

Order CHARADRIIFORMES

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

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

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

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

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

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

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

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

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Family LARIDAE skuas, jaegers, gulls and terns

A large assemblage of small to very large charadriiform seabirds. We recognize four subfamilies within the Laridae following Mayr & Amadon (1951), AOU (1983).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*, *albostrigata*, *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 caspia Caspian Tern

COLOUR PLATE FACING PAGE 576

Sterna caspia Pallas, 1770, *Novi Comment. Acad. Scient. imp. Petropol.* 14 (1): 582, pl. 22, fig. 2 — Caspian Sea.

Specifically named after the type-locality (Latin *Caspius*, of the Caspian Sea).

OTHER ENGLISH NAMES Taranui.

MONOTYPIC

FIELD IDENTIFICATION Length 47–54 cm; wingspan 130–145 cm; weight c. 680 g. Largest tern. Huge gull-like tern, with deep dagger-shaped bill on big angular head; bulky body, with deep rounded belly and rather short tail with shallow fork; very long narrow wings; and long legs. Pale grey above and white below, with black cap and short crest; huge red bill; and diagnostic wholly dark outer primaries on underwing. Flight recalls that of large gulls: steady and purposeful, with slow heavy wing-beats. Hoarse heron-like croaking call, distinctive. Sexes alike. Slight seasonal variation. Juvenile and immatures separable.

Description Adult breeding Forehead, crown and nape, black, forming cap with short crest; cap can be finely speckled white. Rest of head and neck and underbody, white. Upperparts, pale grey, with contrasting white rump and tail, and indistinct

white trailing-edge to wing. Upperwing varies with wear and moult: uniform pale grey or with slightly darker outer primaries, which gradually darken, especially at tips, producing contrasting dusky wedge, with darker blackish trailing-edge on outerwing. Underwing, white, with diagnostic blackish-grey outer primaries. Bill, red, usually with narrow dusky subterminal band and tiny pale tip. Iris, brown or red-brown. Legs and feet, black, with orange to pink soles. **Adult non-breeding** Differ from breeding by: Much white streaking on cap, appearing palest, even white, on lores, forehead and forecrown (cap can appear grey at distance); black mask extends from in front of eye to ear-coverts, with narrow white eye-ring; some also develop white patch round eye. Upperwing: dark wedge on outerwing, darker, dull black, and contrasting more with rest of wing. Tail darkens to brownish grey with wear, with pale-

grey centre during moult. Tail can be grey in some, contrasting with white uppertail-coverts. Bill slightly duller, orange-red, with broader black subterminal ring (sometimes covering entire tip). **Juvenile** Similar to adult non-breeding, differing by: Head-pattern similar but with faint brown tone when fresh; forehead and crown become paler with wear. Upperparts vary: mantle, scapulars, tertials and innerwing-coverts, pale grey, broadly scaled paler; heavily marked birds have bold dull-black marks on saddle, tertials and inner few wing-coverts, appearing coarsely patterned; in palest birds, dark marks absent or restricted to larger scapulars and tertials. Rump and uppertail-coverts, white, mottled in centre with pale grey and varying dark spots; in heavily marked birds, may be coarsely marked as saddle. Tail, pale grey, with narrow white edges and tip; some have grey-black tips to central feathers, others a broader and more complete dark subterminal band. Upperwing: pale grey, grading to darker grey on outer primaries and their coverts, with narrow white trailing-edge, broad white tips to all coverts, and faint darker grey cubital and secondary bars, latter becoming darker and more obvious with wear. Bill shorter at first; duller orange-red, often with larger black subterminal band. Legs and feet, greyish yellow to dark red-brown or dull brownish-orange at first, soon turning black. **Transition to first immature** Post-juvenile moult protracted and gradually attain non-breeding plumage like adult non-breeding. During transition to first immature non-breeding distinguished by: In early stages, head-pattern, saddle, rump and uppertail-coverts as adult non-breeding with rest of plumage as juvenile; some have much white on lores, forehead and forecrown; and dusky cubital and secondary bars, outerwing and tail become darker with wear. Later, much as adult non-breeding but retain dark worn juvenile plumage: faint dusky cubital bar; contrasting dark secondary bar; and dark outer primaries and primary coverts, forming prominent long dark wedge on outerwing. Bare parts as adult non-breeding. **First immature (non-breeding and breeding)** Inseparable from adult non-breeding.

Similar species None.

Gregarious when breeding; at other times, usually seen singly or in small groups, though often roost and loaf with other terns. Inhabit wide variety of coastal habitats, especially estuaries and sandy beaches, and inland wetlands, especially large lakes and rivers. When perched, look powerful and broad-shouldered; carriage rather horizontal, with stocky outline. Huge red bill and flat head with short crest and angular nape give fierce impression; adopt markedly upright stance when alert or in display. Appear huge beside other terns, standing much taller; folded primaries project well beyond tip of tail. Gait less free than other terns, with rather waddling walk and lurching run. Sit on water, riding buoyantly. Flight more gull-like than that of other terns: purposeful and steady, with usually deep powerful strokes of long pliable wings, though wing-beats sometimes slow, stiff and shallow, appearing somewhat pliable on downstroke. When foraging, patrol in slow lazy flight, 3–15 m above water, with downwards-pointing bill emphasizing front-heavy appearance; pause to hover before making dramatic plunge after fish, or turn and dive in manner recalling hunting harrier, often breaking off dive near surface of water; overall impression rather gannet-like. In direct flight, bill held horizontal. Usual flight call, loud hoarse heron-like croaking *kaa-a*, audible at some distance; also deep raucous *kra-kra-kra-uh* or *kra* when alarmed. Begging juveniles utter high-pitched whistling *pee-a-ee* in flight or when perched.

HABITAT Mostly sheltered coastal embayments, including

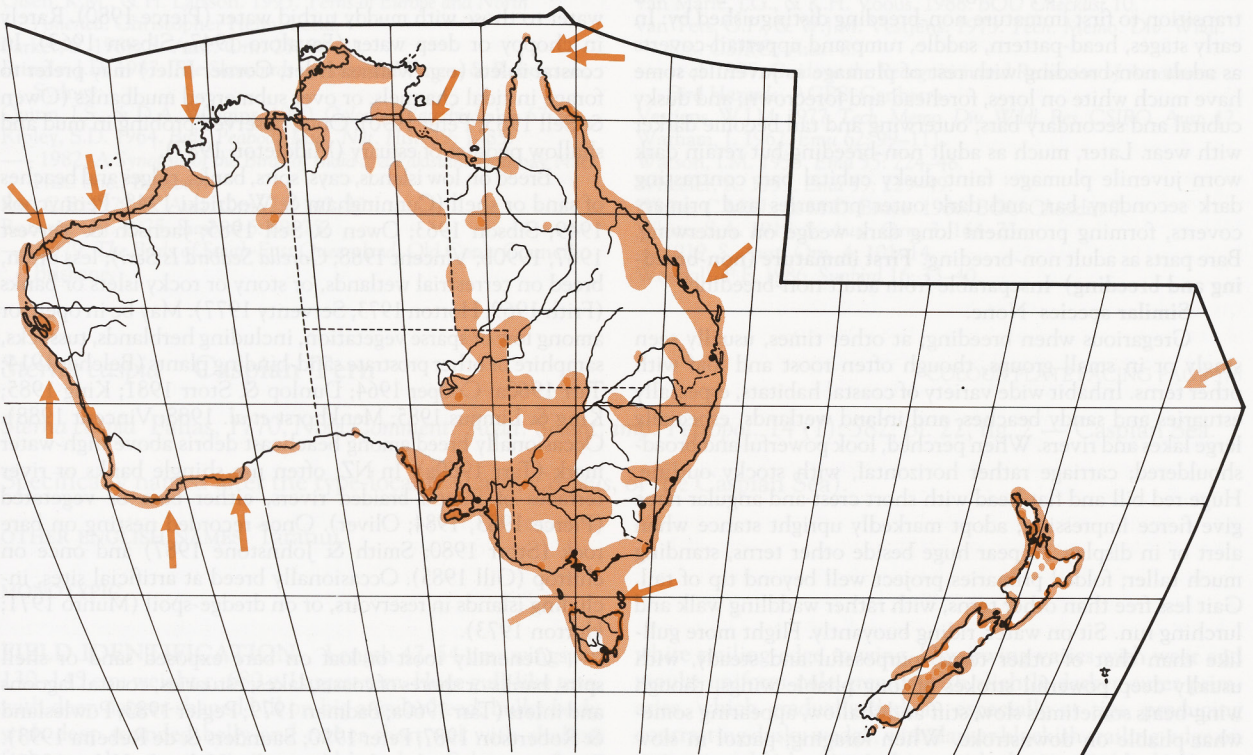
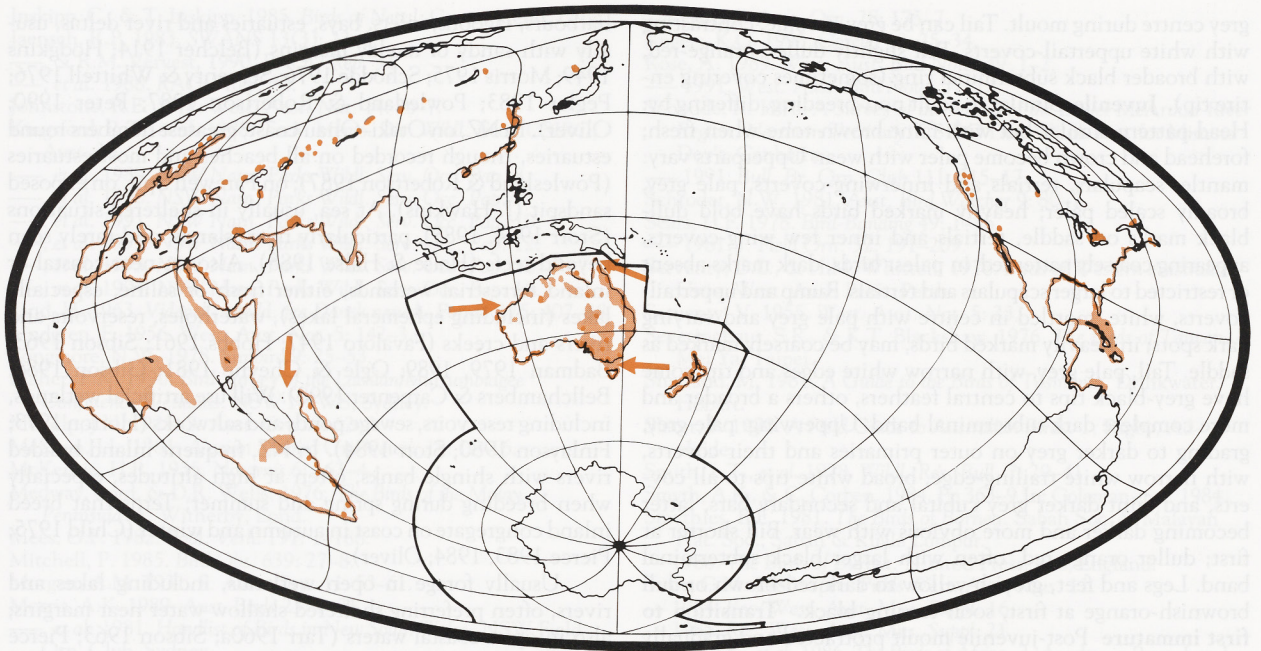
harbours, lagoons, inlets, bays, estuaries and river deltas, usually with sandy or muddy margins (Belcher 1914; Hodgkins 1949; Morris 1975; Schodde 1976; Serventy & Whittell 1976; Pegler 1983; Powlesland & Robertson 1987; Peter 1990; Oliver). In NZ, on Otaki–Ohaou coast, greatest numbers round estuaries, though recorded on all beaches and most estuaries (Powlesland & Robertson 1987); on Farewell Spit, on exposed sandspit (J. Hawkins). At sea, usually in sheltered situations (Storr 1984, 1985), particularly near islands, and rarely seen beyond reefs (Halse & Halse 1988). Also on near-coastal or inland terrestrial wetlands, either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs and rivers and creeks (Favaloro 1947; Hobbs 1961; Sibson 1963; Badman 1979, 1989; Ogle & Cheyne 1981; Gibson 1986; Bellchambers & Carpenter 1990). Will use artificial wetlands, including reservoirs, sewage ponds and saltworks (Horton 1973; Finlayson 1980; Storr 1984). In NZ, frequent inland braided rivers with shingle banks, often at high altitudes, especially when breeding during spring and summer; Terns that breed inland congregate on coast in autumn and winter (Child 1975; Pierce 1983, 1984; Oliver).

Usually forage in open wetlands, including lakes and rivers, often preferring sheltered shallow water near margins; also in open coastal waters (Tarr 1960a; Sibson 1963; Pierce 1983, 1984; Oliver; Vic. Atlas). Prefer wetlands with clear water to those with muddy turbid water (Pierce 1980). Rarely in choppy or deep water (Favaloro 1947; Sibson 1963). In coastal inlets (e.g. Waimea Inlet, Corner Inlet) may prefer to forage in tidal channels, or over submerged mudbanks (Owen & Sell 1985; Peter 1990). Once observed probing in mud and shallow puddles of estuary (Middleton 1987).

Breed on low islands, cays, spits, banks, ridges and beaches of sand or shell (Cunningham & Wodzicki 1948; Pennycook 1949; Sibson 1963; Owen & Sell 1985; Jaensch & Vervest 1987, 1990b; Vincent 1988; *Corella Seabird Is Ser.*); less often, breed on terrestrial wetlands, or stony or rocky islets or banks (Frith 1969; Horton 1973; Serventy 1977). May be in open, or among low or sparse vegetation, including herblands, tussocks, samphire or other prostrate sand-binding plants (Belcher 1914; Tarr 1960a; Cooper 1964; Dunlop & Storr 1981; King 1985; King & Limpus 1985; Menkhorst *et al.* 1988; Vincent 1988). Occasionally breed among beachcast debris above high-water mark (Tarr 1960a). In NZ, often use shingle banks or river terraces of inland braided rivers, either bare or vegetated (Pierce 1983, 1984; Oliver). Once recorded nesting on bare rock (Storr 1980; Smith & Johnstone 1987) and once on cliff-top (Gill 1985). Occasionally breed at artificial sites, including islands in reservoirs, or on dredge-spoil (Munro 1971; Horton 1973).

Generally roost or loaf on bare exposed sand or shell spits, banks or shores of coasts, lakes, estuaries, coastal lagoons and inlets (Tarr 1960a; Badman 1979; Pegler 1983; Powlesland & Robertson 1987; Peter 1990; Saunders & de Rebeira 1993). Rarely on exposed reefs at low tide (Halse & Halse 1988). Usually near, but not in, water; rarely, in shallows (Cooper 1964) or on debris in shallows (Favaloro 1947). In NZ, also recorded on banks and spits of shingle in braided rivers, on marshy flats, and silica flats of inland volcanic lakes (Sibson 1963; CSN). May shelter behind coastal sand-dunes or on near-coastal lakes in bad weather (Storr 1987; Dale 1988).

DISTRIBUTION AND POPULATION Breed at widely scattered sites in North America, Europe, Africa, Asia and A'asia. In North America: from Washington S through w.



Nevada to w. Mexico and inland in nw. Wyoming and n. Utah; from s. Mackenzie and ne. Alberta, through Saskatchewan, Manitoba and North Dakota, to s. Ontario and Michigan; Newfoundland and s. Quebec, and farther S on Atlantic coast, from Virginia to South Carolina; also Gulf of Mexico, from Florida to Texas. In Africa: in Madagascar, Mozambique (round Zambezi R. delta), South Africa, Namibia, between Guinea-Bissau and Mauretania, Tunisia, and Egypt. In Eurasia: on shores of Baltic Sea and n. Gulf of Bothnia, central Turkey, n. Black Sea, shores of Caspian Sea, including delta of Volga R.,

and in belt from Aral Sea, E through L. Balkhash to L. Baikal. Elsewhere in Asia: round Red Sea, Persian Gulf, w. India, and n. Sri Lanka; also China, scattered from Hainan N to n. coast of Yellow Sea; and near Vladivostok. In Aust. and NZ. During non-breeding season: Pacific coasts of North America, from central California S to Baja California, and along Atlantic coast from North Carolina S along Atlantic-Gulf coasts through e. Mexico and Central America to n. Colombia and Venezuela; also Bahamas and Greater Antilles. Occur along Atlantic coasts of continental Europe, from Straits of Gibr-

tar NE to Baltic Sea and n. Gulf of Bothnia; in Mediterranean, along coasts from Straits of Gibraltar N to mouth of Rhone R.; Italy and Sicily; from Albania to Aegean Sea, and through Sea of Marmara to w., n. and far e. coasts of Black Sea. In Africa, from n. Morocco, along s. Mediterranean coasts to Egypt and S along Nile R. and Red Sea—Indian Ocean coasts to L. Victoria and ne. Tanzania; in s. third, along course of Zambezi R. from coastal Mozambique inland to n. Botswana and ne. Namibia; Madagascar; coasts from ne. South Africa to nw. Angola; and from central Zaire, along middle reaches of Congo R., N to s. Chad and then W to coasts from Gulf of Guinea to Mauritania, and inland S of Niger R. In Asia, coasts of Red and Caspian Seas; also n. Arabian Pen. and Persian Gulf, Indian coasts to n. Bay of Bengal; Taiwan and e. Chinese coast from Kwangtung to Liaoning Provinces; A'asia (Blake 1977; AOU 1983; de Schauensee 1984; Urban *et al.* 1986; BWP).

Aust. Widespread on coast and inland in E. **Qld** Widespread in coastal regions from s. Gulf of Carpentaria to Torres Str., and along e. coast. Scattered records inland in central districts; many records in w. districts, especially L. Eyre Drainage Basin, from round Cunnamulla, NW to Gulf Country N of Mt Isa and Cloncurry (Qld Bird Reps; Aust. Atlas). **NSW** Widespread E of Great Divide, mainly in coastal regions. W of Great Divide, a few scattered records on Slopes and Plains, but widespread records in Riverina and Lower and Upper Western Regions, with occasional records elsewhere (NSW Bird Reps; Aust. Atlas). **Vic.** In most coastal regions. Scattered records throughout w. half, including Murray Valley (Vic. Atlas). **Tas.** Widespread King I. and Furneaux Grp, and entire coast (Thomas 1979; Tas. Bird Reps; Aust. Atlas). Once recorded inland at Great L. (Tas. Bird Rep. 12). **SA** Along coasts, from Carpenters Rocks in SE, to Nuyts Arch. and Ceduna, with isolated record at Yalata Aboriginal Reserve (near Nundroo) (Aust. Atlas). Inland along Murray R., with many records in NE, from L. Callabonna, N to L. Goyder, and W to L. Eyre. Other n. records, at Algebuckinna and Oolgawa Waterhole (95 km NNE of Oodnadatta) (Badman 1979, 1989; Kingsford & Porter 1993; Aust. Atlas). **WA** Widespread in coastal regions, from Great Aust. Bight to Dampier Pen. Sparsely recorded on coasts E of King Sound. A few scattered records in e. regions, inland from Cambridge Gulf, S to Sturt Ck and L. Gregory (Aust. Atlas). **NT** Scattered records round much of coast; sparse inland records from L. Nash, NE to Victoria R. Downs (Storr 1977; Boekel 1980; Aust. Atlas; H.A.F. Thompson & D.K. Goodfellow).

NZ May have colonized NZ recently; rarely recorded during nineteenth century, but now firmly established and common (Sibson 1992). **NI** Widespread on coasts N of line from Kawhia Harbour to mouth Waioeka R., including Auckland Isthmus, Coromandel Pen. and most of Bay of Plenty. Also recorded mouth Waiau R.; records widely scattered along most of e. coast, especially between East Cape and Mahia Pen., in n. and w. Hawke Bay, and from Porangahau to near Honeycomb Lighthouse; more widespread along s. and sw. coasts from C. Palliser to Kakaramea. Scattered Taranaki records from C. Egmont to near Awakino. Inland records include: L. Waikare; Volcanic Ls, including Ls Rotorua, Rotama and Rerewhakaaitu; Waikato R.; L. Taupo; Manawatu R.; and L. Wairarapa (Sibson 1992; CSN; NZ Atlas). **SI** Most widespread along coasts of Nelson and Marlborough, from Kahurangi Pt to C. Campbell; isolated records Kaikoura; widespread from n. Pegasus Bay, S to Otago. Within Canterbury, also widespread inland, from Upper Wilberforce R., S to Ahuriri and Waitaki Rs. In Southland, once recorded Catlins L., but many

records on coast from near Chaslands Mistake, W to Te Waewae Bay, and inland (N) to upper Oreti R. In West Coast, scattered records between Big Bay and mouth of Haast R., but more widespread from Heretaniwha Pt to Karamea (CSN; NZ Atlas).

Kermadec Is Single, 29 Jan. 1967 (Merton 1970). Unconfirmed record, before 1890 (Cheeseman 1890).

Chatham Is Single, Chatham I., 7 Dec. 1985 (Imber 1994).

Breeding Aust. Widespread, mainly at scattered coastal sites, but occasionally inland. **Qld** Wellesley Is, se. Gulf of Carpentaria; islands off far n. coast, from Bird I., S to Three Isles, and from islands round Shoalwater Bay, including Pelican Rock, S to Fairfax Is (Walker 1987, 1992; King 1993; McLean 1993; Walker *et al.* 1993a,b; Aust. NRS; Aust. Atlas). Inland at Ls Bindegolly and Moondarra (Carruthers 1964; Horton 1973, 1975; Qld Bird Rep. 1984; Aust. NRS). **NSW** Menindee Ls (Morris *et al.* 1981). **Vic.** Scattered sites, including: Goodwin Sands, Mallacoota; Mann's Beach; Ram's Head, off French I.; Mud Is; Airey's Inlet; Port Fairy; and Yambuk (Menkhorst *et al.* 1988; Vic. Bird Rep. 1987; Aust. NRS; Aust. Atlas). Inland at Mildura (Vic. Bird Rep. 1987). **Tas.** Widespread Furneaux Grp and widespread at scattered sites on entire coast (Tas. Bird Reps; Aust. NRS; Aust. Atlas). **SA** Widespread along coasts from The Coorong, NW to Ceduna (Aust. NRS; Aust. Atlas). Inland at Ls Eyre and Goyder (Paine 1976; ABBBS 1977; Badman 1989). **WA** Widespread from Arch. of the Recherche to Dirk Hartog I. and Faure I. in Shark Bay; also, Pilbara region from round Pt Cloates to North Turtle I.; rarely, in Kimberley Div., at Adele I., mouth Hunter R., Pascal I. and Myres I. (Ford 1965; Abbott 1979; Storr 1980, 1984; *Corella Seabird Is Ser.*; Aust. NRS; Aust. Atlas). Inland at L. Gregory (Jaensch & Vervest 1990a; Aust. NRS). **NT** Sandy I. No. 1 (Cobourg Pen.), Willy's Rocks and Sir Edward Pellew Grp (Schodde 1976; Aust. NRS; H.A.F. Thompson & D.K. Goodfellow). Colonies of >80 pairs or nests include: L. Gregory, WA, >812 nests, Aug. 1983 (Aust. NRS); West I., SA, c. 200 pairs, 1975–76 (Paton & Paton 1977); L. Moondarra, Qld, up to 200 pairs (Horton 1975); West Wallabi I., Houtman Abrolhos, WA, up to 80 pairs (Johnstone & Storr 1994). **NZ NI** Widespread sites on Auckland Isthmus, from Parengarenga Harbour, S to Waitemata Harbour and Waiheke and Pakatoa Is; also Coromandel Pen. and Bay of Plenty at Tauranga and Ohia Harbours, and mouths of Waioeka and Waiau Rs; on e. coast, on Mahia Pen., and at Porangahau; in S, isolated breeding at Palliser Spit; few breeding locations on w. coast, including Waitara, Kawhia Harbour and mouth Waikato R. Recorded inland at Meremere and L. Rotorua. **SI** Farewell Spit, Waimea, Nelson Boulder Bank, Wairau Lagoon and Bar, and L. Grassmere; widespread in Canterbury, with a few coastal sites, including Ls Ellesmere and Wainono; abundant on inland braided rivers, from upper Wilberforce and Rakaia Rs, S to Waitaki, Ahuriri and Hopkins Rs. In Southland, at Waituna Lagoon and Invercargill; West Coast records include mouths of Waitangitona, Whataroa, Arahura and Taramakau Rs (Gurr & Kinsky 1965; Muller 1969; Munro 1971; Edgar 1971, 1974; Pierce 1980, 1983, 1984; Foreman 1991; CSN). Colonies of >80 pairs or nests include: Papakanui Spit, Kaipara Harbour (Veitch 1979); Farewell Spit, c. 150 nests, 1985–86 (CSN 34, 35); Whangapoua, Coromandel Pen., 140 nests, 1979 (Jones 1980); Mangowhai Spit, c. 120 pairs, 1985–86 (CSN 34, 35); Waikato R. estuary, c. 100 nests, Nov. 1977 (CSN 25); Bowentown Shellbanks, 96 nests, Nov. 1988 (CSN 37).

Populations Aust. Indices of relative abundance from annual aerial surveys (transect counts) of wetlands in c. 12%

of land area of e. Aust., Oct. 1983–92 (Braithwaite *et al.* 1985a,b, 1986, 1987; Kingsford *et al.* 1988, 1989, 1990, 1991, 1992, 1993) were: 500–650; 1993; 229; 1100–2250; 140–250; 85; 346; 810; 2112; 2320 respectively. Numbers breeding Rottneest I. have increased since 1950s (Saunders & de Rebeira 1993). **NZ** Totals for winter and summer counts in Kawhia and Aotea Harbours, 1987–92 (Cuming 1994a,b) were: Kawhia Harbour: 1987, winter 17, summer, 8; 1988, 4, 21; 1989, 21, 36; 1990, 8, 20; 1991, 43, 37; 1992, 13, 4. Aotea Harbour: 1987, 17, 3; 1988, 5, 6; 1989, 3, 2; 1990, 11, 7; 1991, 11, 6; 1992, 5, 5.

In NZ, eggs formerly collected for food by Maori and Pakeha; the latter used them to bake Christmas cakes (Buddle 1951). A colony at Invercargill was disrupted by disturbance from photographers (CSN 20). At L. Moondarra, Qld, eggs trampled by cattle, and feral cats thought to have eaten chicks (Horton 1973). One nest deliberately destroyed by motorcycle riders (Pierce 1984). Occasionally become tangled in fishing nets (ABBBS 1984a), and, rarely, are shot at (ABBBS 1974).

MOVEMENTS Poorly known; in HANZAB area, partly resident, partly dispersive and, possibly, partly migratory. No evidence to support claims that at least partly sedentary (e.g. Williams 1973). Apparently follow watercourses inland, though occurrence at small lakes indicates at least some movement overland (Hobbs 1961; Sibson 1992); recorded flying over plains (NSW Bird Rep. 1973). Apparently move between islands (e.g. Storr 1964) and between islands and mainland (e.g. ABBBS 1979).

Where breeding occurs year-round or where breeding protracted, often considered resident (e.g. North West C., WA, Carter 1904; Rottneest I., WA, Storr 1964; Houtmann Abrolhos, WA, Storr 1966) and present throughout year in some areas, e.g. Darwin (Crawford 1972; McKean 1981). Considered dispersive in some areas (Morris 1975); at some places where breeding does not occur, recorded irregularly, with no apparent seasonal trends (Watson 1955). Some dispersion in response to rainfall, e.g. occasionally occur L. Frome, SA, in good seasons (McGilp 1923). Some evidence of large-scale seasonal movements; high reporting indices on Vic. coast in spring and summer, when breeding recorded, suggest movement into State (Vic. Atlas); reporting rates Tas. region, winter, 1%, summer, 10%, suggesting movement out of Tas. for winter (Aust. Atlas). Regular movement from colonies after breeding; at least some birds from different breeding populations appear to mix in non-breeding areas (e.g. Pierce 1984), and some evidence of birds from particular colonies moving to same non-breeding area each year (e.g. Barlow 1991). Timing of movements from colonies related to timing of breeding, which varies regionally, e.g. at Mt Isa, Qld, breed autumn and winter and most move away in summer; in NZ, breed spring and summer and most move away for autumn and winter (Horton 1973; see Falla *et al.* 1981). Direction of dispersal also varies between colonies, e.g. in NZ, some from Northland colonies move S to winter in Firth of Thames, Manukau or inner Waitemata; at Bluff, adults and juveniles disperse to N (Falla *et al.* 1981; see Sibson 1992); in Canterbury NZ, inland breeders appear to move to non-breeding grounds on coast (Pierce 1984).

Departure **NZ** After breeding, pairs and family groups from breeding grounds in coastal and inland Canterbury converge on coastal and inland river deltas and at coastal lagoons and lakes; all inland breeders appear to move to non-breeding areas on e. coast (Pierce 1984). Present Cass R., NZ, where

some breeding occurs, till Feb. (Pierce 1983). Leave Farewell Spit when breeding finished and numbers build up on Motueka Sandspit (not a nesting site) (J. Hawkins). At many areas, maximum numbers after breeding season, e.g. early Mar. at Manawatu R., NI; late Mar., Port Whangarei, NI (CSN 32, 37). Birds from Invercargill colony dispersed widely to N, with several recoveries as far as NI (Barlow 1991; CSN 37, 38). Also much movement of birds from Northland colonies, with banded bird recovered SI (see Banding). Influx into major non-breeding sites of Manukau Harbour and Firth of Thames possibly begins as early as late Dec. (Sibson 1992), though in 1989 numbers at Miranda, Firth of Thames, increased from Mar. (CSN 37). **Aust.** At L. Moondarra, Mt Isa, Qld, where breed May–Sept., few present from Dec. (Horton 1975); on Big Green I., Tas., where lay eggs about Nov., leave from Apr. (Norman 1970). In Aust., some sites where breeding does not occur show seasonal patterns consistent with passage, e.g. numbers at Tuggerah Ls, NSW, highest in spring and autumn and lowest in winter (NSW Bird Rep. 1991). Some birds may move from coastal breeding colonies to inland non-breeding areas; mostly recorded Murray R., sw. NSW, from Jan. (Hobbs 1961). In some areas, birds breeding on islands apparently move to nearby mainland coasts when not breeding (e.g. Storr & Johnstone 1988).

Non-breeding Seasonal trends indicate that many coastal areas used during non-breeding season: in NZ, high numbers at mouth of Opihi R. in winter (Pierce 1980); at Manukau Harbour and Firth of Thames, winter counts higher than summer counts (Sibson 1992); and fewer at Waimea Inlet in spring and early summer when many adults away breeding (Owen & Sell 1985). Numbers at Manukau Harbour and Firth of Thames, NZ, appear to be higher in years following successful breeding in Northland (e.g. 1957–60 and 1966–71, Sibson 1992). Some evidence birds from Invercargill colony move to same non-breeding area each year (e.g. Avon–Heathcote estuary, Barlow 1991). Also occur regularly at some non-coastal areas where breeding not recorded (e.g. Tinaroo Dam, Atherton Shire, Qld, Mar.–Dec., Bravery 1970). Recorded in some breeding areas in non-breeding period (e.g. Fisherman I., WA, Johnstone 1978); in NZ, some inland breeding areas occupied during non-breeding period, such as Rotorua (Sibson 1963) while others mostly deserted, such as Canterbury (Pierce 1984). Extralimitally, recorded from Timor, Oct. and Jan.; and regular s. New Guinea, Aug.–Apr.; possibly come from Aust. (McKean *et al.* 1975; Coates 1985; White & Bruce 1986). Move locally between roosting and foraging sites (e.g. Sibson 1963; Garnett & Cox 1988); in Eucla area, WA, sometimes shelter at near-coastal lakes during storms. Observed flying inland, c. 80 km from coast morning after severe cyclone with strong ne. winds (Masters & Milhinch 1974; Storr 1987).

Return In sw. NSW, where breeding not recorded, most records before Aug. (Hobbs 1961). At Swan R., sw. WA, where breed in winter and spring on nearby islands, mostly occur before late Apr. (Storr & Johnstone 1988). At Cass R., NZ, breeding occurs from Aug. (Pierce 1983); at Invercargill colony, adults return Aug. (Barlow 1991) with flocks recorded before nesting (e.g. CSN 38).

Breeding Breed irregularly in some areas (Pierce 1984), even at sites where normally irregular or vagrant (e.g. Capricorn–Bunker Grp, Qld, Walker *et al.* 1993b); some breeding apparently opportunistic (e.g. Horton 1973). Fidelity to natal colony not known (Barlow 1991); of 738 chicks banded Mt Isa colony, Qld, five recovered as breeding adults at natal colony up to 106 months after banding (Horton 1973); colour-marked

adults returned to Invercargill colony (CSN 37). Pairs nesting on river beds and lake shores in Canterbury, NZ, said to have high fidelity to breeding site, though some breeding areas used only irregularly (Pierce 1984). In some areas where breeding not recorded, present only during breeding period, e.g. at Richmond R., NSW, recorded between Aug. and Jan. (Gosper 1981); in other areas, present throughout year, e.g. Torres Str., Qld (Draffan *et al.* 1983). At least temporarily desert colonies after disturbance, sometimes moving colony to new site nearby (e.g. Pennycook 1949; Jones 1980). Some breeding areas possibly deserted for years (e.g. South Neptune Is, SA, Stirling *et al.* 1970).

Dispersal of young In some areas where no breeding takes place, adults often accompanied by flying, begging young (e.g. Tuggerah Ls, NSW, NSW Bird Rep. 1991). Some young remain near colony for at least a few months (Horton 1973). At least some move long distances soon after fledging, e.g. juvenile banded Palliser Spit, NZ, reach Manukau Harbour within months of leaving nest (Sibson 1963); juveniles banded Vic., recovered along e. coast as far N as Qld within months of banding, with nestling banded Corner Inlet, Vic., recovered c. 1280 km NNE only 19 days later. Juveniles from inland colonies recovered elsewhere in inland and on coast within months of banding (see Banding). Subadults appear to stay away from colonies for several breeding seasons; do not return to Invercargill colony till 4, occasionally 3, years old (Barlow 1991). Thus birds away from breeding areas in breeding season may be mostly subadults; mainly subadults counted at Manukau Harbour and Firth of Thames, NZ, in summer (Sibson 1992).

Banding, Colour-marking Banding shows adults and young move long distances. Maximum distance between natal site and recovery site c. 1900 km from Green I., Tas., to Deception Bay, Qld (ABBBS 1984b). Maximum distance between banding and recovery locality of adult in Aust. c. 1400 km from Green I. to Hastings R., NSW (ABBBS 1992). Some recoveries indicate high fidelity to general area, e.g. nestling banded Carnac I., WA, recovered dead only 26 km ENE over 8 years 8 months after banding; and nestling banded Mt Isa found dead only 34 km SE at L. Mary Kathleen, Qld, 16 years after banding (ABBBS 1990, 1991). In NZ, bird banded Nelson moved to Avon-Heathcote Estuary (J. Hawkins).

FOOD Carnivorous; almost entirely fish. **Behaviour** Diurnal. Usually feed by SHALLOW PLUNGING: hover up to 15 m above water, with bill pointing down; flex wings, then dive, fully submerging, and quickly re-emerge (HASB; BWP). Often check dive at last minute. Juveniles dive from lower heights. Usually swallow fish in flight, head first. Most feeding activity early to mid-morning. Extraliminally, may scavenge, steal food from other charadriiforms, and skim surface for prey (BWP). Show some opportunistic behaviour, e.g. recorded following cormorants cooperatively hunting herring *Nematalosa*, diving to take fish forced to surface (Carruthers 1969). In NZ, recorded feeding on shoals of small fish in shallows off beach, with Kelp Gulls *Larus dominicanus*, Silver Gulls *L. novaehollandiae*, and White-fronted Terns *Sterna striata*; also took fish that were washed onto beach (Stidolph 1939). Also reported taking young crickets in pasture with other birds (CSN 19 Suppl.); and wading on soft mud, pecking, probing and foot-trembling in shallow pools (Middleton 1987). In NZ, turbidity of lakes in winter, preventing birds from sighting prey, may be factor making Terns move to estuarine environments (Pierce 1980).

Adult On Lizard I., Qld (31 food items; S. Blaber): Crustaceans: decapods: Alpheidae 3.2% freq.; Penaeidae 3.2;

Fish: Apogonidae 3.2; Atherinomorus: *Atherinomorus lacunosus* 13; Xocoetidae 13; Lutjanidae 3.2; Pomacentridae 3.2; unident. teleosts 58. **Other records** Invertebrates (Middleton 1987); Crustaceans: shrimps (Oliver); Insects: Orthoptera: Gryllidae young crickets (CSN 19 Suppl.). Fish (Stidolph 1939; Sibson 1963; Pierce 1980; CSN 19 Suppl.; Oliver; FAB): Clupeidae herrings (CSN 1, 23): *Nematalosa* (Carruthers 1969); Bythitidae: rock cod (HASB); Salmonidae: trout fry (Oliver); Hemiramphidae (CSN 1); Mugilidae (HASB); Cyprinidae: *Cyprinus carpio* (Favaloro 1947); Pleuronectidae (CSN 1).

Young Whole fish regurgitated to chicks. Beaks of pipers (Hemiramphidae) broken off before fish fed to chicks (CSN 1). At Mt Isa, Qld (regurgitations; Horton 1973): Fish: Clupeidae: *Nematalosa* 40% no., 55% wt; Melanotaeniidae: *Melanotaenia* 10, 4; Terapontidae: *Amnismararataba percoides* 50, 41. **Other records** Fish: Hemiramphidae (CSN 1); Salmonidae: trout *Salmo* (Pierce 1983).

Intake Take longer prey (up to 181 mm) than other A'asian terns (Hulsman 1981).

SOCIAL ORGANIZATION No major studies; some details for Aust. in Tarr (1960a) and Cooper (1964) and for NZ in Pierce (1984); for extralimital material see BWP. Appear less sociable than other terns (Tarr 1960a). Many records of single birds or pairs (e.g. Gosper 1981, 1983; Lane 1984, 1985; *Corella Seabird Is Ser.*), sometimes threes (Sedgwick 1978; Lane 1984); said to occur mainly in pairs or small parties, sometimes in flocks (Cooper 1964), though literature suggests flocking not unusual. Sometimes breed colonially (see Breeding dispersion). Occasionally gather in larger flocks away from nesting sites: 2–20 (Serventy 1941; Schodde & Glover 1955; Smith & Johnstone 1978; Aumann 1991); c. 30 (Stidolph 1939); unusual concentration of 195+ (Vic. Bird Rep. 1983). Recorded gathering to rest or roost in groups of: a 'few dozen' (Sibson 1963), 20 (CSN 35), 30–60 sometimes including several juveniles (Sibson 1963; Simpson 1972; CSN 31, 35; J. Hawkins), 80–130 (Sibson 1992; CSN 30); post-breeding flock of 31 (CSN 34). In NZ after breeding, pairs and families said to converge at certain habitats (Pierce 1984). Attracted to co-operative fish drives by Australian Pelicans *Pelecanus conspicillatus* and cormorants (Carruthers 1969), and recorded following dolphins *Tursiops truncatus* (Sedgwick 1978).

Bonds Monogamous pair-bond persists from year to year (BWP); site-fidelity probably quite high (Pierce 1984). Age of first pairing, 4, occasionally 3, years (Barlow 1991). Little known on when bonds form; at Horseshoe Reef, Tas., courtship and nest-building seen Nov. (van Tets *et al.* 1977). **Parental care** Both sexes incubate (Tarr 1960a; Ford 1965) and defend nest (e.g. North; Aust. NRS); partner of sitting bird usually keeps watch a few hundred metres away (Cunningham & Wodzicki 1948). Both parents feed chicks (Simpson 1972; Pringle 1987) and, at least sometimes, both accompany chicks (Ford 1965; *Corella Seabird Is Ser.*). Length of time dependent on adults, unknown; fledged and flying young recorded with two adults (Ford 1965; Smith & Buckley 1986) or with adults (number not specified) (Brothers 1980); banded second-year bird seen begging (J. Hawkins).

Breeding dispersion Often as solitary pairs (e.g. Cunningham & Wodzicki 1948; Tarr 1960a; Cooper 1964; Storr 1964, 1966; Ford 1965; Lane 1984; Pierce 1984; *Corella Seabird Is Ser.*; CSN 32, 33, 34; North; Campbell) but also in colonies. Colonies usually small: 3–160 pairs (e.g. Whitlock 1919; Cooper 1964; Storr 1966; Kikkawa 1976; Abbott 1979; King 1993; CSN 30; 31, 34, 35; Aust. NRS; *Corella Seabird Is*

Ser.); occasionally larger, e.g. up to 200 pairs (Paton & Paton 1977), colony of 'several hundreds' (Condon 1965), and very large colony of 812 nests (Aust. NRS). Few details on distances between nests: 812 nests in c. 1790 m² (Aust. NRS); 140 in 400 m² (Jones 1980); 10 in 230 m², with some only c. 2 m apart (Stidolph 1939); 12 nests c. 6 m apart (Tarr 1949). Often nest in association with other species of terns and gulls (see Breeding); in Canterbury district, NZ, Pierce (1984) found solitary nesting pairs (usually over 8 km apart) had marked association with colonies of Kelp Gulls; distance from Caspian Tern nest to nearest Gull nest averaged 16 m (4.5–120; 24). **Territories** Extraliminally, when nests close, only small nest-territory defended (BWP). Within HANZAB region, Ford (1965) refers to two adults, probably with chick, defending territory; Pierce (1984) recorded that in one breeding area, conspecifics escorted away by off-duty bird. **Home-range** At Cass and Godley Rs, NZ, almost all hunting by off-duty Terns done up to 10 km from nest-sites (Pierce 1984).

Roosting Singly or in pairs; sometimes in flocks (see above). At some sites, gather to roost in evening (Schodde & Glover 1955) or at dusk (Sibson 1963); at one location, regularly gathered to roost on salt-lake at night (Simpson 1972); at one breeding colony calling continued throughout night (Brothers 1980). Also observed gathering at high-tide roost (Sibson 1992). Recorded resting on sandy beaches (Storr 1964) and sandbanks (Sibson 1963). Large numbers may shelter along coast and coastal lakes during rough weather (Bedgood 1970). Often associate with other species at roosts, e.g. White-fronted Terns, Silver Gulls, Black-winged Stilts *Himantopus himantopus* and other waders (Stidolph 1939; Symon 1940; Heather 1982; J. Hawkins).

SOCIAL BEHAVIOUR Little studied within HANZAB region but well known extraliminally (see BWP). Recorded bathing in puddles and freshwater soaks (Storr 1964).

Agonistic behaviour Aggressive (HASB), especially isolated pairs (Sibson 1992) and breeding birds (Storr 1966), but often nest alongside other species (see Breeding); Terns breeding in colony next to breeding colony of Silver Gulls showed no aggression to Gulls (Cooper 1964). Pierce (1984) recorded residents calling often when escorting conspecifics away from breeding area. Resting pair noted trying to drive smaller species of terns away (Warham 1962). Sutton (1926) observed aerial interaction between Tern and skua, where the two birds had two or three strikes at each other. Also recorded swooping at Swamp Harriers *Circus approximans* (CSN 35) and dogs (Cleland 1936), and bird in breeding plumage observed attacking Pacific Gull *Larus pacificus* (Ford 1965). **Alarm** When flock approached by people, flew overhead giving harsh call, then after a few minutes settled farther along beach (Stidolph 1939).

Sexual behaviour Courtship display similar to that of other terns. Pair dives from great height and, in formation, twists and turns in series of aerial revolutions before landing; then preen one another and copulate (Tarr 1960a). During courtship, fish may be caught and offered to intended mate (Simpson 1972).

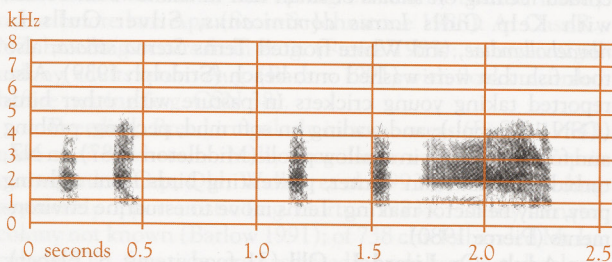
Relations within family group A few days after hatching, parents lead chicks from nest to vegetation (Tarr 1960a). Sometimes young enticed from nest by parents; adult observed moving 13–15 cm away from young bird, but still facing it, then dipping head and raising tail until body almost vertical, with neck bent and bill laid along ground; young bird stayed still while adult held posture for several minutes before resum-

ing normal stance. Other Terns may attack young as they leave nest (Cooper 1964). Chicks guarded by at least one parent for first 5–10 days. Presumably beg by quivering wings and calling incessantly (Campbell). Possible that parents sometimes neglect weaker chick of clutch (Tarr 1960a; Pierce 1984). **Anti-predator behaviour of young** Brothers (1980) found fully fledged young hiding in vegetation. Said to take to water if pressed (NZRD). **Parental anti-predator strategies** Usually both parents become agitated when nest approached. When observer 1.5 km distant (HASB), parents rose screaming (Tarr 1949; HASB); when within c. 100 m of nest or young, parent flew rapidly at intruder, gave harsh calls, and skimmed just overhead; when beside nest or young, flew c. 3 m overhead and, when immediately overhead, screamed, held feet forward, then flew almost vertically upwards and turned away for next attack (Tarr 1960a); when observer approaching nest, bird flew on leeward side of observer, then threw itself vertically, kicked feet, uttered piercing scream, then dropped short distance, and flew off, repeating performance a number of times (North); when nest being inspected, adults flew to observer, raised themselves almost perpendicular in air, flapped wings and called often (North). During disturbance by people, while Terns airborne, Kelp and Silver Gulls swoop to take unattended chicks and eggs (J. Hawkins). Nesting birds may also attack corvids (Storr 1964), Pacific Gulls (Johnstone *et al.* 1990; Aust. NRS), Kelp Gulls and Swamp Harriers (Stidolph 1939; Cunningham & Wodzicki 1948); observed attacking Harriers co-operatively (CSN 35). Adults usually tolerate Kelp Gulls to within several metres of nest or young before diving on them (Pierce 1984).

VOICE In HANZAB area, anecdotal information only. Extraliminally, five calls described (BWP, with sonagrams). Utter harsh scream from nest when threatened, even if person still up to 1.5 km distant (HASB), often leading observer to nest or young (Carter 1904; Gould). Can utter the harshest scream while carrying fish in bill (Tarr 1949; Oliver). Silent when resting on ground, but utter guttural cry when preparing to take off (Buller 1888). Call often when escorting conspecifics from nest-site (Pierce 1984).

Adult ALARM CALL: loud harsh rasp, grating and unmusical, not unlike cry of domestic goose; most common call (Buller 1888; Stidolph 1939). Uttered when moving from nest; repeated by mate as it approaches nest; and monotonously repeated by both as they hover over nest (Tarr 1949; North). See short calls of sonagram A. **GAKKING CALL:** piercing scream given when nest disturbed and bird flies at intruder (see Social Behaviour) (Tarr 1960a; North); see last call of sonagram A. **SQUEAL:** long peevish squeal or whistling cry *queea-queea* (Buller 1888). Probably same as high-pitched whistle of Stidolph (1939).

Young Squeal or whine incessantly when following par-



A H. Crouch; Wallaroo, SA, Dec. 1974; P36

ents (Buller 1888; Campbell; T. Howard) and continue to do so several months after fledging (Falla *et al.* 1981).

BREEDING No major studies; Tarr (1960b) summarized observations of 20 nests; Pierce (1984) studied sites and success of scattered pairs in Canterbury, NZ, 1970–90. Total of 139 records in Aust. NRS up to June 1993. Breed in isolated pairs or in small colonies, mainly on offshore islands (Tarr 1960b; Campbell).

Season Aust. In s. Aust.: Aug. or Sept. to Jan. (Campbell), Oct. to late Feb. (North), early July to late Oct. (Storr 1964); eggs, late July to mid-Jan. (Aust. NRS). In n. Aust.: no apparent fixed season, eggs recorded in Mar. and May–Nov. (Carter 1904; North; Aust. Atlas; Aust. NRS). **NZ** Oct. or Nov. to Jan. (Stidolph 1939; Campbell); laying: late Sept. to late Nov. (Pierce 1984), early Sept., mid-Sept. (Pennycook 1949).

Site On sand-spits, small sandy islands, behind sandhills fringing beach, on edge of lagoon, on exposed shell-banks, on island in dam, mound of sand, grassy mound, rocky summit of islet, sandy area on granite outcrop, plateau between small cliff and Nitre-bush, among vegetation on top of island, up to 12.2 m asl; in open, among sparse ground-cover, e.g. pigface, Beaded Glasswort, Sea Rocket; in almost complete cover of grasses and prostrate plants; sometimes near bushes or other shelter such as large sticks, driftwood, piles of beachcast seagrass; in inland NZ, on braided shingle river beds and raised shingle banks or terraces (Stidolph 1939; Serventy 1943; Cunningham & Wodzicki 1948; Tarr 1949, 1960b; Carruthers 1964; Cooper 1964; Ford 1965; Pierce 1984; Menkhorst *et al.* 1988; Campbell; Aust. NRS; J. Hawkins). Nests often washed-out by high-tide; will re-nest in same place (J. Hawkins). When all eggs of one colony disappeared, another colony was formed nearby (Stidolph 1939). Often nest among Silver Gulls (Storr 1964), on outskirts of Silver Gull colony (Aust. NRS); pairs associated with colonies of Kelp Gulls, and a few at colonies of Black-billed Gulls *L. bulleri*, Australasian Gannets *Morus serrator* and White-fronted Terns; average distance to nearest nest of Kelp Gull, 16 m (4.5–120; 24) (Pierce 1984; J. Hawkins); c. 46 m from Fairy Terns *S. nereis* (Aust. NRS), c. 27 m from Crested Terns *S. bergii* (Ellis 1958) within c. 5 m of White-fronted Terns (Skira & Brothers 1987); on same island with White-faced Storm-Petrels *Pelagodroma marina*, Black Swans *Cygnus atratus*, Eastern Reef Egrets *Egretta sacra*, Crested Terns, Pacific Gulls, Silver Gulls, Sooty Oystercatchers *Haematopus fuliginosus* and Rock Parrots *Neophema petrophila* (Aust. NRS).

Nest, Materials Slight hollow scraped in ground; bare or well lined with grass, a few twigs, seaweed, feathers, small stones and shells (Cunningham & Wodzicki 1948; Pennycook 1949; Pierce 1984; Campbell); twigs from nearby saltbushes (Storr 1966). Sometimes made from debris above high-tide mark (Tarr 1960b). Excavated earth round edge of scrape well trodden down (Cooper 1964); scrape may become ringed with bones by time chicks ready to leave (HASB). One clutch laid in disused nest of Kelp Gull (Pierce 1984). **MEASUREMENTS** (cm): diameter, 15 to c. 23; depth, 3.8 to c. 6.4 (Tarr 1960b; Cooper 1964; Campbell; Aust. NRS).

Eggs Oval to elongate oval, coarse, slightly lustrous; stone-grey or light olive-brown (Campbell); dull yellowish-stone, occasionally shaded with light bluish-grey (North); with irregular freckles, spots and blotches of umber, dull greyish-black and blackish brown, intermingled with similar but fewer underlying markings of dull grey or inky grey; others have streaks, ill-shapen figures and spider-like markings of

very dark umber and blackish brown, with a few almost black, all larger on thicker end (Campbell; North). In NZ: ground-colour very pale green, almost white, to deep stone, sparingly marked with small deep-brown spots and blotches and underlying ones of mauve (Stidolph 1939). **MEASUREMENTS:** 62.5 (57.8–71.5; N probably 41) x 43.5 (41.3–47.5) (Tarr 1960b). Three eggs in NZ: 70 x 43.5, 67.5 x 44, 63 x 45 (Oliver).

Clutch-size Aust. Average 2.1: C/1 x 1, C/2 x 17, C/3 x 2; clutches in w. Aust. larger than in Vic. and Tas. (Tarr 1960b); average 1.9: C/1 x 3, C/2 x 9; some nests contained three eggs (Aust. NRS). **NZ** Average 2.3 (1–3; 17) (Pierce 1984).

Laying At one nest, second egg laid 2 days after first (Tarr 1960b); extraliminally, eggs laid at 2–3 day intervals (Bergman 1953), c. 1 day (BWP). Eggs laid between 10:00 and 14:00 (Tarr 1960b). Presence of young of all stages and eggs indicate laying asynchronous within colony (Aust. NRS). Re-lay after failure, at least twice (Jones 1980); re-lay, or continue to lay, at same site and nearby, after storm washed away nests (Pennycook 1949). Re-laid morning after being washed-out by storm (J. Hawkins); c. 2 weeks after failure (Jones 1980). One nest contained a gull's egg (Aust. NRS).

Incubation By both sexes (Tarr 1960b). **INCUBATION PERIOD:** two eggs in a clutch took 21 days to hatch (Tarr 1960b). On one occasion, young took 2–3 days after pipping to emerge from egg; hole enlarged to 12.7 mm 48 h after pipping (Tarr 1960b).

Young Young led from nest after a few days (Tarr 1960b). Chicks guarded by parents. For one nestling, adults spent much time with it, standing beside it for 10–15 min without moving if clear of vegetation (Cooper 1964); also see Social Organization: Parental Care. **FLEDGING PERIOD:** At Nelson Boulder Bank, 5 weeks (J. Hawkins).

Fledging to maturity Breed when 4, occasionally 3, years old (Barlow 1991).

Success From 14 eggs, 11 (79%) hatched (Aust. NRS); of 37 clutches, 27 (73%) hatched and 20 (54%) produced fledgelings; of ten clutches that failed: four were flooded, two infertile, one deliberately run over by motorcyclist and three unknown; average young fledged/pair/season, 0.6 (n=35 pairs). Only one pair raised a brood of two; one chick usually found dead within a few days of hatching (Pierce 1984). A nest was abandoned after site occupied by terns and gulls (Cunningham & Wodzicki 1948). Contents of eggs probably sucked out by gulls (Stidolph 1939); dingoes took young (Aust. NRS).

PLUMAGES Prepared by R.P. Scofield. Hatch in natal down, which is replaced before fledging by distinctive juvenile plumage. Undergo protracted and complete post-juvenile (first pre-basic) moult to first immature non-breeding plumage. Apparently then moult directly to second immature non-breeding (second basic) when 12–16 months old. Thereafter, much as adult, with two moults each year: a partial pre-breeding (pre-alternate) moult to breeding plumage and a complete post-breeding (pre-basic) moult to non-breeding plumage. Immatures between 2 and 4 years old probably separable from adults by timing of moults and pattern of head in breeding plumage. Not known when adult plumage attained. First breed when 4, occasionally 3, years old (see Breeding). No subspecies. Text below based on about 52 Aust. and NZ specimens (AIM, AM, ANWC, HLW, MV, NMNZ, NTM, TMAG, QM).

Adult breeding (Definitive alternate; possibly fourth and subsequent but not certain when definitive plumage attained). **Head and neck** Forehead, crown and anterior feathers

of nape, black (89) with metallic green (162) gloss when fresh, forming distinctive black cap, with short nuchal crest (formed by slightly elongated feathers of anterior nape). Lores, rear of nape, chin, throat and neck, white. **Upperparts** Pale grey (86; slightly darker grey when worn) grading to white at sides and rear of rump; uppertail-coverts, white. **Underparts** White. BWP states that some have pale-grey wash between lower throat and belly but no evidence of this in A'asian specimens. **Tail** White; on some, a faint pale-grey (86) wash on inner webs of inner rectrices. Tips may darken with wear. **Upperwing** Coverts, tertials, secondaries and inner primaries, pale grey (86; slightly darker when worn). Outer primaries (p4 or p5 to p10) appear pale silvery-grey (c86) when fresh; dark grey (83) ground-colour of outer webs and tips gradually exposed with wear; feathers have indistinct pale-grey wedges at bases. **Underwing** Coverts and axillaries, white. Secondaries and inner primaries have pale-grey (c86) wash, darkening to light grey (85) on p6–p10 (corresponding to patterns on upperside of primaries) and forming diagnostic dark tip to underwing.

Adult non-breeding (Third and subsequent basic). As adult breeding except: Feathers of upper lores, white streaked with black (89). Feathers of crown, black (89) with broad white edges. In most, black (89) mask extends from in front of eye, below eye, to ear-coverts; feathers have narrow white edges that wear quickly, leaving mask wholly dark. A few, possibly not fully adult, do not have mask, only indistinct black streaking on white ground. Remiges usually more worn than adult breeding and outer primaries appear darker; worn rectrices sometimes appear darker grey than in adult breeding.

Downy young Varies greatly (see Chaniot 1970). Ground-colour of upperparts and colour of throat vary between off-white and grey-brown (91); upperparts varyingly (but sparsely) freckled black-brown; only weak correlation between dark or light characters in one tract and presence of similar colours in another. Underparts paler and unmarked, usually white on throat and belly. Individuals of same clutch usually alike.

Juvenile Head and neck Feathers of forehead, crown (to level of eye) and upper nape, black (89) with orange-buff (153) edges when very fresh, which quickly fade to off-white; cap appears streaked, less distinctly as pale edges lost with wear. Small patch in front of and below eye, and cheeks and ear-coverts next to eye, black (89) or black-brown (119), forming mask much as in adult non-breeding. Lower nape, white, grading to pale-grey (86) mantle. Rest of head and neck, white. **Upperparts** Mostly pale grey (86), grading to white on rump and uppertail-coverts, and with varying markings on saddle. Feathers of mantle and scapulars have varying broad buff-yellow (53) edges, which quickly fade to off-white. In darkest birds, most feathers of upperparts (except sides or all of rump and back) have black-brown (119) V-shaped subterminal marks, with dark streaks on some scapulars; palest birds may lack V-shaped marks on upper mantle, back, rump and inner scapulars and have only faint light grey-brown (119C) V-shaped marks on lower mantle and outer scapulars. Uppertail-coverts, pale grey (86) or grey-white, with buff (53) tips that quickly fade to off-white; in darkest birds, inner uppertail-coverts have broad dark-brown (119A) or brown (119B) subterminal V-shaped marks and longer lateral uppertail-coverts have 1–3 narrow light grey-brown (119D) bars. **Underparts** White. **Tail** Rectrices, light grey (85) with buff (53) edges and dark-brown (119A) or brown (85) subterminal spots or bars on inner webs. Central few feathers of dark birds may have one or two complete subterminal dark

bars; pale birds may only have indistinct dark marks at tip. **Upperwing** Tertials and secondary coverts, pale grey (86) with buff-yellow (53) tips, which quickly fade to off-white; in darkest birds, tertials, and greater and median secondary coverts have black-brown (119) subterminal V-shaped marks (forming indistinct carpal bar), and marginal and shortest lesser secondary coverts have dark-brown (119A) subterminal spots, forming indistinct cubital bar. Primary coverts, grey (84) with broad off-white fringes. Remiges, patterned like adult, but outer primaries have fainter overlying silvery sheen and so appear slightly darker. Tips and inner edges of p1 to p5, p6 or p7, white, often with diffuse dark subterminal spots. **Underwing** As adult.

First immature non-breeding (First basic). Like adult non-breeding but separable through most of protracted post-juvenile moult by retained juvenile plumage: indistinct cubital bar (unmoulted darker lesser secondary coverts and primary coverts); and heavily worn, dark-brown (219) outer primaries (usually p6–p10) contrasting with fresh silvery-grey (84) inner primaries. New inner primaries and outer secondaries have narrow white edges. In A'asia, usually retain varying number of rectrices; generally replace t5, t6 and t1 leaving rest extremely worn by second autumn. Dark markings of these juvenile feathers are all but lost by bleaching and wear. Moult-cycle of all immature plumages delayed by comparison with adult.

Second immature non-breeding (Second basic). Very similar to adult non-breeding, differing only by timing of moult (retaining some juvenile outer primaries, primary coverts and rectrices before second pre-basic moult completed) and, possibly, darker alula (light grey [85] cf. pale grey [86] on rest of wing) with broad off-white edges.

Second and third immature breeding (Second and perhaps third alternate). Some breed in this plumage (Barlow 1991). Like adult breeding, but some distinguished by small white terminal spot on both edges of each feather of crown, which appears black speckled with white. Also, may replace more inner primaries in pre-alternate moult than adult, or show other differences in timing of moult.

BARE PARTS From museum labels (AIM, ANWC, MV, NTM, QM) and photos (Pringle 1987; Olsen & Larsson 1995).

Adult breeding Iris, rufous (41), rufous-brown (136) or dark brown (219). Bill, pink-red (9) to red (12) in breeding plumage, usually with light grey-brown (27) subterminal band; tiny area at tip, orange-buff (153). Legs and feet, grey-black (82) or black. **Adult non-breeding** Like adult breeding but bill, dull orange (116) with dark olive-brown (129) tip or subterminal band up to 25 mm wide. **Downy young** Iris, dark brown (219). Bill, yellow-brown (123C) or orange-yellow (18); most have black-brown (119) tip. Legs and feet, yellow-brown (123B) or light brown (123A). **Juvenile, Immature** Iris, dark brown (219). Bill, yellow-brown (123C) to orange-yellow (18) with basal one-third black-brown (119), becoming brighter with age. Legs and feet, orange-buff (118 or 153) with black-brown (119) tinge and darker joints. Gradually darken with age, spreading from joints.

MOULTS Based on examination of c. 52 A'asian skins (AIM, AM, ANWC, HLW, MV, NMNZ, NTM, TM, QM) and data from 22 live birds from nw. Aust and Vic. (AWSG). Aust. situation confused by apparent lack of seasonality in breeding in n. Aust. Below, dates refer to se. Aust. and NZ. **Adult post-breeding** (Pre-basic; probably third and subsequent). Complete; primaries outwards. Begins with forehead,

crown and nape, Dec.–Jan., sometimes while feeding well-grown young. Moulting of primaries begins with p1 in late Jan., when most have left breeding colonies, though some (especially in nw. Aust.) may begin moulting of primaries at breeding colonies, suspend moulting during dispersion and re-start moulting on arrival in non-breeding areas. Moulting of body finished by May. Moulting of tail apparently in sequence: t1–t6–t5–t4–t3–t2. Moulting of tail and wing finished by July or Aug. **Adult pre-breeding** (Pre-alternate; probably fourth and subsequent). Partial. Moulting head, mantle, back and outer scapulars, from Aug. Moulting of primaries begins almost as soon as post-breeding moulting finishes (but no overlap was observed). Extent of moulting of inner primaries appears to be governed by timing of breeding; ranges from no moulting of inner primaries to almost complete moulting of primaries. In Vic. and NZ, any or all of p1–p4 or p5 may be moulted from Aug. to Sept. or Oct. This arrested primary-moulting does not continue where it is left off after the breeding season (even in n. Aust.). **Post-juvenile** (First pre-basic). Complete or nearly so. Protracted. Begins in non-breeding areas about Apr. or May and usually completed by Nov., though some in Oct. still retained highly worn t3, t4, t5 and juvenile alula and appeared to have begun second pre-breeding moulting, which suggests that post-juvenile is not complete. **Subsequent immature moultings** Appear to be similar to those of adult but post-breeding (pre-basic) moultings may start earlier and last longer. Pre-breeding (pre-alternate) moulting may last longer and therefore involve greater number of inner primaries (up to p7). These differences result in immatures having different PMS than adults at the same time of year, as well as comparatively greater wear on unmoulted feathers.

MEASUREMENTS (1) Aust. and NZ, adults, all year, skins; T6–T1 = distance between tips of t6 and t1 (depth of tail-fork); Bill D(G) = depth of bill at gonys; Bill D(N) = depth of bill behind nostrils (AIM, AM, ANWC, MV, NMNZ, NTM, TMAG, QM). (2) Europe, Middle East, and Africa, adults, all year, skins (BWP).

	MALE	FEMALE	
WING	(1) 417.8 (15.24; 406–460; 14) (2) 421 (9.14; 404–441; 19)	413.9 (21.19; 383–452; 15) 412 (12.1; 387–429; 22)	ns *
TAIL	(1) 133.7 (8.90; 115–150; 11) (2) 141 (7.63; 130–155; 13)	137.3 (7.78; 123–151; 13) 135 (6.79; 125–147; 13)	ns ns
T6–T1	(1) 30.2 (5.36; 23–41; 11)	36.5 (4.52; 28–43; 13)	**
BILL	(1) 71.3 (5.37; 63.0–82.3; 16) (2) 72.4 (2.73; 69–79; 18)	68.7 (4.35; 62.5–77.3; 20) 67.8 (3.17; 62–73; 22)	ns **
BILL D(G)	(1) 16.0 (1.77; 13.7–18.0; 5)	14.7 (0.56; 14.2–15.7; 6)	ns
BILL D(N)	(1) 21.2 (1.11; 19.3–22.9; 11)	20.1 (1.84; 17.0–22.7; 13)	ns
TARSUS	(1) 44.3 (2.30; 40.0–49.8; 16) (2) 46.2 (2.13; 43–50; 19)	43.5 (2.76; 39.3–49.0; 20) 44.4 (2.59; 40–49; 23)	ns *
TOEC	(1) 44.3 (2.16; 41.7–47.9; 12) (2) 42.4 (1.80; 40–45; 15)	42.2 (2.55; 38.4–47.0; 13) 40.4 (1.77; 38–43; 15)	ns **

(3) NW. Aust. and Vic., adults, live (AWSG).

	UNSEXED
WING	(3) 419.9 (23.18; 370–446; 17)
BILL	(3) 76.2 (2.66; 70–81; 18)
BILL D(G)	(3) 12.8 (1.71; 10.4–14.8; 6)
THL	(3) 146.2 (5.19; 135.1–153.0; 10)

WEIGHTS (1) Aust. and NZ, adults, all months, skins

(ANWC, MV, NTM). (2) NZ, skins (AIM, NMNZ); excludes emaciated female of 472 (May) and juvenile of 505 g (Feb.).

	MALES	FEMALES
(1)	566.3 (177.28; 356–775; 4)	587.5 (144.46; 405–765; 6);
(2)	454, 415	425, 480, 608

No significant differences between sexes in Aust. sample when sexes combined.

(3) NW. Aust. and Vic., live (AWSG).

	ADULTS	IMMATURES
Jan.	(3) 679.0 (33.05; 645–725; 5)	–
Mar.	(3) 752.3 (20.66; 725–774; 4)	750
Apr.	(3) 1323.0 (147.0; 1130–1590; 8)	1174
May	(3) 700	–
Aug.	(3) 610	–

Weights increase significantly ($P < 0.01$) each month between Jan. and Apr. For weights in Palaearctic (which appear lighter) see BWP, and Quinn (1990).

STRUCTURE Wing, long, narrow and pointed. Eleven primaries: p10 longest, p9 11–22 mm shorter, p8 38–53, p7 74–85, p6 105–115, p5 135–146, p4 162–179, p3 189–202, p2 220–230, p1 240–257; p11 minute, covered by primary coverts. Tail, forked in adults; depth of fork c. 20 mm shorter in juveniles and significantly shorter in non-breeding plumages; 12 rectrices. Bill, long and gently decurved; lower mandible straight with only slight angle at gonys; very stout at base. Tarsus, long and heavy; scutellate; tarsus about same length as mid-toe and claw. Toes, fully webbed, with folds of skin on outside edge of outer toes; outer toe c. 81% of middle, inner c. 71%, hind c. 28%.

GEOGRAPHICAL VARIATION Slight; only some variation in size, not marked enough to justify recognition of any subspecies. Largest in Aust. and South Africa, smallest in North America, Red Sea and Persian Gulf; size intermediate in w. Palaearctic (BWP). Bills of NZ birds possibly shorter than in Aust. but insufficient data to test; more data needed.

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Volume 3, Plate 35

Caspian Tern *Sterna caspia* (page 586)

1 Adult breeding; 2 Adult non-breeding; 3 Downy young; 4 Juvenile; 5 Late stage of moult from juvenile to first immature non-breeding; 6, 7 Adult breeding; 8 Adult non-breeding; 9 Juvenile; 10 Late stage of moult from juvenile to first immature non-breeding

Gull-billed Tern *Sterna nilotica* (page 576)

11 Adult breeding; 12 Adult non-breeding; 13 Adult non-breeding, subspecies *affinis*; 14 Downy young; 15 Juvenile; 16 Mid-way through moult from juvenile to first immature non-breeding; 17, 18 Adult breeding; 19 Adult non-breeding; 20, 21 Juvenile; 22 Mid-way through moult from juvenile to first immature non-breeding