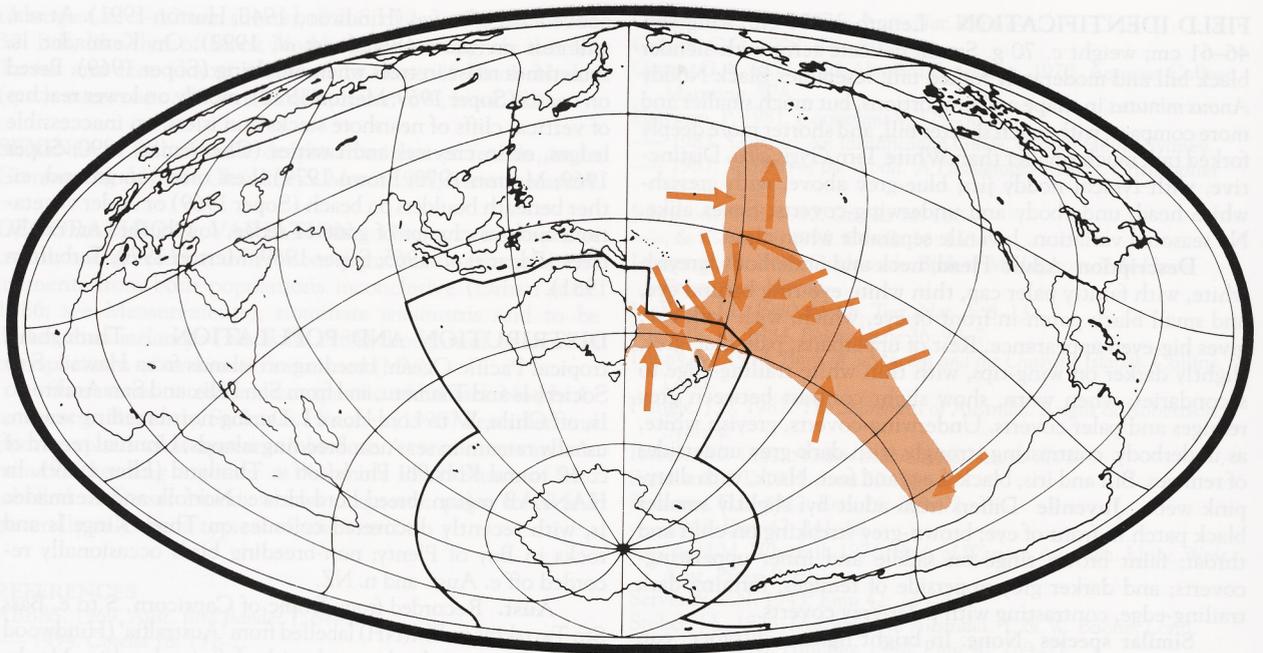
above level of waves (Hindwood 1940; Hutton 1991). At sea, will rest on water (Brandis *et al.* 1992). On Kermadec Is, sometimes roost in trees when moulting (Soper 1969). Breed on coasts (Soper 1969; Merton 1970), mostly on lower reaches of vertical cliffs of nearshore stacks and islets, on inaccessible ledges, or in crevices and cavities (Cheeseman 1890; Soper 1969; Merton 1970; Brown 1979). Less often on ground, either beneath boulders on beach (Soper 1969) or under vegetation, such as clumps of grass or sedge, low bushes or, rarely, trees (Edgar *et al.* 1965; Soper 1969; Merton 1970; Tarburton 1981).

**DISTRIBUTION AND POPULATION** Throughout tropical Pacific Ocean, breeding on islands from Hawaii, S to Society Is and Tuamotu, and from San Felix and San Ambrosio Is, off Chile, W to Lord Howe I. During non-breeding season, usually remain in seas near breeding islands. Unusual record of c. 30 round Koh Phi Phi Is, off s. Thailand (Eller 1989). In HANZAB region, breed Lord Howe, Norfolk and Kermadec Is, with recently discovered colonies on Three Kings Is and rocks in Bay of Plenty; non-breeding birds occasionally recorded off e. Aust. and n. NZ.

**Aust.** Recorded from Tropic of Capricorn, S to e. Bass Str. Two skins in BM(NH) labelled from 'Australfia' (Hindwood 1949); first mainland record with definite locality, Manly, NSW, in 1928. Below, singles unless stated. **Qld** North Stradbroke I.: N of Pt Lookout, 14 Apr. 1973 (Corben *et al.* 1974); beachcast, 12 km S of Pt Lookout, 2 Mar. 1974 (Vernon & Martin 1975); 26 Jan. 1982, 2 Jan. 1983, 19 Feb. 1983 (Smyth & Corben 1984); beachcast, Main Beach, 2 Mar. 1983 (Qld Bird Rep. 1983); off Pt Lookout, 30 Mar. 1986, 15 Nov. 1986 (Qld Bird Rep. 1986); E of Stradbroke I., 24 June 1989 (Qld Bird Rep. 1989); Pt Lookout, 2 Feb. 1991; S of Pt Lookout, 3 Feb. 1991 (Qld Bird Rep. 1991); Sandy C., Fraser I., Feb. 1981 (Sutton 1990); E of C. Moreton, 8 Feb. 1986 (Qld Bird Rep. 1986); specimen, Heron I., 31 May 1989 (Qld Bird Rep. 1989). **NSW** Records up to 1975 summarized by Holmes (1976). Manly: beachcast, 24 Dec. 1928 (Iredale 1929); specimen, 30 Mar. 1964 (Hindwood 1965); beachcast, Cronulla, 15 Jan. 1949 (Hindwood 1949); beachcast, Dee Why, late Jan. 1961 (Hindwood 1965); beachcast, Long Reef, 20 Jan. 1967 (Sawyer 1967); specimen, near Bungwahl, 21 Jan. 1971 (Cooper & Forshaw 1971); South Solitary I., 16 Jan. 1975 (NSW Bird Rep. 1975); beachcast, Windang, 19 Jan. 1975 (NSW Bird Rep. 1975); 10 km N of Port Macquarie, 30 Jan. 1975 (NSW Bird Rep. 1975); beachcast, Bundagen Head, near Sawtell, 2 Feb. 1975 (NSW Bird Rep. 1975); Awaba State Colliery, near Newcastle, 19–26 Mar. 1978 (van Tets & Fullagar 1978; NSW Bird Rep. 1978); Ballina, 25 Jan. 1985, 11 Feb. 1985 (NSW Bird Rep. 1985); Jervis Bay, 3 and 9–10 Feb. 1985 (NSW Bird Rep. 1985); 1–2, off Sydney Heads, 23 Feb. 1985 (NSW Bird Rep. 1985); off Wollongong: nine, 24 Feb. 1985; seven, 15–16 Feb. 1986; 28 Feb. 1987; 24 Feb. 1990 (NSW Bird Reps 1985, 1986, 1987, 1990). **Vic.** Single, specimen, c. 60 km S of Gabo I. (38°08'S, 149°32'E), 22 Jan. 1978 (Barton 1978); single, e. Bass Str. (37°53'S, 149°37'E), 5 Feb. 1985 (Vic. Bird Rep. 1985). **Anomalies** In 1985, several records (minimum 14) in NSW between Ballina and Wollongong; two of three Vic. records also in 1985 (see above).

**Mid-Tasman Sea** Recorded 43°06'S, 158°01'E, 13 Feb. 1976 (Jenkins 1976).

**NZ NI** First recorded 1882, at C. Maria van Diemen (NZCL). Nearly all records from Auckland Isthmus and associated offshore islands, and Bay of Plenty. Between 1964 and



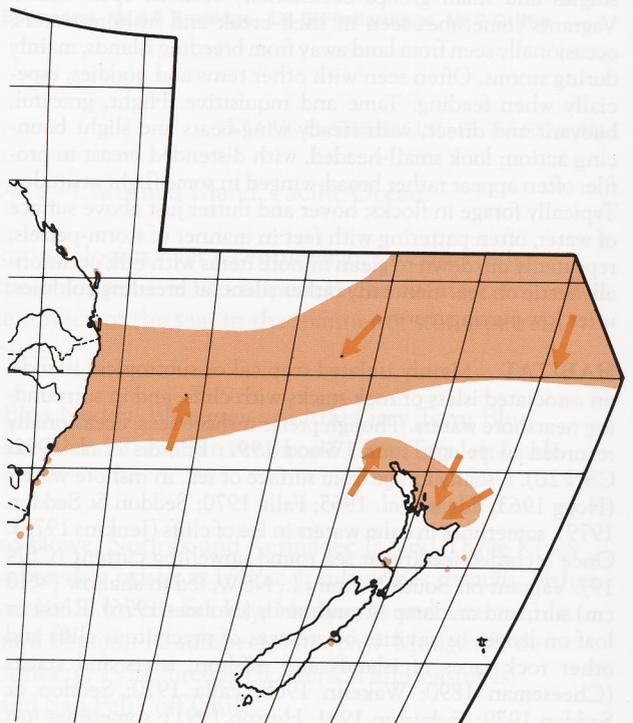
1990, nine beachcast birds recovered: six from beaches of Auckland West and three from Auckland East (NZ Beach Patrol Scheme). On e. coast of Auckland Isthmus, mainly between about Karikari and Pataua, with several records at sea in Bay of Islands and off C. Brett (Johnson 1955; Hogg 1963; Waller 1970; CSN); also round Poor Knights and Mokohinau Is (CSN). In Bay of Plenty, where hundreds sometimes recorded (Falla *et al.* 1981), occur E to at least Whakatone R. (Edgar 1978). Farther E, mainly recorded at sea, with records from E of East C., S to c. 40°S. In W of NI, recorded from C. Maria van Diemen, S to at least Muriwai, with isolated record of single (specimen) from Stratford, 8 Mar. 1984 (CSN 32). **SI** Single, beachcast, Little R., Banks Pen., mid-Apr. 1968, after 'Wahine gale' (Falla *et al.* 1981; NZCL).

**Breeding LORD HOWE I.:** On main island, Ball's Pyramid and other islets. Total breeding population between 100 and 1000 pairs, of which >50 pairs breed on Ball's Pyramid (Fullagar & Disney 1975; Brown 1979; Hutton 1991). **NORFOLK I.:** Mostly on Nepean and Philip Is (Hermes 1985; Hermes *et al.* 1986) with estimated 1000–10,000 pairs on Philip I. in 1977 (Schodde *et al.* 1983); also nest on other offshore islets and rocks (Hermes *et al.* 1986); nested on Norfolk I. at Duncombe Bay (Moore 1985) and possibly near Captain Cook Memorial (Tarburton 1981). **KERMADEC IS:** Raoul I. and offshore islets and rocks, including Napier Rock, North and South Meyer Isl. (>2000 pairs), Herald Isl. (including Dayrell and North and South Chanter Isl.: 1000s); also Macaulay I., Curtis I. and L'Esperance Rock (Sorensen 1964; Edgar *et al.* 1965; Soper 1969; Merton 1968, 1970; Morrison 1979; Tennyson & Taylor 1989). **NZ:** West I., Three Kings Is; recently recorded Sugarloaf Rock, Bay of Plenty; and Volkner Rocks (Falla 1970; NZCL; CSN). Colonized Bay of Plenty since early 1950s (Falla 1970).

On Lord Howe I., considered the 'fisherman's friend', as local fishermen able to locate large schools of kingfish by following feeding flocks of Ternlets (Hutton 1991).

**MOVEMENTS** Poorly known, but not migratory. One subspecies, *albivitta*, breeds HANZAB region, though up to

two other subspecies may occur. Present at breeding islands throughout year. On some breeding islands, some dispersal after breeding apparent, and can be recorded far from breeding islands. Flock recorded Andaman Sea, May 1988, c. 6000 km from nearest known breeding island (Eller 1989), though this may represent undescribed breeding populations rather than movement. Possibly displaced by storms (HASB); sometimes



beachcast (e.g. Falla *et al.* 1981; CSN 20); one blown c. 6 km inland, apparently by strong se. winds (Cooper & Forshaw 1971).

Recorded round breeding islands all year, e.g. Norfolk I. (Hermes 1985) and Lord Howe I. (Hindwood 1940). On Lord Howe I., some appear to disperse after breeding and less common round island in summer (Hutton 1991). On Kermadec Is, recently deserted breeding sites indicate at least some do not occupy breeding sites outside breeding season (e.g. on Nugent I., Merton 1970). Some movement away from breeding islands outside breeding season; records on e. Aust. mainland and adjacent waters, Dec.–June (with most in second half Jan.), consistent with post-breeding dispersal (Holmes 1976; Hoskin 1991; Wood 1991) rather than w. displacement by summer storms (Morris 1972; HASB). In NI, NZ, apparently mostly summer visitor, sometimes in small flocks (Falla *et al.* 1981; NZCL), though also recorded round breeding areas in NI region in all seasons (Cunningham 1950; Anon. 1979; Jenkins 1980; CSN 24, 26, 29). In non-breeding season, occasionally recorded at sea; two sighted in Tasman Sea in mid-May (Jenkins 1971).

**FOOD** Carnivorous. Crustaceans, fish and squid. **Behaviour** Diurnal; roost at night (Ashmole & Ashmole 1967; R.P. Scofield). Feed inshore and near to shore (Diamond 1978; Hutton 1991). Hover into wind and circle repeatedly, often very low, over same area. Feed by **DIPPING**, gleaning small items (neuston) from or just below surface of water; use feet to maintain distance from water and will **PATTER** briefly in manner of storm-petrels (Hindwood 1940; Soper 1969; Pringle 1987: photo; Hutton 1991). Will sit on water and paddle (HASB). Forage in flocks of up to 500 (Edgar *et al.* 1965), often with noddies *Anous* (Merton 1970); also often forage over schools of fish that have been forced to surface by predatory fish (Hindwood 1940; Hutton 1991). Feeding may attract Silver Gulls *Larus novaehollandiae*; Gulls then monopolize food, excluding Grey Ternlets, which leave (Falla 1970).

**Adult** Molluscs: squid (Murphy); Crustaceans (Hindwood 1940; Hutton 1991; Oliver), 10 mm (Murphy): euphausiids (Soper 1969); Fish (Hindwood 1940; Hutton 1991; Murphy). Detailed extralimital studies in Pacific Ocean, on Christmas I. (Ashmole & Ashmole 1967) and nw. Hawaiian Is (Harrison *et al.* 1983).

**Young** Fed by regurgitation (Soper 1969).

**Intake** On nw. Hawaiian Is, average volume of regurgitates 1.8 ml, containing average 55 prey items ( $n=111$ ); average length of prey, 10 mm (2–50; 635) with most items, 10–30 mm (Harrison *et al.* 1983). On Christmas I. (Pac.), average volume of three largest regurgitates: 3.4 ml or 7.5% of body-weight; c. 75% of all fish <2 cm long; largest fish, 1.5% of body-weight; all but one squid, 0–2 cm long; largest squid, 1.1 ml or 2.4% of body-weight. Fifty-three cephalopod larvae in one regurgitation (Ashmole & Ashmole 1967).

**SOCIAL ORGANIZATION** Poorly known; no detailed studies. Generally gregarious. Rest in small groups (e.g. 12+, Hindwood 1940) to large flocks (e.g. Cheeseman 1890); away from breeding islands seen resting and feeding in conspicuous flocks of c. 200 to 1000+ (Falla 1970; Seddon & Seddon 1979). Often feed in flocks (Hindwood 1940; Soper 1969; Merton 1970; Seddon & Seddon 1979; Hutton 1991), which are sometimes large, e.g. on Kermadec Is, up to 300–500 in Nov. (Edgar *et al.* 1965), flock of several thousands in early Jan. (Merton 1970). Sometimes feed with Black Noddies (Soper 1969; Merton 1970; Hermes 1985), and Silver Gulls may

follow feeding flocks of Ternlets (Falla 1970). At sea and off n. NI and Qld, seen singly or in small groups of up to nine birds (e.g. Waller 1970; Jenkins 1971; Brandis *et al.* 1992; Qld Bird Repts 1986, 1989).

**Bonds** No information. **Parental care** Both sexes incubate (Hutton 1991). After fledging, young appear to be fed by parents for considerable time before fully independent (Soper 1969; Hutton 1991). Possibly raise two broods a season; adults observed feeding chick c. 21 days old and what appeared to be fully fledged juvenile (Soper 1969).

**Breeding dispersion** Appear to be loosely colonial at some sites, more solitary at others. On Merton Isl., Kermadec Is, widely dispersed (Soper 1969); Herald Grp, Kermadec Is, in loose colonies (Merton 1970); on Kermadec Is, Iredale (1910) refers to seeing a 'fair size' breeding colony; on Great Admiralty Rock, Lord Howe I., in isolated pairs (North); on Norfolk and Lord Howe Is, not in colonies but certain localities preferred to others (Basset Hull 1909) and sometimes a number of nests close together in the sand (Crowfoot 1885). **Home-range** Away from breeding islands, flocks roosting on stacks in Bay of Plenty seldom fed more than c. 100 m from stacks and said not to remain on wing for long (Falla 1970).

**Roosting** Little information. Seen to rest (Falla 1970; Seddon & Seddon 1979) or sunbathe (Cheeseman 1890) in flocks during day (see above). When starting to moult, mid-Jan., adults noticed changing roosting habitat (Soper 1969). Once observed resting on surface of water (Brandis *et al.* 1992).

**SOCIAL BEHAVIOUR** Very poorly known; no detailed studies. Birds often open bill wide, but bright-orange gape does not appear to be significant in display (Soper 1969). Wakelin (1968) refers to birds 'playing' in air currents round cliffs.

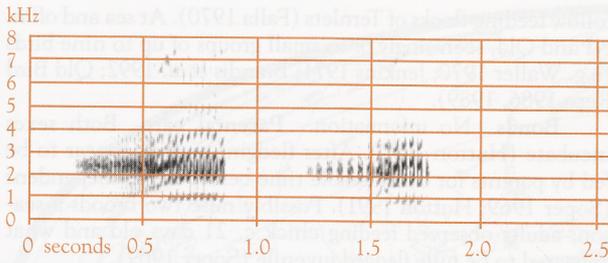
**Agonistic behaviour Alarm** On Kermadec Is, before breeding, tame, allowing people to approach to within c. 1 m; when disturbed, succession of small flocks will leave resting places to fly overhead and scream noisily before settling. On discharging a gun, clouds of birds rose in air, circled and wheeled about, then quickly settled (Cheeseman 1890).

**Sexual behaviour** Two aerial displays seen when breeding underway. In first, birds hover and weave in unison across each other's flight-paths. In second, a single bird hovers in front of incubating mate, with wings and tail raised at c. 45° and executes series of dipping U-shaped flights; seem to need breeze to perform display and seldom seen in calm weather; when conditions suitable, display done without losing position relative to cliff-face (Soper 1969).

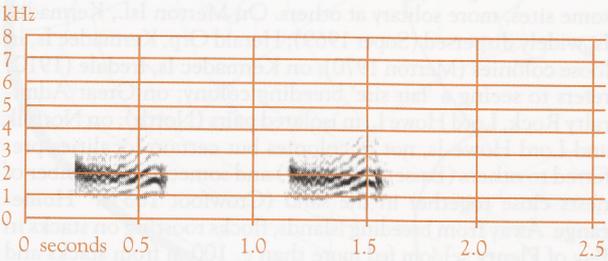
**Relations within family groups** Chicks fed by regurgitation, with chick approaching from side in manner of petrel. Chick appears to induce regurgitation by pecking at legs and feet of parent; parent leans forward with bill wide open and lowered almost to ground; regurgitated material taken rapidly from back of parents' mouth. Adults not seen to carry fish or other food in bill or to regurgitate onto ground (Soper 1969).

**Parental anti-predator strategies** Young brooded continuously for 3 days then left for increasingly long periods; at 8 days, unguarded most of day (Soper 1969). Give purring calls in response to people (Hermes 1985). Not tame when breeding; leave eggs when approached (Crowfoot 1885; North).

**VOICE** Very little information. Scream noisily (sonagram A) while flying over people (Cheeseman 1890). Utter continuous purring *cror-r-r-r* while sitting on rocks (Oliver); probably this call, though made in flight, in sonagram B.



A R. Swaby; Norfolk I., Nov. 1966; P39



B R. Swaby; Norfolk I., Nov. 1966; P39

**BREEDING** Not well known, no major studies; some information from Kermadec Is (Soper 1969). Solitary or loosely colonial but prefer some sites to others (Basset Hull 1909; Merton 1970). Possibly double-brood; five instances of adults regularly feeding chicks c. 21 days old and birds that appeared fully fledged (Soper 1969).

**Season** LORD HOWE I.: eggs, late Sept. to late Oct. (Basset Hull 1909); last chicks fledge, late Feb. (Fullagar *et al.* 1974). NORFOLK I.: laying, Sept.–Nov. (North); eggs, early Oct. to early Jan.; young, early Oct. to mid-Mar.; fledging, from early Jan. (Basset Hull 1909; Moore 1985; Hermes *et al.* 1986; Aust. NRS). KERMADEC IS: eggs, late Aug. to mid-Nov.; fledged young, late Feb. (Iredale 1910). Breeding not highly synchronized, and eggs and young of all ages found at one time (Soper 1969; Merton 1970).

**Site** On cliffs and steep rock-faces, up to c. 600 m asl; occasionally on ground, under trees; in cavities, crevices, ledges, between rocks, in shade of boulders on beach, under clumps of vegetation; open to sky or under rock or overhang; widely dispersed, usually well hidden (Basset Hull 1909; Hindwood 1940; Tarburton 1981; North; Aust. NRS). Shade throughout day important in selection of site (Soper 1969).

**Nest, Materials** Eggs laid on bare rock or depression in sand; unlined, or lined with a few pieces of dry grass, leaves or seaweed (Basset Hull 1909; Hindwood 1940; Aust. NRS).

**Eggs** Oval and elongate-oval to nearly elliptical; close-grained, dull or lustrous; cream, creamy buff or greyish stone, evenly but sparingly freckled and spotted faint reddish-brown or brown, intermingled with similar underlying markings of dull bluish- or inky-grey; others have short thick wavy markings, evenly distributed and sometimes confluent, forming small clouded patches (Basset Hull 1909; North; Aust. NRS). **MEASUREMENTS:** Lord Howe and Norfolk Is: 42.3 (1.95; 38.1–45.7; 14) x 29.6 (0.79; 28.4–30.5) (North 1889; Basset Hull 1909; North); Kermadec Is: 42.2 (1.21; 39.8–45.0; 80) x 29.2 (0.72; 26.7–30.5) (A.J.D. Tennyson); 42.9 (1.1; 40.9–45.7; 21) x 28.9 (27.1–30.2) (Soper 1969). **WEIGHT:** Kermadec Is: 17.7 (1.79; 11.0–20.5; 80 eggs of various ages) (A.J.D. Tennyson).

**Clutch-size** One (Soper 1969; North).

**Incubation** By both sexes (Hutton 1991). **INCUBATION**

**PERIOD:** c. 32 days (Hutton 1991). First pipping to hatching takes c. 3 days (Soper 1969).

**Young** Precocial, semi-nidifugous. Brooded continuously for first 3 days; thereafter, left for increasingly long periods; at 8 days, unguarded for most of day (Soper 1969). Fed by regurgitation, bill to bill, with chick approaching from side (Soper 1969). Hatch in down; at 17 days, some quills showing through down; at 25 days, more feathers than down; virtually free of down at 42 days (Soper 1969).

**Fledging to maturity** **FLEDGING PERIOD:** c. 37 days (Hutton 1991); just able to fly at 31 days, and often make short flights at 36 days (Soper 1969). Young continue to be fed by parents after fledging (Soper 1969; Hutton 1991).

**Success** No information.

**PLUMAGES** Prepared by D.J. James and R.P. Scofield. Small tern, probably maturing in <1 year. Sequences of plumages and moults poorly known. Hatch in natal down. Said to moult to juvenile plumage and fledge by 42 days old (NZRD). Have complete post-breeding and, probably, partial pre-breeding moults each cycle, without seasonal change in appearance. Post-juvenile moult probably complete, after which inseparable from adults on present knowledge. Age at first breeding, unknown. Sexes similar. Two to eight subspecies; one, *albitivitta*, in HANZAB region and described below. Plumage descriptions based on skins (AIM, AM, ANWC, NMNZ).

**Adult** (Probably first and subsequent basic and, possibly, alternate). **Head and neck** Forehead, lores and crown, grey-white (between white and 86), grading to slightly darker, pale grey (almost 86) on nape, neck and below eye. Narrow white partial eye-ring behind and above eye; broader, partial black (89) eye-ring in front of eye merges with small black spot in recess in front of eye. Females usually have slightly paler grey crown, nape and mantle than males, but difference not reliable for sexing skins; could possibly be used to sex mated pairs. **Upperparts** Mantle, pale grey (c86), grading from slightly paler hindneck; rest of upperparts slightly darker (light grey [slightly paler than 85]). With wear, upperparts become slightly darker, light grey (slightly darker than 85). **Underparts** Pure white on belly, grading to white with faint-grey wash (much paler than 86) on breast, flanks and undertail-coverts. Amount of grey wash on underparts increases slightly in populations from S to N (Holyoak & Thibault 1984). **Uppertail** Light grey (85) at base grading to mid-grey (84) distally, with slight silvery bloom when fresh; becomes significantly darker and browner (dark brownish-grey [brown 83]) when very worn; shafts, grey-brown (83). **Undertail** Mid-grey (84) to dark grey (83); shafts, cream (92). **Upperwing** Secondary coverts, light grey, like scapulars; become slightly darker when worn, creating subtle contrast with fresher, paler upperparts in alternate plumage. Primary coverts and alula, light bluish-grey (between 85 and 87). Primaries, light blue-grey (c87) when fresh, with white edges to inner 3–4 primaries, and dark grey (83) outer web to p10; shafts, dark brown (223). Primaries become darker and browner (dark brownish-grey [brown 83]) when very worn. Secondaries, light grey (c85) (subtly darker than coverts when fresh), grading to pale grey (86) on inner edge and with broad white tips (c. 4 mm wide and extending 15 mm down inner edge) that form neat white trailing-edge, which becomes narrower with wear. Tertiaries, light grey, like coverts, with narrow white inner edge (usually concealed). **Underwing** Subhumeral and all coverts, white, contrasting strongly with remiges. Primaries, mid-grey (between 84 and 85). Secondaries, light grey (85) with slightly paler, grey-white (between

white and 86) tips. Shafts of remiges, cream (92) to white.

**Downy young** Based on photos in Pringle (1987) and Soper (1969). Mostly pale to light grey (86–85) except for mid-grey (84) forehead, crown, lores and cheeks. Underparts paler than upperparts, off-white.

**Juvenile** Like adult except: **Head and neck** Feathers of crown, mid-grey (84) with narrow grey-white (between white and 86) fringes, which give uneven or slightly mottled appearance. Forehead, pale grey (86) with concealed mid-grey (84) bases to feathers. Ear-coverts, throat and foreneck, pale grey (86) with dusky streaks. Dark ring in front of eye possibly slightly narrower. **Upperparts** Slightly darker than adult, mid-grey (slightly paler than 84), and possibly slightly browner; differences obscured by wear. **Upperwing** Said to have dark remiges (Harrison 1983) or primaries (Harrison 1987) contrasting with coverts; could be effect of wear; photo (Pringle 1987: p. 638) of juvenile still with clinging down suggests greater coverts and remiges darker than lesser and median coverts and saddle.

**BARE PARTS** Based on photos (Harrison 1987; Pringle 1987; Hutton 1991; NZRD), published descriptions (Millie 1963; Soper 1969; Murphy) and museum labels (NMNZ). **Adult** Bill, black (89); mouth, yellow. Iris, black-brown (119) to dark brown (119A). Tarsus and toes, black (89) or blackish brown (119); webs, dull pink (5) to brown-pink (219D) or pink-grey; claws, black-brown (119). **Downy young** Like adult but with: small white egg-tooth when newly hatched; tarsus has bluish (78) tone; and webs possibly dark. **Juvenile** Not known to differ from adult.

**MOULTS** Poorly known. Based on examination of c. 30 skins with dates (ANWC, NMNZ) and literature. Subtropical populations that breed seasonally probably moult seasonally, and tropical populations that breed year-round probably moult year-round. Following refers to subspecies *albigitta* except where stated. **Adult post-breeding** (Pre-basic). Complete. Primaries, sequentially outwards. Usually two, but sometimes three, feathers active at a time. On Kermadec Is, moult of primaries begins late Oct. to early Nov. (not Jan., *contra* Soper [1969]), before chicks fledge: two skins from 13 Oct. had PMS of 0 and 1; median PMS for last week of Nov., 11 (2–19; 9); two skins from Dec. both had PMS of 11; one skin from Apr. had fresh primaries, and three from Aug. had old primaries; one apparently aberrant adult from Aug. had PMS of 47. On Lord Howe I., schedule possibly a little later: two skins 22 Feb. had PMS of 19 and 23; one bird from Mar. had PMS of c. 27 (Pringle 1987: photo, p. 636); secondaries of this bird seem old apart from outermost (s1), which was growing. One skin from Bay of Plenty, Mar., had old primaries. Moult of tail appears irregular and usually asymmetrical; grow only one feather on each side at a time; either t1 or t6 usually moulted first, the other second (but sometimes either one up to fourth); occasionally t3 or t4 moulted first; usually either t2 or t5 moulted fifth and the other last. Moult of tail appears to begin shortly after moult of primaries begins. Non-breeders and failed breeders probably moult earlier. Subspecies *imitatrix*: Nine adult non-breeding birds, San Ambrosio, were moulting wing and tail in Feb. (Murphy). Subspecies *cerulea*: On Christmas I. (Pac.) few birds seen in middle of moult, suggesting that they finish moult at sea between breeding episodes (Schreiber & Ashmole 1970). **Adult pre-breeding** (Pre-alternate). Little information; only indirect evidence for existence of this moult: (1) it occurs in closely related genus *Anous*; and (2) twelve skins

(NMNZ) of breeding birds from Kermadec Is, Nov. and Dec., show contrast in wear between body and wing as would be expected if pre-breeding moults occurred. May sometimes moult tertials. No data on whether some primaries or tail ever moulted twice per cycle. One adult from Bay of Plenty, Apr., had completely fresh plumage, except for active moult of nape, which possibly part of pre-breeding moult (skin, NMNZ). **Post-juvenile** (First pre-basic). No information. Probably complete, because: (1) it is complete in other noddies; and (2) none of c. 70 skins examined had combination of first-basic body-plumage and retained juvenile wing and tail. Probably undertaken at sea soon after departure from breeding islands.

**MEASUREMENTS** (1) Subspecies *albigitta*: Kermadec Is, adult, skins; T5 = length of t5 (= Tail) (AIM, NMNZ).

	MALES	FEMALES	
WING	(1) 204.0 (289; 200–209; 7)	202.9 (4.28; 196–208)	ns
T5	(1) 115.0 (3.32; 110–120; 7)	112.1 (5.04; 102–119; 9)	ns
BILL	(1) 27.9 (1.52; 24.1–28.3; 6)	26.8 (0.69; 26.0–28.3; 9)	ns
TARSUS	(1) 24.8 (0.91; 23.1–25.6; 7)	24.8 (0.74; 24.0–26.4; 10)	ns
TOE	(1) 28.1 (0.82; 26.8–28.9; 7)	27.7 (0.95; 26.3–29.8; 10)	ns

Subspecies *albigitta*: (2–4) Lord Howe I.: (2) Adults, skins (AM); (3) From Holyoak & Thibault (1984). (4) Curtis and Macauley Is, Kermadec Is, adults, live; methods as HANZAB; T1 = length of central rectrix; T5 = length of t5; T6 = length of t6 (A.J.D. Tennyson).

	UNSEXED
WING	(2) 205.5 (5.24; 192–217; 20) (3) 206 (199–209; 5) (4) 204.3 (3.74; 197–214; 30)
T1	(4) 72.0 (2.62; 68–77; 30)
T5	(2) 113.0 (6.23; 100–122; 26) (4) 110.5 (4.84; 102–120; 30)
T6	(4) 94.4 (6.28; 76–105; 18)
BILL	(2) 26.7 (1.56; 23.1–29.5; 25) (3) 27.5 (26.5–28; 5) (4) 26.5 (0.90; 24.8–28.1; 30)
TARSUS	(2) 25.1 (0.72; 23.5–26.1; 26) (3) 26 (25–27; 5) (4) 26.0 (0.87; 24.0–27.3; 30)
TOE	(2) 28.2 (1.89; 26.1–31.4; 27)
TOE C	(4) 35.2 (1.11; 32.3–37.4; 30)

No differences between samples (1) and (2) when sexes combined. Extralimital measurements in Holyoak & Thibault (1984), Lacan & Mougine (1974), Millie (1963), Mougine & de Naurois (1981), Rauzon *et al.* (1984), Soper (1969), Yamashina (1940), Mathews, Murphy and Oliver.

**WEIGHTS** (1–2) Subspecies *albigitta*: (1) Kermadec Is (NMNZ); (2) Lord Howe I. (3) Subspecies *nebouxii*: Tutuila I., American Samoa (Rauzon *et al.* 1984; Clapp & Sibley 1966). (4) Subspecies *teretirostris* and *murphyi* combined: Iles Gambier and Tuamotu (Lacan & Mougine 1974).

	MALES	FEMALES	
(1)	68 (7.40; 57–75; 5)	72 (3.09; 68–77; 6)	ns
(2)	85, 87	68, 88	
(3)	52, 57	45, 47, 48	
(4)	45 (40–50; 5)	45 (40–55; 5)	

Sample from Samoa (sample 3) significantly lighter than either sample of *albirostris* (samples 1, 2) ( $P < 0.001$ ). Sample from Kermadec Is (sample 1) significantly lighter than sample from Lord Howe I. (sample 2) ( $P < 0.05$ ).

(5–6) Kermadec Is, adults, live (A.J.D. Tennyson): (5) Breeding birds, Curtis I., Nov. 1989; (6) Non-breeding birds, Macauley I., Sept. 1993.

	UNSEXED
(5)	68.2 (2.77; 63–73; 18)
(6)	77.1 (8.44; 67–93; 12)

**STRUCTURE** Wing, long and pointed. Eleven primaries: p10 longest, p9 3–10 mm shorter, p8 13–21, p7 28–38, p6 48–58, p5 58–73, p4 75–86, p3 92–99, p2 102–110, p1 110–121; p11 minute. Fourteen secondaries, including four tertials; tips of longest tertials reach to tip of p8 or p9 on folded wing. Tail, rather short and moderately forked for tern; 12 rectrices; t5 longest, t6 12–23 mm shorter, t4 10–22, t3 20–29, t2 27–38, t1 39–45. Bill, slender, about same length as head; straight and only slightly tapered; moderately prominent gonydeal angle about two-thirds from base; nostril, horizontal ellipse, about one-third from base. Tibia, bare on lower third or so. Tarsus relatively long for tern, slender, with reticulate scaling. Front toes, long, with rather blunt short claws, joined by gently incised webs; mid-claw, pectinate; hindtoe very reduced. Outer toe 99–103% of middle (but claw of outer much shorter), inner 80–85%, hind 10–14%.

**GEOGRAPHICAL VARIATION** Complicated, poorly understood and in need of review. Genus *Procelsterna* falls into two subspecies- or species-groups: (1) *cerulea* group, mostly of tropical surface-waters (includes *saxatilis*, *teretirostris*, *nebouxii* and *murphyi*); and (2) *albirostris* (not *albirostrata* as in Aust. CL) group, mostly of subtropical surface waters (includes *skottsbergii* and *imitatrix*). Most authors have recognized only one species, with varying number of subspecies (e.g. Harrison 1983, 1987; Holyoak & Thibault 1984; Sibley & Monroe 1993; Christidis & Boles 1994; Peters; HASB; NZCL); others have treated *cerulea* and *albirostris* groups as two species (Salvin 1896; Williams 1960; Sibley & Monroe 1990; Murphy; Oliver; Aust. CL). Compared with *albirostris* group, *cerulea* group differs by: (1) much smaller size (depending on populations, wing averages c. 15–20 mm shorter, tail 5–10, bill 1–3, tarsus 1–3 [Holyoak & Thibault 1984]; also see Weights); (2) bill less deep and broad at base; (3) underparts, bluish grey from chin (where pale bluish grey [c86]) to undertail-coverts (where light bluish grey [c85]); (4) wing-lining, light grey (85); (5) upperparts, darker, mid-bluish grey (blue 84), contrasting only slightly with underparts; and (6) downy young darker (Holyoak & Thibault 1984). Also differs in breeding biology, dimensions of eggs, behaviour and diets. If not for intermediates, these differences would justify recognition of two species. However, Holyoak & Thibault (1984) considered there to be a cline of light to dark and large to small from S to N. Plumages, measurements and geographical location suggest that *murphyi* intermediate between the two groups (Mougin & de Naurois 1981; Lacan & Mougin 1974), and may represent a clinal intergradation or hybrid zone; more data needed from Iles Gambier and Tuamotu. Otherwise, within the two groups there is slight clinal geographical variation, and probably few of the described sub-

species deserve recognition: *saxatilis* and *teretirostris* were synonymized under *cerulea* by Mathews and Mougin & de Naurois (1981) respectively; Holyoak & Thibault (1984) recognized only two subspecies, *cerulea* and *albirostris*. No convincing argument has been presented for any arrangement (Christidis & Boles 1994), so here recognition of only one species follows predominant international consensus.

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Nicolas Day  
1926

**Volume 3, Plate 45**

Common Noddy *Anous stolidus* (page 789)

1 Adult; 2 Downy young; 3 Juvenile, darkest (= typical) birds; 4 Juvenile, palest birds

Black Noddy *Anous minutus* (page 801)

5 Adult; 6 Downy young; 7 Juvenile

Lesser Noddy *Anous tenuirostris* (page 812)

8 Adult, typical bird; 9 Adult, with atypical head-pattern; 10 Downy young; 11 Juvenile, pale-capped bird, worn plumage; 12 Juvenile, dark-capped bird, fresh plumage

Grey Ternlet *Procelsterna cerulea* (page 818)

13 Adult; 14 Downy young; 15 Juvenile

White Tern *Gygis alba* (page 825)

16 Adult; 17 Downy young; 18 Juvenile



Nicolas Day  
1995

**Volume 3, Plate 46**

Common Noddy *Anous stolidus* (page 789)  
1, 2 Adult; 3 Juvenile, darkest (= typical) birds

Black Noddy *Anous minutus* (page 801)  
4, 5 Adult; 6 Juvenile

Lesser Noddy *Anous tenuirostris* (page 812)  
7, 8 Adult, typical bird

Grey Ternlet *Procelsterna cerulea* (page 818)  
9, 10 Adult

White Tern *Gygis alba* (page 825)  
11, 12 Adult; 13 Juvenile