

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.
Jacaniidae	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, Jacaniidae) 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 Jacaniidae. 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).¹

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

¹ 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.¹ 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.

¹ 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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Sterna stolidus Linnaeus, 1758, *Syst. Nat.*, ed. 10(1): 139 — Americae pelago = West Indies.

Both generic and specific names reflect the earlier notion that noddies were stupid because they had no fear of people and allowed themselves to be easily caught (Greek ἄνους, silly, foolish; Latin *stolidus*, foolish, stupid).

OTHER ENGLISH NAMES Brown Noddy, Noddy Tern, Noddy, Greater Noddy.

POLYTYPIC Subspecies *pileatus* (Scopoli, 1786) breeds Red Sea and Indian and Pacific Oceans E to Hawaii, Marquesas, Easter and Los Desventurados Is, and S to HANZAB region. Extralimittally: Nominate *stolidus* breeds Caribbean Sea and Atlantic Ocean S to Gough I.; subspecies *ridgwayi* Anthony, 1898, breeds islands off w. Central America; subspecies *galapagensis* Sharpe, 1879, breeds Galapagos Is. Birds breeding from WA, N to Savu Sea, Indonesia, perhaps warrant subspecific recognition.

FIELD IDENTIFICATION Length 40–45 cm; wingspan 79–86 cm; weight 185 g. Largest noddy. Medium-large, slender dark-brown tern, with long rather stout bill, about same length as head, and appearing decurved over whole length; long narrow wings; and long wedge-shaped tail, appearing pointed when closed but showing shallow central notch when spread, and extending slightly beyond folded primaries at rest. Bigger and bulkier than Black *Anous minutus* or Lesser *Anous tenuirostris* Noddies, with proportionately much shorter, stouter, decurved bill; slightly longer, narrower wings; longer tail; and overall lankier jizz in flight. Dark greyish-brown, with dull-white cap, slightly darker brown-black remiges and paler brown diagonal bar across inner upperwing, and distinctive paler greyish underwing. Sexes similar. No seasonal variation. Juveniles distinct.

Adult Forehead to mid-crown, dull-white, forming prominent pale cap, grading to pale brownish-grey on hindcrown and nape; pale cap bordered below by thin indistinct white line from base of bill to rear of eye. Rest of head and neck, dark greyish-brown, with contrasting black loreal patch, sharply demarcated from dull-white forehead in curving line between eye and bill (demarcation sometimes nearly straight); and contrasting small white patch above and narrow white arc below eye, giving spectacled appearance. Rest of upperparts, dark greyish-brown, with slightly darker brown-black tail, primary coverts and remiges, and obvious, paler-brown diagonal band across secondary coverts from base of wing to carpal; with wear, upperwing becomes browner and diagonal band more pronounced; at all times, contrast between brown secondary coverts and darker blackish remiges and primary coverts gives characteristic two-toned pattern to upperwing. Underparts, dark brown, sometimes tinged grey. Underwing, light grey-brown, with diffuse narrow dark border; paler than

underbody. Bill, black. Iris, dark brown. Legs and feet, grey-black, with red-brown to dark brown-grey tinge to tarsus and toes; webs sometimes ochre. **Juvenile** Coloration of cap and prominence of pale fringes to feathers of upperparts varies. Typical juveniles differ from adult by: Forehead and forecrown, much duller, grey-brown, with varying pale mottling, grading to darker brown on crown and nape; overall effect is of much duller and less distinct pale cap, bordered by thin dull-white line from base of bill to rear of eye. Some have wholly dark-brown forehead and crown, bordered by dull-white line, and so lack pale cap. Rest of head and neck, dark brown, without grey tones of adult. Upperparts browner than in adult, with varying pale fringes to feathers, visible only when close: well-marked birds have light grey-brown barring on mantle, grey-brown fringes or diffuse barring on tertials, and broader diffuse grey-brown scaling on scapulars and secondary coverts; some have duller and much less distinct pale fringing. Scaling on secondary coverts makes pale diagonal band appear more prominent than on adult (though some overlap with adult in worn plumage). Tail, as adult, but with thin pale-grey tip, visible only when close. Underparts, grey-brown, with indistinct pale fringes to feathers. A few birds have silvery-white forehead and forecrown, barely contrasting with fine white line from bill to eye; grade rapidly to dark-brown rear-crown and nape, which can be streaked or mottled white; compared with adult, have whiter and more prominent, though smaller, pale forehead. In all, bill much shorter than in adult. **Immatures** Like adults but with head-pattern like that of juvenile. Bill as in adult.

Similar species Dark plumage with pale cap, and wedge-shaped tail distinguish from all seabirds except **Black and Lesser Noddies**. **Black Noddy** differs by: (1) smaller and slimmer, with slightly shorter tail, falling level with wing-tips at rest (beyond in Common), and giving more compact ap-

pearance in flight; (2) bill proportionately much longer (about one-third longer than length of head), thinner and straighter, not appearing decurved; (3) plumage blacker and more uniform; while plumage becomes browner with wear, Black Noddy always appears darker and blacker than Common and never has paler band on wing-coverts; (4) cap, larger, whiter and contrasts more with blacker plumage; in flight, bolder white cap especially obvious when seen from head-on (some juvenile Common Noddies have equally white cap, but it is smaller and confined to forehead). Demarcation between cap and dark lores typically straight (usually curved in Common, though can be straight, especially in juvenile). In flight, also distinguished by: (5) slightly shorter, broader wings, often appearing straighter and more rounded at tips; (6) uppertail, paler and greyer, often contrasting strongly with blackish rest of upperparts, especially on bird seen from above and behind (Common has uniformly brown-black tail, contrasting only slightly with paler upperparts); (7) underwing-coverts appear black, concolorous with underbody, and contrasting only slightly with glossy remiges (underwing of Common, distinctly paler grey-brown, with diffuse narrow dark border, contrasting clearly with dark-brown underbody); (8) normal flight of Black slightly faster and more buoyant, with quicker, shallower wing-beats; when feeding, has more fluttering action, with slightly faster, deeper wing-beats than Common Noddy. In size, shape and flight, **Lesser Noddy** differs from Common in much the same way as described for Black Noddy. IN FRESH PLUMAGE, Lesser also differs by: (1) plumage darker, black-brown, with characteristic grey cast to head, neck, upper mantle and sides of breast (these areas browner on Common); appears more uniform in flight; (2) pale ashy-grey cap appears larger and more diffuse, grading evenly down sides of face, neck and hindneck to greyish upper mantle. On typical birds, ashy grey extends diagnostically onto lores (Common has dark lores sharply demarcated from pale cap). Atypical birds and some, possibly all, juveniles have sharper demarcation of lores and cap, much as in Common; at least some of these have distinctive narrow pale-grey band on anterior lores resembling weaker version of typical pattern; (3) in flight, uppertail as Black Noddy, though contrasting less with body. IN WORN PLUMAGE, Lesser much paler and browner; appears similar in overall colour to Common, though remains distinctly greyer on head, neck and mantle. Best distinguished by: at rest, longer, slimmer bill, slimmer build, characteristic pattern of head and greyer cast to neck and mantle; in flight, by differences in size, shape and flight, and more uniform upperparts and underwing. At distance, can be confused with juvenile **Sooty Tern** *Sterna fuscata* (q.v.) and dark-plumaged **jaegers** *Stercorarius*. Latter distinguished by characteristic white wing-flashes if seen; normal flight in light winds usually faster, more purposeful, with slower, more powerful wing-beats interspersed with short glides low to water; often fly much higher above sea (flight of Common typically slower and more lethargic than jaegers, with continuous shallow wing-beats; normally stay within a few metres of surface of sea).

Gregarious tern of tropical and warmer subtropical seas; normally in flocks, sometimes in hundreds when feeding or roosting; occasionally in thousands round breeding islands. Often associate with other terns, especially other noddies, and seabirds; join mixed-species feeding flocks. Normally feed well out to sea, often congregating in dense flocks over surfacing shoals of fish; in some areas of non-breeding range, forage close inshore; feed by hovering just above surface before dipping to snatch prey; do not plunge like typical terns but occasionally

shallow plunge. Roost and loaf in flocks on beaches, cays, rocky islets and stacks; sometimes on buoys, channel markers, posts and other structures. Often settle on rigging of ships or small boats, and alight on flotsam and even backs of turtles. Often settle on water, forming dense rafts; float buoyantly, like small gull, showing rather shaggy rear-end in silhouette. Gait on land somewhat awkward and trotting, as other medium-sized terns. Normal flight characteristically languid, direct and low to water, with continuous, easy, shallow wing-beats. Common calls include grating *karrk*, *kree-aw* and low *kuk kuk kuk*.

HABITAT When breeding, usually on or near islands: rocky islets and stacks with precipitous cliffs, or on shoals or cays of coral or sand, and in surrounding waters. In non-breeding periods, more often recorded in pelagic zone (Gibson-Hill 1950; Schodde *et al.* 1983; Brandis *et al.* 1992; HASB).

Breed on isolated or offshore islands, of rock, coral or sand, bare or vegetated. Most breeding islands have <25% vegetation cover, of grasses and dicot-herbs; may be unvegetated, or have low (<1.2 m) shrubs (Limpus & Lyon 1981; *Corella Seabird Is Ser.*; HASB). Often breed on or among clumps of *Lepturus*, *Sarcocornia* or other grasses or dicot-herbs; less often in shrubs, e.g. *Atriplex*, *Nitraria* and *Melaleuca* (Brown 1979; Fuller & Burbidge 1981; Storr *et al.* 1986; Burbidge & Fuller 1989; Hutton 1991; Fuller *et al.* 1994; *Corella Seabird Is Ser.*; J.N. Dunlop). On Cocos-Keeling Is, occasionally nest in trees, such as *Argusia*, *Pisonia* and coconut palms (Gibson-Hill 1949b, 1950; Stokes *et al.* 1984). On Christmas I., occasionally in tall, terraced, monsoonal forest; may have begun to nest in trees only recently (Dunlop 1987; Stokes 1988). Occasionally nest on ground, in sand, coral shingle, or piles of rock (Gibson-Hill 1950; Hindwood *et al.* 1963; Garstone 1978; Stokes *et al.* 1984; Hermes 1985; Hermes *et al.* 1986; King 1986). On Lord Howe, Norfolk and Christmas Is, often nest on ledges and crevices of precipitous cliffs or nearshore stacks and islets; on Christmas I., also on shingle ridges between beach and forest (Hindwood 1940; Gibson-Hill 1947, 1949b; McKean & Hindwood 1965; van Tets & van Tets 1967; Tarburton 1981; Dunlop 1987; Stokes 1988; Hutton 1991; Guest 1991; A.J.D. Tennyson). On Christmas I., usually within 5–10 m of shoreline (Gibson-Hill 1949b). Once recorded nesting on shipwreck (Hutton 1991).

Forage on or just below surface of sea (Gibson-Hill 1947; Hutton 1991; HASB; see Food); in inshore waters round islands, often along line of breakers (Corben 1972; Storr *et al.* 1986; Hutton 1991; Carter 1994) or in lagoons of atoll (Stokes *et al.* 1984). At sea, in pelagic zone (Hutton 1991; J.N. Dunlop).

Mainly roost or loaf on islands, either on cliffs or stacks and rocky islets (Hutton 1991), on coral or sandy beaches of cays and shoals, or on isolated reefs (Hindwood 1940; Gibson-Hill 1947, 1948a; van Tets & van Tets 1967; HASB). Occasionally also in trees, e.g. *Pisonia* (Smith & Ogilvie 1989). Sometimes loaf in rafts on water (Garstone 1978; HASB). Will also roost on wrecks, floating material, and backs of turtles or large birds (Hindwood 1940; HASB).

DISTRIBUTION AND POPULATION Widespread in tropical and subtropical seas. In Atlantic Ocean, breed mainly on islands in Caribbean Sea and se. Gulf of Mexico, from the Bahamas, through s. Florida to islands off Yucatan Pen., and through West Indies to Lesser Antilles and islands off Venezuela; also on scattered islands farther S, from Fernando de Noronha, through South Trinidad, to Tristan da Cunha and Gough I.; from Ascension to St Helena; also in Gulf of Guinea.

In w. Indian Ocean, breed from Madagascar and Mascarenes to Seychelles; also round coasts of Tanzania and Kenya, n. Somalia and n. Ethiopia; coasts of Red Sea on Arabian Pen., E to Oman. In central Indian Ocean, breed from Chagos, N through Maldive Is to Laccadive Is. Farther E, from Cocos-Keeling and Christmas Is, E to Aust. and N through Indonesia, Malaysia and s. Philippines to w. Pacific Ocean, including: islands off se. China and s. Japan, S through Micronesia, to Lord Howe, Norfolk and Kermadec Is, and E to Hawaii, Marquesas and Pitcairn Is. In e. Pacific, breed Easter I. and Sala y Gomez, E to San Ambrosio, San Felix and N to Galapagos and islets off Costa Rica and w. Mexico. During non-breeding period, mostly occur in waters round breeding islands, but occasionally ranging farther: in North America, occur round n. coasts of Gulf of Mexico, and on e. coasts to North Carolina; in Africa, from Senegal S to Gulf of Guinea, South Africa, and from e. Tanzania N to Horn of Africa; also Indian subcontinent. Vagrant to Europe (Ali & Ripley 1969; AOU 1983; Croxall *et al.* 1984; de Schauensee 1984; Urban *et al.* 1986; Pratt *et al.* 1987; Langrand 1990; Dickinson *et al.* 1991; Everett & Anderson 1991; Reichel 1991; Wells 1991; BWP).

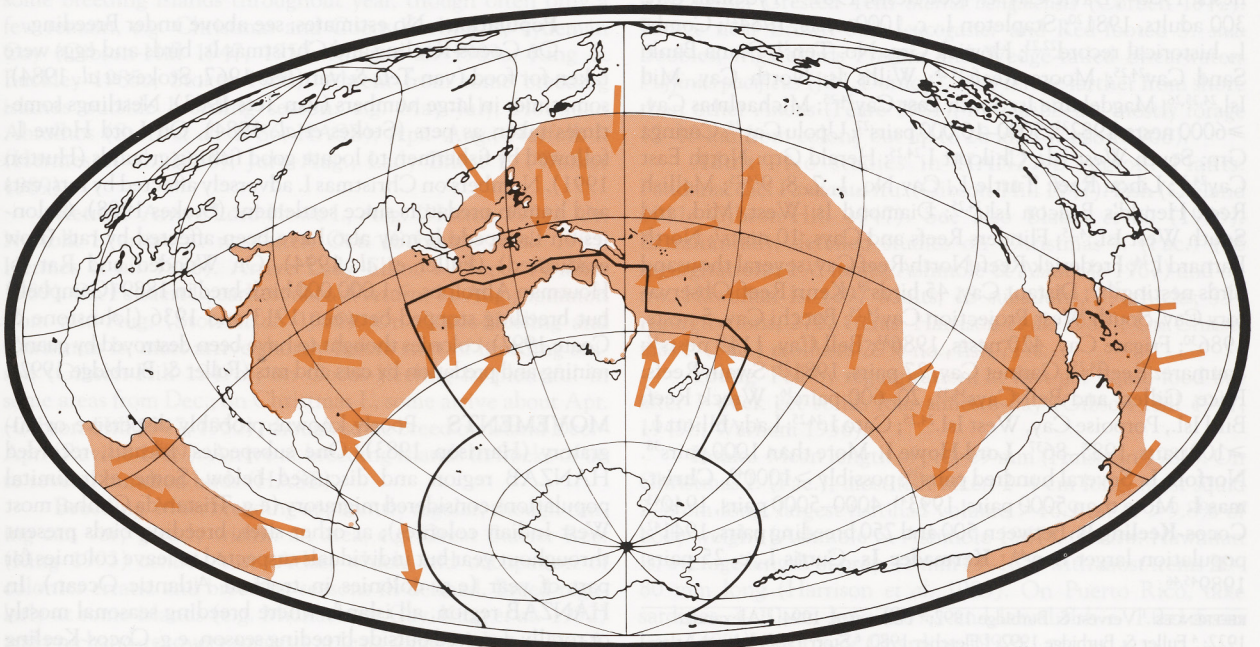
Aust. Mainly off Qld, but also nw. and central WA. **WA** Mostly at sea over Sahul Shelf, to N of Ashmore Reef, SW to waters off C. Leveque and E to seas NW of Joseph Bonaparte Gulf (Aust. Atlas). Occasionally recorded coasts of Kimberley and Pilbara (e.g. Storr 1984b; Hooper & Wells 1988). Elsewhere, very sparsely distributed round coast; excluding records from breeding station on Pelsaert I., Aust. Atlas gives only five records S of 20°S, between Barrow I. and Busselton; historical record of great numbers off Pt Cloates in 1902 (Carter 1902). Also recently recorded in SW at Boullanger I., Jurien, Floreat Beach, and breeding at Lancelin I. (Vervest 1989; Vervest & Burbidge 1992; Vervest *et al.* 1992; J.N. Dunlop). **NT** Accidental round Darwin, occasionally after strong or cyclonic winds (McKean & Gray 1973; McKean *et al.* 1975; H.A.F. Thompson & D.K. Goodfellow). First acceptable record in Top End was specimen from Wessels Is, 15 Oct. 1972 (Howe & Dodd 1973). Thought to occur more often, though irregularly, in Gulf of Carpentaria (Schodde 1976; H.A.F. Thompson &

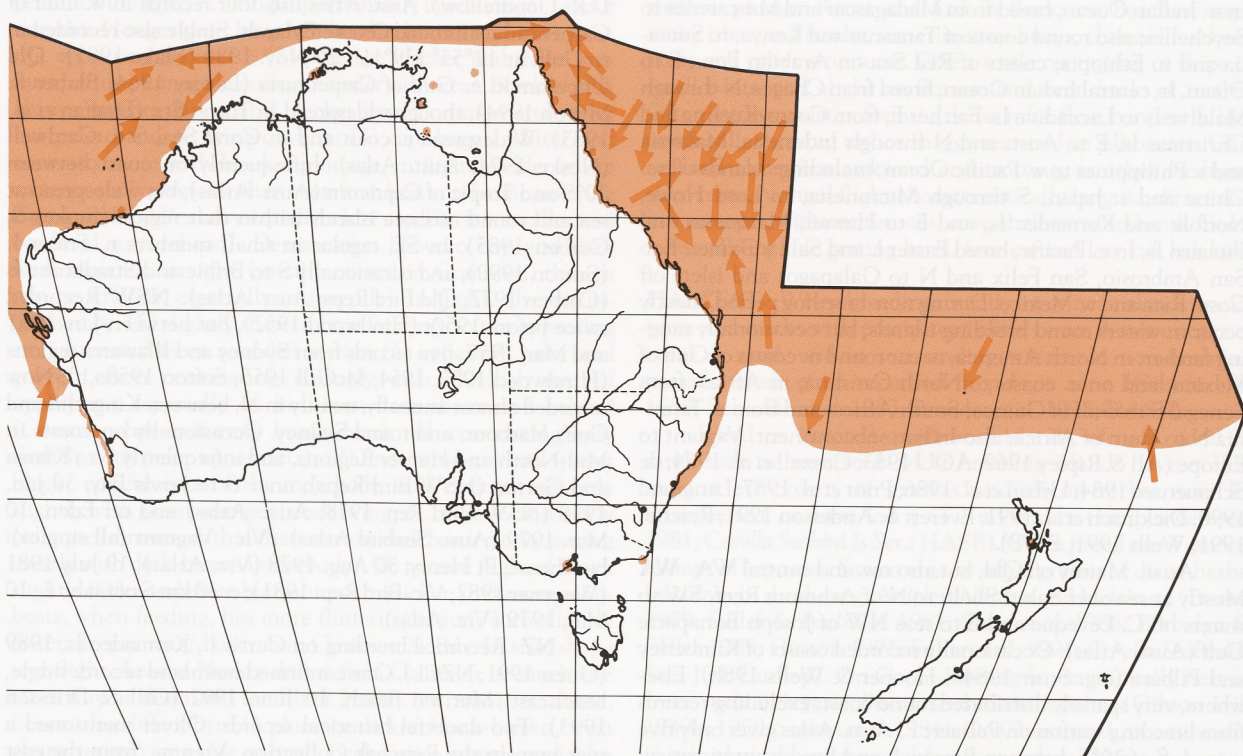
D.K. Goodfellow). Aust. Atlas lists four records in w. Gulf of Carpentaria, all round Groote Eylandt. Single also recorded in n. Gulf, at 12°53' 139°11", 20 Nov. 1984 (Blake 1985). **Qld** Uncommon e. Gulf of Carpentaria (Lavery 1964; Blaber & Milton 1994), though widespread in Torres Str. (Draffan *et al.* 1983). Widespread e. coast and in Coral Sea, S to Cardwell (Noske 1974; Aust. Atlas). Infrequently on coast between 20°S and Tropic of Capricorn (Aust. Atlas), but widespread at sea and round offshore islands within that region (Stokes & Corben 1985). In SE, regular in small numbers n. Fraser I. (Sutton 1990), and occasionally S to Bribie and Stradbroke Is (Corben 1972; Qld Bird Reps; Aust. Atlas). **NSW** Recorded twice before 1950s (Hindwood 1952), but between Jan. 1951 and Mar. 1957, five records from Sydney and Illawarra regions (Hindwood 1952, 1954; McGill 1955; Sefton 1958a,b). Now recorded almost annually, mainly in N, between Kingscliff and Coffs Harbour, and round Sydney. Occasionally on coasts in Mid-North and Hunter Regions, and infrequently S to Kiama and Gerroa (NSW Bird Reps); once S to Jervis Bay, 30 Jan. 1978 (NSW Bird Rep. 1978; Aust. Atlas) and off Eden, 10 Mar. 1979 (Aust. Seabird Atlas). **Vic.** Vagrant (all singles): beachcast, Pt Henry, 30 Aug. 1978 (Vic. Atlas), 19 July 1981 (Wegener 1982; Vic. Bird Rep. 1981); c. 30 km S of Gabo I., 10 Mar. 1979 (Vic. Atlas).

NZ Recorded breeding on Curtis I., Kermadec Is, 1989 (Guest 1991; NZCL). One confirmed mainland record: single, beachcast, Muriwai Beach, 16 June 1992 (Gill & Driessen 1993). Two doubtful historical records: Oliver mentioned a specimen in the Reischek Collection, Vienna, 'from the east coast of the North Island and dated 1885'; and Buller (1905) wrote of a specimen in the CM 'taken on the high seas, not very far from our coasts'. Neither specimen can be found (Gill & Driessen 1993).

Kermadec, Norfolk, Lord Howe, Christmas and Cocos-Keeling Is Common, breeding.

Breeding Aust. In WA, on a few islands, mainly N of 20°S; in Qld, on islands from Torres Str., S to c. 17°S, and with a s. population on islands from Frederick Reef (20°S) S to Lady Elliott I. (King 1993). **WA:** Lancelin I., 10 pairs^{1,2}; Houtman





Abrolhos: Pelsaert I., c. 132,000 nests in 1993; 79,200 pairs in 1986; formerly on Rat and Wooded Is^{2,3,4}; Bedout I., 1968⁵; Lacepede Is: 20–36 pairs; East I., West I. and Middle I.^{2,6}; Sandy Isl., Scott Reef, 70 pairs^{2,7}; Ashmore Reef: 13,000–35,000 breeding pairs; West, Middle and East Isl.^{2,7,8}. QLD: Bramble Cay, 20 nesting pairs, 1987; 3000 pairs, 1980⁹, >10,000 birds¹⁰; Murray Is Sandbank¹¹; Maclellan Cay, ≤300 nests¹²; Pandora Cay, ≥300 nests¹³; Wallace I., 30 pairs, 1988¹⁵; Raine I., >17,000 nests, 1982¹⁶; Bird Is¹¹; Ashmore Banks, up to 298 nests¹⁷; Quoin I., c. 1000 nests, 1980¹⁸; Sandbank No. 8, 4000 nests, 1980¹⁴; Davie Cay, c. 4000 nests, 1981¹⁹; Tydeman Cay, 300 adults, 1981²⁰; Stapleton I., c. 1000 nests, 1984²¹; Combe I., historical record^{22,23}; Howick Grp: No. Ten²⁴; Diana Bank: Sand Cay^{24,25}; Moore Reefs^{24,25}; Willis Is: North Cay, Mid Isl.^{24,25,26}; Magdelaine Is: South East Cay^{24,25}; Michaelmas Cay, ≥6000 nests, 1982²³, 5000–10,000 pairs²⁷; Upolu Cay²⁸; Coringa Grp: South West Isl., Chilcott I.^{24,25}; Herald Grp: North East Cay^{24,25}; Lihou Reef: Turtle I., Cay No. 1, 7, 8, 9^{24,25}; Mellish Reef: Herald's Beacon Isl.^{24,25}; Diamond Is: West, Mid, and South West Isl.^{24,25}; Flinders Reefs and Cays, 10 nests⁷; North Barnard I.²⁴; Frederick Reef: North Reef Cay, several thousand birds nesting^{24,25}; Distant Cay, 45 birds²⁹; Kenn Reef: Observatory Cay, South West Projection Cay^{24,25}; Bacchi Cay, 5 nests, 1986³⁰; Frigate Cay, 420 nests, 1986³¹; Bell Cay, 1145 nests³²; Saumarez Reef^{24,25}; Gannet Cay, 27 pairs, 1981³³; Swain Reefs: Price, Gillett and Bell Cays^{34,35}, 20–600 pairs³⁶; Wreck Reef: Bird Isl., Porpoise Cay, West Isl.^{24,25}; Cato I.^{24,25}; Lady Elliott I., ≥100 pairs, 1985–86³⁷. **Lord Howe I.** More than 1000 pairs³⁸. **Norfolk I.** Several hundred pairs³⁹; possibly >1000⁴⁰. **Christmas I.** More than 5000 pairs, 1993⁴¹; 4000–5000 pairs, 1940⁴³. **Cocos-Keeling Is** Between 500 and 750 breeding pairs, 1941⁴²; population larger now⁴⁴. **Kermadec Is** Curtis I., c. 25 pairs, 1989^{45,46}.

REFERENCES: ¹ Vervest & Burbidge 1992; ² Fuller *et al.* 1994; ³ Alexander 1922; ⁴ Fuller & Burbidge 1992; ⁵ Fletcher 1980; ⁶ Storr 1980; ⁷ Aust. Atlas;

⁸ Stokes & Hinchey 1990; ⁹ Elvish & Walker 1991; ¹⁰ Draffan *et al.* 1983; ¹¹ Kikkawa 1976; ¹² King *et al.* 1983a; ¹³ King *et al.* 1983b; ¹⁴ King *et al.* 1983c; ¹⁵ King *et al.* 1989; ¹⁶ King 1986; ¹⁷ King & Limpus 1983; ¹⁸ King & Buckley 1985a; ¹⁹ King & Buckley 1985b; ²⁰ King & Buckley 1985c; ²¹ King 1985a; ²² King 1985b; ²³ King 1985c; ²⁴ HASB; ²⁵ Hindwood *et al.* 1963; ²⁶ Serventy 1959; ²⁷ Aust. NRS; ²⁸ Wheeler 1967; ²⁹ Lane & Heatwole 1991; ³⁰ Walker *et al.* 1989; ³¹ Walker & Jones 1986a; ³² Walker & Jones 1986b; ³³ Walker & Jones 1986c; ³⁴ Costello 1978; ³⁵ Moverley 1985; ³⁶ Limpus & Lyon 1981; ³⁷ Walker 1986; ³⁸ Fullagar *et al.* 1974; ³⁹ Hermes *et al.* 1986; ⁴⁰ P.J. Fullagar; ⁴¹ Carter 1994; ⁴² Gibson-Hill 1949a; ⁴³ Gibson-Hill 1949b; ⁴⁴ Stokes *et al.* 1984; ⁴⁵ Guest 1991; ⁴⁶ NZCL.

Populations

No estimates; see above under Breeding. On Cocos-Keeling and Christmas Is, birds and eggs were taken for food (van Tets & van Tets 1967; Stokes *et al.* 1984), sometimes in large numbers (van Tets 1983). Nestlings sometimes taken as pets (Stokes *et al.* 1984). Off Lord Howe I., followed by fishermen to locate good fishing grounds (Hutton 1991). Numbers on Christmas I. adversely affected by rats, cats and human predators since settlement (Stokes 1988). Colonies on Lacepede Is may also have been affected by rats (now eradicated) (Fuller *et al.* 1994). On Wooded and Rat Is, Houtman Abrolhos, >1,000,000 birds bred in 1889 (Campbell) but breeding stopped between 1913 and 1936 (Johnstone & Coate 1992); colonies thought to have been destroyed by guano-mining and predation by cats and rats (Fuller & Burbidge 1992).

MOVEMENTS Poorly known; probably dispersive or migratory (Harrison 1983). One subspecies, *pileatus*, recorded HANZAB region and discussed below. Some extralimital populations considered migratory (e.g. Tristan da Cunha, most West Indian colonies); at other sites, breeding birds present throughout year but individuals suspected to leave colonies for part of year (e.g. colonies in tropical Atlantic Ocean). In HANZAB region, all islands where breeding seasonal mostly or totally deserted outside breeding season, e.g. Cocos-Keeling

Is, Houtman Abrolhos, Norfolk I.; where breeding year-round, numbers vary seasonally, e.g. Michaelmas Cay, Bell Cay (Gibson-Hill 1950; Orn. Soc. Japan 1974; Blake 1977; Harrison 1983; van Halewyn & Norton 1984; Hermes *et al.* 1986; Walker & Jones 1986b; King *et al.* 1992; see BWP).

Occasionally land on ships (e.g. Hindwood 1952; MacDonald & Lawford 1954; NSW Bird Rep. 1977). Some mainland records associated with strong winds (e.g. McKean & Gray 1973; Hoskin 1991; NSW Bird Rep. 1989) and recorded in areas outside normal range after gale-force winds (e.g. McKean & Gray 1973). Single recorded in wreck of Lesser Noddies (Storr & Johnstone 1988).

Departure On Lord Howe I., adults and young said to leave end Feb. or early Mar., with laggards till Apr. or later (Hindwood 1940; North), or to leave in May, when cold weather sets in (Hutton 1991). On Norfolk I., leave by late Mar. (Schodde *et al.* 1983); all leave by May (Hermes *et al.* 1986). Leave Lady Elliot I., Great Barrier Reef, early winter (Walker 1986). On Willis I., Great Barrier Reef, breeding recorded most months, and some always present (Hogan 1925; Serventy 1959). On Houtman Abrolhos, leave Pelsaert I. by Apr. (Fuller & Burbidge 1992); common visitor till late Apr. (Storr *et al.* 1986). In Indian Ocean, most leave Christmas and Cocos-Keeling Is shortly after end of breeding season but a few present throughout year; said to be common in parts of Cocos-Keeling Is till June (Gibson-Hill 1949b, 1950), but current pattern at Cocos-Keeling Is apparently different (see Stokes *et al.* 1984); some leave Christmas I., Nov. (Gibson-Hill 1947) but others breed from Dec.–Apr. (Reville 1989).

Non-breeding Range not known. Origins of birds recorded away from breeding range also not known. Flocks recorded at sea hundreds of kilometres from breeding islands (HASB). Regular to some islands where breeding not recorded, e.g. Eagle I. (Smith 1987). Also recorded on Aust. mainland away from breeding areas, sometimes well S of breeding range (see Distribution). Large flocks sometimes seen North West C., WA, mid-May (Carter 1904); recorded all months in se. Qld (Roberts 1979; Smyth & Corben 1984; Storr 1984a); occasional to NSW, mostly between Nov. and July. Occur on some breeding islands throughout year, though often only a few remain, e.g. Christmas and Cocos-Keeling Is, Tydemans Cay (Gibson-Hill 1947, 1950; King *et al.* 1983a; King & Buckley 1985c; Stokes 1988). Absent from some breeding islands outside breeding season: e.g. May–July, Houtman Abrolhos (Storr *et al.* 1986; HASB); Apr.–Aug., Norfolk I. (Hermes *et al.* 1986); July–Aug., Lady Elliot I. (Walker 1989).

Return Arrive Lord Howe I., Aug. (Hutton 1991). On Norfolk I. arrive at nest-sites, Oct. (Schodde *et al.* 1983; Hermes *et al.* 1986). Arrive Lady Elliot I., Sept. (Walker 1989). On Pelsaert I., earliest date of return, 11 Aug.; common from mid-Aug. (Storr *et al.* 1986). On Cocos-Keeling and Christmas Is, most arrive shortly before start of breeding season (Gibson-Hill 1949b); on Cocos-Keeling Is, plentiful in some areas from Dec.; on Christmas I., some arrive about Apr. (Gibson-Hill 1947, 1950), though some breed on island Dec.–Apr. (Reville 1989). Arrive at breeding islands in flocks of up to several hundred birds (HASB).

Breeding Most breeding apparently regular, though timing can vary greatly within an area, e.g. Great Barrier Reef (King 1993) *contra* Aust. Atlas, which said occupation of colonies erratic and breeding seasons ill-defined. Breed regularly at some islands (e.g. Michaelmas Cay, King *et al.* 1992) and one band-recovery suggests at least some fidelity to breed-

ing area (see Banding). Where breeding occurs throughout year, cycle annual, with seasonal trend in numbers; e.g. at Michaelmas Cay, numbers high from Oct. and Nov., with maximum numbers Jan.–Mar., and low numbers July and Aug., though cyclones affect numbers and timing of maximum numbers (King 1985b,c, 1992). Extralimitally, recorded foraging 20 km from breeding area (Morris & Chardine 1992).

Dispersal of young Unknown, though young birds recorded away from breeding islands (e.g. Hindwood 1952).

Banding Maximum displacement between banding and recovery site, 430 km (adult). Adults banded Great Barrier Reef recovered on other islands (King *et al.* 1989) and in New Guinea (ABBBS 1983). Bird banded Cocos-Keeling Is recovered at banding site over 2 years 7 months later (ABBBS 1987). Breeding bird banded Lord Howe I. recovered at same site following season (McKean & Hindwood 1965).

FOOD Carnivorous; mostly fish, though also take squid, pelagic molluscs, medusae, insects and even *Pandanus* fruit.

Behaviour Mostly diurnal, though feed at night when moon full (Gibson-Hill 1947). Feed by DIPPING, gleaning items from or just below surface of water, while flying (Ashmole & Ashmole 1967; Harrison *et al.* 1983; Ainley & Boekelheide 1984). Recorded taking flying-fish (Exocoetidae) in air (Watson 1908; Ali & Ripley 1969). May use feet to keep body out of water but do not patter in manner of storm-petrels (Hydrobatidae) (Watson & Lashley 1915; cf. Morris 1964; Harrison *et al.* 1983). Occasionally SURFACE-SEIZE, sitting on water and round algae and dabbling below surface (Audubon 1835; Ashmole & Ashmole 1967). Also hover, before SHALLOW-PLUNGING onto surface of water, rarely submerging. Skim surface of water to drink (Watson 1908; Corben 1972; Griffiths 1982; Harrison *et al.* 1983; HASB). Follow schools of fish that have been forced to surface by larger predatory fish (especially Scombridae); often do so in mixed flocks with Sooty Terns *Sterna fuscata* (Watson 1908; Blaber 1990; Hutton 1991). On Gough I., recorded following, and feeding among, foraging Rockhopper Penguins *Eudyptes chrysocome* (Griffiths 1982). Seen feeding with Lesser Crested Tern *Sterna bengalensis* (Corben 1972). Forage near Brown *Sula leucogaster* and Red-footed *S. sula* Boobies, frigatebirds *Fregata* and Wedge-tailed Shearwaters *Puffinus pacificus* (J.N. Dunlop). May forage farther from shore than other *Anous* (Feare 1981); in Caribbean, mostly forage 17–18 km from colony but up to 28 km (Watson 1908).

Adult No studies in HANZAB region. Plants: Pandanaceae: *Pandanus* fru. (Gibson-Hill 1947). Fish (Cleland 1911; Gibson-Hill 1947). See also Blaber *et al.* (1995). Extralimitally, detailed studies on Christmas I. (Pac.) (38 regurgitations, 195 items; Ashmole & Ashmole 1967) and on nw. Hawaiian Is. (297 adults, 18 subadults, 39 chicks; 354 regurgitations, 2722 items; Harrison *et al.* 1983). On Christmas I. (Pac.) molluscs 29% no., fish 71%.

Young Fed by regurgitation; at first get liquid food but after 1 week get solids four times a day (Gibson-Hill 1947, 1949b; Warham 1956).

Intake Mean length of prey 69 mm (Hulsman 1981). On Christmas I. (Pac.), most fish taken 2–4 cm long, most squid 2–8 cm long; largest fish had volume >16.9 ml or >9.8% of body-weight (Ashmole & Ashmole 1967). On nw. Hawaiian Is, average length of prey, 48 mm (3–185) with most items 20–80 mm long (Harrison *et al.* 1983). On Puerto Rico, take sardines, 3–10 cm long (38%) and larval fish c. 1.0–1.5 cm long (48%) (Morris & Chardine 1992).

SOCIAL ORGANIZATION No detailed studies. Gregarious; some flocks so large as to appear as grey clouds in distance (North; HASB) but in some locations never seem to congregate in large numbers (Hutton 1991). Arrive at breeding islands in groups; appear gradually for a few days before arriving in large numbers (Campbell; HASB). Large flocks recorded before breeding: e.g. on Bedout I., several thousand in May (Bush & Lodge 1977); on Pelsaert I., Aug., 1000 resting in Aug. (Storr *et al.* 1986). During breeding season, seen on water in rafts near breeding colonies (Garstone 1978) or in groups on beaches; groups larger at night (Hogan 1925). On Christmas I., May–Aug., small flocks gather in CLUBS during day where they rest and sometimes perform courtship displays; Clubs mostly breeding adults, though second-year and juvenile birds also present; by Aug., mainly young of year use beach; no evidence of non-breeding adults using Club; most arrivals at Clubs in first 2 h of daylight (Dunlop 1987). Gibson-Hill (1947) noted Club-type gatherings of unpaired birds at beginning of breeding season and Reithmüller (1931) mentions seeing much courtship behaviour on beach. Later in season, juveniles gather with adults in groups on beaches and rocks (Hindwood *et al.* 1963; Hutton 1991). At various times of year many observations of birds roosting and resting in flocks: Bramble Cay, Jan., 1000–2000 birds (Elvish & Walker 1991); Distant Cay, c. 100–200 on shoreline (Lane 1989); Bedout I., winter, c. 120 (Abbott 1979); on Raine I., roosting population of Common and Black Noddies in July is large, possibly $\geq 100,000$ birds (King 1986); on Willis I., large flocks on beaches in Nov.–Jan., whereas singly or in groups perched in bushes in Mar. (Davis 1923). At sea, usually in small feeding flocks, e.g. of c. 50 birds (Hutton 1991; HASB); off se. Qld in mid-winter, large groups of hundreds (Qld Bird Rep. 1983), and one flock of 30 that broke up into singles and small groups (Corben 1972). Rest with Sooty Terns, Brown Boobies, and many small terns (Hogan 1925; Noske 1974; Lane 1989). Seen feeding with other terns and seabirds (see Food). On breeding islands of Coral Sea, mix indiscriminately with Sooty Terns and Black Noddies (Hindwood *et al.* 1963; also see Breeding).

Bonds Not studied. On Pelsaert I., in late Aug. 1977, hundreds of birds engaged in display flights, but most birds already paired (Storr *et al.* 1986). Extraliminally, assortive mating discussed in Chardine & Morris (1989). **Parental care** Both sexes build nest (Hutton 1991), incubate (Gibson-Hill 1947, 1949b) and said to brood young (Serventy 1959). Davis (1923) said female took greater share than male but gave no details on how sex of birds was determined. At first, fledged young remain near nest and return to nest to be fed; later, beg for food away from nest; birds that appear to be fully grown seen bullying parents to regurgitate (Gibson-Hill 1947, 1949b).

Breeding dispersion Breed in colonies, which are often large, e.g. on Pelsaert I., more than 100,000 nests (see Distribution). Colonies can be densely packed or widely spaced. Details of groupings or density within colonies include: On Pelsaert I., densities in areas of samphire greater than elsewhere, as high as 254 nests/100 m² (Garstone 1978; Burbidge & Fuller 1989; Fuller & Burbidge 1992); in Dec. 1986, colony of c. 79,200 nests in 13.89 ha (57 nests/100 m²) in Dec. 1989, c. 116,500 nests in 17.93 ha (65 nests/100 m²); in Nov. 1991, c. 130,000 nests in 14.44 ha (90 nests/100 m²); on Rat I. in 1889, c. 120 birds/100 m² (Campbell). On MacLennan Cay, up to 300 nests in loose groups throughout vegetated areas (King *et al.* 1983a); on Bell Cay, nests widely spaced among vegetation (Walker & Jones 1986b); on Norfolk I., nest in small groups of up to 20 pairs, scattered over island (Crowfoot 1885; Hermes

1985); on Willis I., nests scattered over grassed areas (Hogan 1925; Serventy 1959). Occasionally single nests or small colonies recorded (e.g. Noske 1974; Brown 1979; Walker *et al.* 1989; A.J.D. Tennyson). Sometimes nest in association with other species (see Breeding). **Territories** Defend nesting site (Hogan 1925) and potential nesting site (Warham 1956); on Pelsaert I., defence observed in Aug. after pairing (Storr *et al.* 1986).

Roosting Communal (e.g. van Tets & van Tets 1967; for flock sizes, see above). At night (e.g. Hogan 1925; Warham 1956, 1961; HASB) and during day (see below). Normally rest on land (HASB): on beaches, sometimes just above edge of water; whole beach may be lined with birds (e.g. Davis 1923; Hogan 1925; Moverly 1985); in bushes (Davis 1923; Warham 1956); on shoals and reefs (Hindwood 1940). Can rest on water for several hours without becoming waterlogged (HASB), though said to be reluctant to settle on sea (Gibson-Hill 1947); at times perch on floating objects or animals; during breeding season, may form rafts on sea near breeding colonies (Garstone 1978). Some activity recorded at night at breeding colonies (Tarr 1949), and will forage on moonlit nights (Gibson-Hill 1947). Clamour of colonies subsides at night (Serventy & Whittell 1976) but some calling persists (Gibson-Hill 1947). Arrive at nocturnal roosts towards evening, when commonly groups of 50–100 birds stand together, preening and loafing (Warham 1956); some arrive after dark (HASB); numbers build up in afternoon but many arrive when almost dark (Warham 1961). Some leave roost soon after sunrise, though many leave several hours after this (HASB); many on the wing in half-light before dawn (Warham 1956). During day, birds usually gather in groups and stand, rest, preen or sunbathe (e.g. Hogan 1925; Hindwood 1952; Warham 1961); Clubs form during breeding season (see above); Club sites not used for roosting at night (Dunlop 1987). On Willis I., during day, Nov.–Jan., large flocks on beach; in Feb., often perch on bushes rather than beach; in Mar. in morning, many perch on bushes (Davis 1923). On North Keeling I., groups stood on crest of beaches where they were sprayed by sea-water; most noticeable towards end of breeding season (Gibson-Hill 1947, 1948a). Birds sleep with heads tucked into scapulars. Sunbathe by lying with one wing outstretched and resting on fanned tail, which is pushed to one side at right angles to sun (Warham 1956, 1961; HASB).

SOCIAL BEHAVIOUR No detailed studies. Many observations by Warham (1956) on Pelsaert I., similar to those of more detailed extralimital study on Dry Tortugas, Florida (Watson 1908). Tame (Bassett-Hull 1909); on Christmas I., so tame that can be killed with sticks (to be barbecued at beach parties) (van Tets & van Tets 1967). White of forehead and white arcs round eye prominent in display. Nesting displays may be given by birds without nests or by those with eggs (HASB). **Flock behaviour** Dreads common, birds rising silently but returning with great clamour; sometimes started by other species giving Alarm Call, at other times cause not obvious; as many as four Dreads in 2 min; not all birds participate (HASB). Within colony, breeding not synchronized. **Comfort behaviour** Hindwood (1952) refers to single moulting bird preening a lot. Scratch head with foot while in flight; simply glide for a few metres while scratching (Warham 1956). Dive through wave-crests, possibly to clean plumage (HASB).

Agonistic behaviour Squabbling seen in pre-breeding flocks. On Willis I., two birds in flight often struggle for same piece of nesting material; also steal material from unattended

nests (Reithmüller 1931). Breeding birds defend nest and potential nest-sites (Hogan 1925; Warham 1956; Storr *et al.* 1986). In aggressive displays, bird thrusts head forward with bill open and gives croaking call (HASB). **Threat** Birds seem to threaten intruders that approach too closely by displaying inside of mouth as bill snapped open (Warham 1956) and by giving open-mouthed display, with tongue arched (HASB). When one bird tries to land near another, resident gives Kree-aw Call with bill lifted up. After disagreement with neighbour, bird calls (with bill only just open), stretches head forward and turns swiftly from side to side roughly in direction of opponent (Davis 1923; Warham 1956; HASB). **Fighting** Threat often followed by fight: birds rise into air, with bills locked, and may pursue each other for some distance (Hutton 1991; HASB).

Sexual behaviour **Courtship behaviour** Seen at nest-sites, in Clubs (Gibson-Hill 1947; Dunlop 1987; Hutton 1991) and on beaches (Reithmüller 1931). **Aerial displays** Pairs often seen performing high-speed zigzag flights (Tarr 1949; Warham 1956); members of pair keep close together, often flying with slow and exaggerated wing-beats, giving a type of butterfly flight (Warham 1956). On Pelsaert I., in late Aug. 1977, hundreds of birds in display flights, though most had paired and performed mutual displays on old nests or on ground (Storr *et al.* 1986). **Ground displays** In Clubs of unpaired birds at beginning of breeding season, one bird occasionally **BOWS** to neighbour: simply lowers head slowly till tip of bill almost touches chest, and then raises head sharply; after a pause, neighbour may reciprocate. If neighbour does not reciprocate, performing bird may turn to another neighbour; occasionally bird carries small twig or picks up a piece of seaweed to present at start of Bowing ceremony (Gibson-Hill 1947). **NODDING** occurs in birds without nests and those with eggs; on ground, two birds stretch necks stiffly forwards, suddenly open bills to reveal orange mouth, then fence with bills and soon begin repeatedly nodding, jerking heads sharply backwards and upwards, and bowing (Warham 1956). Early in season, Nodding more elaborate, with birds circling each other and remiges touching, or almost touching, ground (HASB). Also, one bird struts round mate, Nodding and opening and shutting bill before pair begin Bowing together (Reithmüller 1931). Pairs without nests often stand close together and raise slightly opened bills skyward as they growl, especially in evening (Warham 1956). On site of future nest, one bird, probably female, spends long periods while prospective mate occasionally offers dried sticks or the like; offerings followed by Bowing, after which birds may preen each other (Gibson-Hill 1947; HASB). Birds also seen flying round holding grass in their bills 10 days before nests found (Davis 1923). **Greeting** Members of pair arch necks, open bills and press tongues upwards to make an inverted V, then suddenly throw heads upwards with a resounding click (Tarr 1949). At change-over, returning bird usually calls on approach, and partner answers once or twice; relief ceremony consists only of mutual Bowing (Gibson-Hill 1947). **Courtship feeding** Often seen, mostly in late afternoon; sometimes by pairs that have selected nest-sites but have no nest. Assumed that male feeds female; female begs from newly arrived mate by dabling with her bill towards his, whereupon he opens his bill and disgorges food which she picks up and eats; accompanied by cackling sounds (Warham 1956; HASB); Hutton (1991) says male disgorges food into mouth of female. Not seen during incubation (Gibson-Hill 1947). **Allopreening** On site of future nest, after mate has presented offerings and given Bowing display, birds may stand side by side, gently caressing each other's head and shoulders

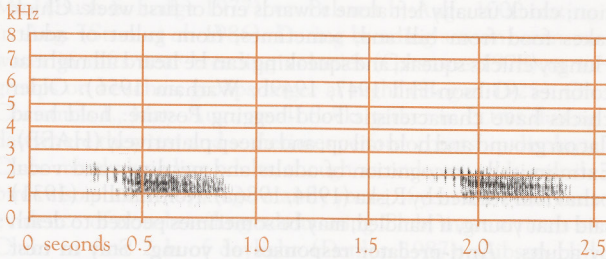
with their bills; this seldom occurs after laying (Gibson-Hill 1947). After courtship feeding, one bird, assumed to be female, often preens head of mate (Warham 1956). **Copulation** Male Bows to female, and if she responds, emitting purring chuckle, he attempts to mount. After successful mating, male often remains pressed against side of female (Gibson-Hill 1947).

Relations within family groups Young fed by regurgitation; chick usually left alone towards end of first week. Chick takes food from bill and, sometimes, from gullet of adult. Hungry chicks squeak, and squeaking can be heard all night at colonies (Gibson-Hill 1947, 1949b; Warham 1956). Older chicks have characteristic Food-begging Posture: hold head flat on ground and hold tail up, and cheep plaintively (HASB). Extralimitally, recognition of adults and nestlings and vocal behaviour studied by Riska (1984, 1986a). Reithmüller (1931) said that young, if handled, may be sometimes pecked to death by adults. **Anti-predator responses of young** Stay in nest until able to fly (Reithmüller 1931). If alarmed by human intruders may regurgitate; also seen to run off nest and fall through saltbush, which may lead to nestlings being lost or killed by neighbours (Warham 1956), and to jump off rock ledges into sea (Gibson-Hill 1947). **Parental anti-predator strategies** When disturbed from nests, give Threat or Alarm Call (HASB). Egg seldom left unattended; parents more attentive and aggressive as incubation progresses; towards end of incubation, sitting bird rises and calls to drive any intruder away, regardless of its size (Gibson-Hill 1947). After hatching, one parent usually remains until chick 3–5 days old; during this time parent even more aggressive than before; towards end of first week, chick usually left alone (Gibson-Hill 1947, 1949b). When an Osprey *Pandion haliaetus* flew overhead, all birds left nests, allowing Silver Gulls to attack nests; Gulls then ignored attacks by returning parents (Tarr 1949). Tame and fearless of people (Sandland 1937; Warham 1956; Fien 1971; Serventy & Whittell 1976). Many leave nests in last seconds of approach by a person, sometimes pecking as they take off; return to nests when intruder 1–2 m away (Sandland 1937; Warham 1956; North). Many birds circle overhead calling, both those that have left nests and unemployed birds (Reithmüller 1931; Warham 1956); birds flutter above observers (Stokes 1988); can sometimes be quite aggressive, and may fly into intruder's face (Hogan 1925; Warham 1956). As nests stepped over (with eggs or young), some birds stay put, ruffling feathers and half-opening wings, and may regurgitate (Warham 1956). Can sometimes be caught by hand on nest (Whittell 1942; Serventy & Whittell 1976; Campbell).

VOICE Only anecdotal information in HANZAB area. Elsewhere, well known from studies by Riska (1984, 1986a,b), who distinguished nine adult calls, which comprise different temporal arrangements of short (c. 4 ms) broad-band clicks; and three calls of young, which are frequency-modulated tonal elements or broad-band bursts of sound, with little similarity to calls of adult. General noise at colony a quiet cawing chorus, not unlike murmuration of starlings (Warham 1956); clamour of colony subsides at night (Serventy & Whittell 1976). At change-over, returning bird usually calls on approach, partner answers once or twice (Gibson-Hill 1947). Noisy in defence of nest against conspecifics (Davis 1923) and give loud calls in flight above head of human intruders (Reithmüller 1931; Sandland 1937; Gibson-Hill 1947; Warham 1956). During Dreads, birds rise silently but return noisily (HASB). At roost, caw and cackle in chorus for some time after dark (Warham 1961). For at least 20 days after hatching, adults do not

discriminate chicks swapped for their own (Riska 1984).

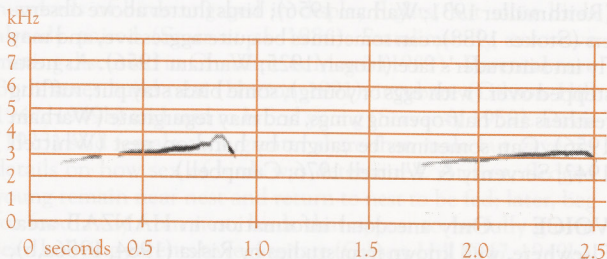
Adult THREAT or ALARM CALL: low harsh guttural croaking *kar-r-rk* (two calls in sonagram A) or *kraa*. Sometimes uttered in flight, and often given at night. When disturbed from nest, or when trying to drive away intruder, sound shortened and pitch rises, call ending in hoarse angry grating cry, as though trying to screech (Gibson-Hill 1947; Warham 1956).



A P.J. Fullagar; Lord Howe I., Feb. 1974; P39

PURR or RUNNING CACKLE given by one bird feeding another; similar to Threat Call (Warham 1956). **KREE-AW**, given with bill uplifted when another bird tries to land nearby (Warham 1956). **CLICK:** heads of birds thrown up with resounding *click*; given in threat and, possibly, in greeting (see Social Behaviour). **CROAKING:** given in aggressive display, with head thrust forward and bill open; often followed by fight (HASB). **KUK:** utter *kukkukkukk...* with bill slightly open, and head stretched forward and turned swiftly from side to side; follows disagreement with a neighbour (Warham 1956). **Other calls** Person walking through colony accompanied by circling mass of cawing birds, which have left nests or are unemployed (Warham 1956). Hoarse guttural crooning in defence of nest against people (White 1946). After Bowing of male, female may give short purring chuckle; male may then attempt to mount (Gibson-Hill 1947). Pairs without nests give growling calls (Warham 1956) especially in evening.

Young Hungry chicks squeak (sonagram B); can be heard all night in breeding colonies (Gibson-Hill 1947); utter plaintive *cheeping* when begging for food (HASB).



B P.J. Fullagar; Lord Howe I., Feb. 1974; P39

BREEDING Fairly well known. In Aust., no major studies and one record in Aust. NRS; extralimital studies include Morris & Chardine (1992). Colonial.

Season Varies greatly; at some sites, breed annually (King *et al.* 1992); at others, breed twice a year, in spring to early summer and in autumn; on some islands breed at all times of year. Autumn breeding more common at n. sites, spring breeding on Houtmann Abrolhos and islands near Cairns (HASB). Within colony, breeding not synchronized (Fuller *et al.* 1994). **QLD:** On Willis I.: season protracted; laying Feb.–Apr., with eggs also recorded Nov. and late Jan.; in one season, laying began early Feb., appeared to pause in Mar., then re-

started in early Apr., with nest-building continuing into May; advanced young recorded Nov.; fledging, late Jan. to Feb.; young also recorded from late Mar. (Davis 1923; Hogan 1925); on Michaelmas Cay, breed throughout year, with maximum numbers in summer (King 1985c); on Lady Elliot I., eggs to advanced young, Dec.–Feb., with a few eggs in late May (Walker 1986). **WA:** On Houtman Abrolhos: laying as early as Aug. (Fuller *et al.* 1994); building and large young, early Oct. (Tarr 1949); building and eggs, late Oct. (Fuller *et al.* 1994); building, eggs and young at all stages to flying, Nov. and Dec. (Fuller *et al.* 1994); eggs and young, early Nov., late Dec. and early Jan. (Sandland 1937; Serventy 1943; Surman 1994); nests, Nov. and May (Burbidge & Fuller 1989). **ASHMORE REEF:** Mar.–Sept., peak laying, June–July (Stokes & Hinchey 1990). **CHRISTMAS I.:** laying may begin in late Mar. but mostly from May to July; latest eggs, early Sept. (Gibson-Hill 1947, 1949b; Dunlop 1987). **COCOS-KEELING I.:** broadly, Dec.–June; peak laying, late Dec. to Feb. (Gibson-Hill 1947, 1948a); begin nesting in Apr.–May; many nests with eggs, plus a fledged young, mid-Jan.; eggs and young, early July and late Nov. (Stokes *et al.* 1984). **LORD HOWE I.:** laying, late Oct. to late Jan.; adults and young leave late Feb. or early Mar. (Hindwood 1940; Hutton 1991). **NORFOLK I.:** late Oct. to Dec. or Jan. (Schodde *et al.* 1983).

Site On bushes or clumps of vegetation; on ground in pigface or grass; on bare rock, or tops of rocks protruding above vegetation; on shingle beaches, among coral rubble or in sand within c. 5.5 m of grassy area; in barren areas covered with *Sesuvium*; also in fork of tall trees, tops of coconut palms, holes in dead timber and on tree-stump; on Lord Howe, Kermadec and Christmas Is, many nests built on ledges in cliffs (Basset Hull 1909; Davis 1923; Hogan 1925; Sandland 1937; Hindwood 1940; Gibson-Hill 1948a; van Tets & van Tets 1967; Stokes *et al.* 1984; King 1985c; Walker 1986; Dunlop 1987; Stokes 1988; A.J.D. Tennyson). Colonies often spread over entire vegetated areas of islands (Hogan 1925). On vegetated islands, pairs build on bushes first, later arrivals on ground (Basset Hull 1909; Tarr 1949). **MEASUREMENTS:** nests in bushes placed up to 5.7 cm above ground, in saltbush up to 1.2 m above ground; one nest found on top of stump, c. 60 cm above ground (Davis 1923; Warham 1956). Up to five nests per bush on Lord Howe I. (Hindwood 1940). Occupy same area as Sooty Terns and Wedge-tailed Shearwaters *Puffinus pacificus*, with Noddies on bushes, Sooty Terns on ground and Shearwaters in burrows (Sandland 1937; Warham 1956).

Nest, Materials Nests on bushes elaborate, bulky and untidy, with no interweaving of material and moderate depression in centre; built out of grass, twigs, leaves, wood, seaweed, fish bones, coral, shells, brown paper, straw packing and pieces of rope. Nests built in grass, smaller, sometimes merely a littering of material. Nests on bare earth or rock sometimes with debris, such as short sticks, and shells scraped round it. On coral beaches, in depression in rubble, sometimes containing a few dried leaves (Basset Hull 1909; Davis 1923; Reithmüller 1931; Hindwood 1940; Gibson-Hill 1948a, 1949b; Tarr 1949; Fuller *et al.* 1994; HASB; North). Nests on Michaelmas Cay often lined with white pieces of coral or debris (King 1985c). Pluck and tear at many pieces of grass until find one not attached to a root; squabble over material in flight (Reithmüller 1931). Readily steal material from unguarded nests (Davis 1923; Reithmüller 1931). Carry material from c. 3 km away, even though material may be available nearby (Tarr 1949). **MEASUREMENTS:** 25.4 cm in diameter and vary in height, up to 15.2 cm high (HASB); largest nest c. 60

cm in diameter and 15 cm thick (Reithmüller 1931). Material at a site on a rock ledge an untidy layer over area of c. 0.09 m².

Eggs Oval or elongate oval, some pointed at smaller end; fairly smooth, close-grained, lustreless (Gibson-Hill 1949b; North); dull white, cream or buff-white to warm pinkish-white; marked sparingly, particularly on larger end, with rounded and irregular spots and blotches of purplish red, purplish brown, brownish red or dark red, intermingled with smaller underlying markings of faint purplish-red and dull violet-grey; markings sometimes uniformly distributed over shell or confined to cap on larger end; others minutely freckled over rest of shell; rarely, some have a few large patches or coalesced markings on one end or side of shell (Basset Hull 1909; Hindwood 1940; North). **MEASUREMENTS:** 53.0 (2.49; 48.3–57.4; 12) x 36.6 (0.54; 35.8–37.3) (North); 53.6 (50.9–57.6; 5) x 37.2 (35.0–41.4) (Serventy 1959). Lord Howe I.: average 54.4 x 35.1 (Hindwood 1940). Norfolk I.: 53.7 (2.89; 50.3–56.9; 6) x 36.0 (2.01; 33.0–39.1) (Basset Hull 1909). Cocos-Keeling Is: 52.9 (50–54; 10) x 36 (34–37) (Gibson-Hill 1948b). Christmas I.: 53.3 (51–56; 30) x 36.1 (35–38) (Gibson-Hill 1949b).

Clutch-size One (Hogan 1925; Hindwood 1940; Gibson-Hill 1949b; North); 1–2 eggs (King 1985c).

Laying Will re-lay if egg removed, up to three times (Gibson-Hill 1947). No other information.

Incubation By both sexes. Shifts normally short; may make up to five change-overs in a day. Eggs seldom unattended for long; on occasions, sitting birds fly to water for a few minutes to moisten feathers (Gibson-Hill 1947, 1949b). Once, a disturbed bird said, unbelievably, to pick up egg or fly off, carrying egg to new position (Hogan 1925); confirmation needed. If 1- or 2-day-old chick replaced by an egg, adults begin incubating again; if chick older, take little notice of egg or try to remove it from nest (Gibson-Hill 1947). Six eggs hatched between sunrise and noon (Gibson-Hill 1947). **INCUBATION PERIOD:** 33–35 days (n=8) (Gibson-Hill 1949b); c. 35 days (Hutton 1991). Extraliminally, 32–35 days (HASB).

Young Semi-precocial. Hatch in down. Remiges, and feathers on back and shoulder, visible at 7 days, rectrices soon after; by 12 days, feathers can be seen through tuft of upper body; by 20–22 days, down confined to a few tufts on belly, wing-coverts and throat (Gibson-Hill 1947, 1949b). Young keep to nest until able to fly (Reithmüller 1931); will run from nest and fall down through bushes if disturbed (Warham 1956). **Growth** Measurements (mm) of newly hatched chick: length, 114.3; tarsus, 17.5; extended wing, 44.5; bill, 19.1; extended claws, 25.4; hindtoe, 4.8 (Tarr 1949). Growth of one chick (Gibson-Hill 1947) in Table 1. **Parental care, Role of sexes** Parents said to brood for 24 h, changing over between 05:00 and 06:00 (Serventy 1959). Towards end of first week, young usually left alone for most of day (Gibson-Hill 1947). At first, chick fed at short intervals of 2–4 h and food liquid; towards end of first week, food brought 5–6 times/day, and more nearly solid (Gibson-Hill 1947, 1949b). Chicks pick food from partly opened bill of adult (Warham 1956); take food from bill and also reach into gullet (HASB).

Table 1

Age (Days)	1	5	9	11	13	15	19	21	25	29
Length	108	143	177	196	210	220	247	258	267	307
Gapr	22	25	28.5	30.5	33	34	37	39	42	46
Wing (Flat)	–	–	–	–	–	56	78	89	117	148
Longest Primary	–	–	–	8	17	26	39	43	60	65
Longest Rectrix	–	–	–	6	14	16	22	25	34	48

Fledging to maturity **FLEDGING PERIOD:** Can fly a little at 35 days and begin to fly at c. 40 days (Gibson-Hill 1947, 1949b); fledge at c. 50 days (Hutton 1991); 7–8 weeks (n=1) (Davis 1923). From 29 days, chicks, though still unable to fly, liable to jump off rock ledges into sea when approached (Gibson-Hill 1947). On Christmas I., remain near nest-ledge and return there to be fed for a number of weeks after fledging (Gibson-Hill 1947).

Success On Michaelmas Cay, fledging success 22.5–78.6% (King *et al.* 1992). Silver Gulls take unguarded eggs (Tarr 1949); Silver Gulls, Buff-banded Rails *Gallirallus philippensis*, lizards and crabs take eggs and chicks (HASB). On Cocos-Keeling Is, eggs sometimes taken for food by people and a few nestlings taken as pets (Stokes *et al.* 1984). Eastern Reef Egrets *Egretta sacra* take young, mostly nestlings that have fallen from nests (Recher & Recher 1972). If very young chick handled, adults on occasions said to peck it to death (Reithmüller 1931). Cyclones can cause complete nesting failure (King 1985c; Walker 1989); cold weather and rain will drive birds from colony for a few weeks, leading to destruction of eggs and chicks; many colonies destroyed by eggng activity of fishermen (HASB).

PLUMAGES Prepared by K. Bartram. Timing of moults dependent on timing of breeding. Finish post-natal moult to juvenile plumage when c. 42 days old (Petit & Wittow 1983); some variation in coloration of crown in juveniles. Then undergo a complete post-juvenile (first pre-basic) moult to first immature non-breeding (first pre-basic) plumage. Subsequent plumages poorly understood and difficult to identify. Not known when adult plumage attained. Adults undergo two moults annually: a complete and protracted post-breeding moult, and a partial pre-breeding moult, with no seasonal change in appearance. Sexes similar. Subspecies *pileatus* breeds HANZAB region and described below.

Adult (Definitive basic and alternate). **Head and neck** Forehead and forecrown, smoky-white, grading to brownish grey (brownish 80–85) or bluish grey (bluish 85–84) on hindcrown and further darkening to brownish grey (79 or brownish 85) on hindneck. Lores, grey-black (82), dark brownish-grey (brownish 82–83) or dark grey (83) with solid grey-black (82) patch in front of eye, extending narrowly round eye; broken partial white eye-ring forms small spot on upper rear half of eye and white crescent below eye. Thin grey-black (82) stripe extends over base of bill to join grey-black patch in front of eye and separated from pale cap by indistinct fine white line (supercilium), extending across lower forehead to behind eye. Rest of head and neck, brownish grey (83–84) palest on chin and front of face. **Upperparts** Mantle and scapulars, brownish grey (28–84); back, rump and uppertail-coverts, slightly paler, brownish grey (80–85). Upperparts become grey-brown (91–28) with wear. **Underparts** Brown (28), sometimes with grey tinge (85–28). Axillaries, brownish grey (80) to light grey (85). **Tail** Dark brown (219), becoming darker (119A) with wear; undertail has glossy sheen. Shafts, red-brown (219A) above, brown (121B) below. **Upperwing** Secondary coverts and tertials, brown (28–29) with slightly paler (28–27) fringes at tips of coverts; marginal and smaller lesser coverts contrastingly darker brown. Primaries, secondaries and median and greater primary coverts, dark brown (121–121A). Shafts, dark brown (121A) on outer primaries, grading to slightly darker brown (121) on secondaries. **Underwing** Coverts, greyish olive-brown (c29) to grey-brown (dark 91) with broad brownish-grey (80–85) edges; some coverts dark

grey (83); lining appears mottled. Remiges, dark brown (121) with silvery sheen and slightly paler fringes; shafts, brown (121B–121C) on outer primaries, grading to dark brown (121) on secondaries.

Downy young Head and underparts, creamy white, with dark-brown (119A) patch in front of eye. Upperparts, pale grey-brown (pale 119D) with brown (27) tips to down.

Juvenile Vary greatly in coloration of cap, from silver-white, brighter than in adult, to dark brown, lacking white cap completely; in Aust., most birds have dark crowns. **DARKEST BIRDS:** Differ from adult by: **Head and neck** Forehead and crown, light grey-brown (27) or dark brown (119A) with thin light-brown (27–25) to pale-buff fringes to feathers in fresh plumage; hidden bases of feathers, grey (85). Thin dull-white to dirty pale-grey (brownish 85–86) supercilium extends across lower forehead to behind eye. Hindneck, brown (27–28 or 28), concolorous with rest of head and without grey tones of adult. **Upperparts** Browner (27–28) than adult, with light grey-brown (27) fringes to feathers of mantle, and dull whitish-grey (pale 86) fringes to scapulars. **Underparts** Centre of belly to vent, light grey-brown (45–27) with slightly paler fringes. **Upperwing** Coverts and tertials, brown (27–28) with light grey-brown (27–119D) fringes. Primaries and secondaries have faint white fringes at tips. **Underwing** Like adult but with dull pale-grey (86) fringes to coverts. **PALEST BIRDS:** Range of white-capped juveniles poorly known. Many on Lord Howe and Christmas Is and at least some from Great Barrier Reef have white caps (Dunlop 1987; D.W. Eades). Differ from adult by: **Head and neck** Forehead and forecrown, silver-white, continuous with ill-defined silver-white supercilium extending to above ear-coverts; hindcrown to rear of nape, silver-white, with dark-brown (119A) centres to feathers, appearing mottled or streaked darker; hidden bases of feathers, dark brown (119A).

First immature non-breeding (First basic). Head-pattern like that of juvenile; rest of plumage like adult, lacking paler fringes to feathers of juvenile.

Subsequent immature plumages Not known.

BARE PARTS From photos (Coates 1985; Harrison 1987; Pringle 1987; unpubl.: D.W. Eades) and museum labels (AM, ANWC, HLW, WAM). **Adult, Juvenile** Bill, glossy black; inside of mouth, orange. Iris, black-brown. Legs and feet, grey-black (82) with red-brown or brown tinge to tarsus and toes. **Downy young** Iris, black-brown. Bill, legs and feet, grey-black (82).

MOULTS Based mostly on Dunlop (1987), Dorward & Ashmole (1963) and BWP. Very little known of moult at sea in HANZAB region. **Adult post-breeding** (Definitive pre-basic). Usually complete. Primaries outwards. Timing of moult dependent on timing of breeding, which varies greatly between populations and islands; subtropical Aust. populations breed during summer; tropical populations can breed nearly throughout year (see Breeding). Atypically for terns, often begin moult of primaries while feeding young. On Christmas I., suspend pre-breeding moult after moulting inner few primaries (usually p1–p3); moult restarts in winter, when incubating, and primaries re-start where suspended, usually at p4. Elsewhere, where moult completed before breeding, p1 usually shed 2 months after chick hatches. All primaries replaced 6.5–7 months after p1 shed. Most of tail moulted when PMS 10–40; sequence usually t1–t6–t3–t2–t4–t5; often asymmetrical. Moult of most of head, body and wing-coverts finished when PMS 20–40. First moult sides of head and scattered feathers of

mantle and scapulars, followed by throat, breast, smaller lesser coverts, rest of head (nape usually later), upperparts and underparts, and finishing with rest of wing-coverts. **Adult pre-breeding** (Definitive pre-alternate). Partial. Poorly understood, probably varies according to frequency of breeding. Tropical breeders have shorter interval between nesting attempts and therefore have less time to complete pre-breeding moult; probably only involves some feathers of body and a few rectrices. In annual breeders, moult head, upperparts, throat, breast and some to all rectrices. On Christmas I., most birds replace inner primaries, some still doing so when post-breeding moult starts. Failed breeders often continue pre-breeding primary-moult uninterrupted, and probably complete moult when others midway through post-breeding moult. **Post-juvenile** (First pre-basic). Complete. Begins with scattered feathers of head and upperparts and then p1, 7–11 months after hatching. When PMS 10–30, head, body, tail, secondaries (s1–s2 last), and wing-coverts in heavy moult; all feathers of body replaced when 11–14 months old. **Second pre-breeding** (Second pre-alternate). Not known if complete. Starts at same time as adult post-breeding moult. Begin moult of primaries when 12–15 months old, before post-juvenile moult of primaries completed and plumage of head and body still fresh. Thus show two active moult foci in primaries, in contrast to all but failed breeding adults (see above). Begin moult of sides of head, throat, breast, mantle and scapulars when post-juvenile moult of primaries finished and PMS of second series c. 20. No information on subsequent moults.

MEASUREMENTS (1–3) Aust., adult, skins; Bill D(N) = depth of bill at basal end of nostril; Bill D(G) = maximum depth of bill at gonys (AM, ANWC, HLW, MV, QM, SAM, WAM): (1) Aust. except WA and Lord Howe I.; (2) WA; (3) Lord Howe I.

	MALES	FEMALES	
WING	(1) 283.3 (3.41; 280–290; 7)	273.2 (4.96; 270–283; 6)	**
	(2) 272, 272	264.5 (2.65; 262–268; 4)	
	(3) 284.0 (4.00; 276–289; 13)	276.4 (6.02; 266–286; 7)	*
TAIL	(1) 157.5 (5.37; 150–167; 8)	153.5 (3.89; 147–158; 8)	ns
	(2) 148.2 (3.27; 143–151; 5)	151.3 (5.12; 146–157; 4)	*
	(3) 159.9 (4.23; 154–168; 11)	156.4 (5.13; 149–164; 7)	**
BILL	(1) 40.8 (1.01; 39.5–41.9; 7)	38.1 (2.51; 33.8–41.6; 9)	*
	(2) 40.4 (2.02; 37.2–42.7; 5)	38.5 (1.33; 36.6–40.2; 5)	
	(3) 41.8 (1.04; 40.6–43.5; 9)	39.4 (1.37; 37.7–40.9; 6)	*
BILL D(N)	(1) 9.3 (0.51; 8.8–10.2; 7)	8.7 (0.37; 8.2–9.4; 9)	*
	(2) 8.6 (0.27; 8.4–9.0; 5)	7.8, 8.2, 8.2	
	(3) 9.8 (0.27; 9.5–10.3; 10)	8.9 (0.16; 8.7–9.1; 6)	**
BILL D(G)	(1) 8.4 (0.21; 8.2–8.8; 7)	7.5 (0.39; 7.0–8.1; 9)	**
	(2) 8.1, 8.6	7.1 (0.33; 6.6–7.4; 5)	
	(3) 8.7 (0.21; 8.4–9.1; 11)	7.8 (0.23; 7.4–8.0; 6)	**
TARSUS	(1) 26.1 (0.56; 25.0–26.7; 9)	25.7 (0.57; 24.9–26.6; 9)	ns
	(2) 25.2 (0.74; 24.3–26.1; 4)	24.7 (1.16; 23.4–26.2; 5)	ns
	(3) 26.3 (0.53; 25.2–26.9; 11)	25.3 (1.03; 24.4–26.9; 7)	**
TOE C	(1) 39.3 (1.29; 37.8–41.0; 8)	38.1 (0.85; 36.8–39.2; 9)	ns
	(2) 37.4 (0.84; 36.7–38.2; 4)	36.0 (1.50; 33.5–37.3; 5)	
	(3) 39.5 (1.44; 36.6–41.5; 10)	37.7 (1.13; 36.4–39.4; 7)	**

Populations in WA smaller than other populations in HANZAB region, though samples small; when sexes combined, wing, middle toe and claw, bill-depth at nostril, tail and tarsus significantly smaller. Populations on Lord Howe I. slightly larger than other Aust. populations, with significantly deeper bill (especially in males).

(5–6) Throughout Aust. range; unsexed birds and sexes combined (AM, MV, QM, WAM): (5) Juveniles; (6) First-year birds.

UNSEXED	
WING	(5) 264.5 (16.48; 238–280; 6) (6) 268, 286
TAIL	(5) 136.2 (5.54; 128–141; 5) (6) 149, 151
BILL	(5) 35.2 (1.38; 34.0–37.1; 4) (6) 39.7 (1.89; 37.0–41.3; 6)
BILL D(N)	(5) 8.0 (0.93; 7.0–9.0; 5) (6) 8.3 (0.45; 7.8–9.0; 6)
GONYS	(5) 7.1 (0.43; 6.3–7.5; 6) (6) 7.5 (0.4; 6.9–8.1; 6)
TARSUS	(5) 25.8 (0.56; 24.9–26.4; 6) (6) 25.8 (0.65; 24.9–26.5; 6)
TOE C	(5) 37.5 (2.43; 33.1–39.7; 6) (6) 38.5 (1.58; 36.2–40.4; 5)

Juveniles smaller than first-year birds, though samples small. For additional data, see BWP.

WEIGHTS Few data from HANZAB region. Aust., adults; from museum labels (AM, ANWC, QM, WAM): males, 196.4 (23.99; 172–225; 5); females, 164, 165, 188. Other weights: emaciated adult female, Darwin, 96 g; juvenile, 110 g; first-year bird, 112 g. For extralimital data, see BWP.

STRUCTURE Wings, long, broad and pointed. Eleven primaries: p10 longest, p9 1–7 mm shorter, p8 11–23, p7 33–45, p6 53–58, p5 73–91, p4 93–111, p3 113–135, p2 131–153, p1 145–167; p11 small (c. 33 mm), pointed; no emarginations. Nineteen secondaries, including six tertials; tertials and secondaries well defined. Longest tertials reach to p4 or p5 on folded wing. Three moderately developed humerals. Tail, long and wedge-shaped, with notch in centre; 12 rectrices; adult: t3 longest, t1 6–17 mm shorter, t2 2–10, t4 4–14, t5 15–31, t6 53–59; juveniles have smaller notch and shorter tail: t3 longest, t1 6–9 mm shorter, t2 2–6, t4 2–5, t5 13–20, t6 37–45. Bill, stout, only slightly longer than length of head (see Measurements); in profile, almost straight basally, with distal half of culmen decurved; gonys, curved and distinctly angled. Tarsus, short (but longer than in most terns); slender, with rounded profile; scutellate, square at front. Toes, long for tern (see Measurements); webs between front toes slightly incised; outer toe c. 88% of middle, inner c. 73%, hind 21%.

SEXING Males slightly larger, with thicker bill and larger gonys (see Measurements); also see Chardine & Morris (1989) for extralimital data.

GEOGRAPHICAL VARIATION Slight. Four subspecies usually recognized, differing in coloration of head and body, and in size. Coloration varies much with bleaching and wear, making subspecific identification of individuals difficult. Only one subspecies, *pileatus*, recognized in HANZAB region.

Nominate *stolidus* (Atlantic Ocean) differs from Aust. populations by: whiter cap; paler lores; and paler-grey rest of head and upperparts. Subspecies *ridgewayi* (w. Central America), slightly darker than nominate but very similar to Aust. birds. Subspecies *galapagensis* (Galapagos Is) is much darker than other populations: almost black, with dark-grey

cap and pale-grey supercilium. For further details of extralimital variation, see BWP.

Slight variation within HANZAB region. Populations in sw.. WA smaller (see Measurements) and paler than populations elsewhere in Aust. (*contra* BWP, see below): (1) lores vary from grey (85–84) to dark grey (84–83), always contrasting with grey-black (82) line between lores and cap (other Aust. populations have little or no contrast within lores); (2) head, slightly paler, especially throat, which is grey (83–84) (not dark grey [82–83]); and (3) upperparts greyer (olive 84).

Population on Bedout I., nw. WA, appears identical in coloration to other Aust. populations (two specimens examined). Mathews described a subspecies, *gilberti*, from Bedout I., nw. WA, but included all Aust. populations (including Norfolk I.) within this (not just WA birds). Suggestion by BWP that WA birds darker possibly based on descriptions of *gilberti* by Mathews.

Populations on Lord Howe I. (and probably Norfolk I.) similar to other Pacific Ocean populations in HANZAB region but with thicker bill and greater difference in size between sexes (see Measurements).

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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
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