

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*, *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 nilotica Gull-billed Tern

COLOR PLATE FACING PAGE 576

Sterna nilotica Gmelin, 1789, *Syst. Nat.* 1(2): 606 — Egypt.

The generic name is derived from the substantive *Sterna* given to the Common Tern by Turner (1544, *Avium Precip.*), a latinization of the name *tern* given to that species in the north of England (supposedly because it frequented tarns or lakes). Specifically named after the type-locality (Latin *Niloticus*, of the River Nile).

OTHER ENGLISH NAMES Long-legged Tern.

POLYTYPIC Subspecies *macrotarsa* Gould, 1837, breeds Aust. Extralimitally, six more subspecies: nominate *nilotica*, breeds Europe, nw. Africa and Middle East, E to Kazakhstan, Manchuria, Pakistan, and possibly Sri Lanka; subspecies *affinis* Horsfield, 1821, breeds se. Asia; subspecies *addenda* (Mathews, 1912) breeds coastal China and possibly farther W; subspecies *aranea* Wilson, 1814, e. USA, Bahamas, and Greater Antilles; subspecies *vanrossemi* (Bancroft, 1929) s. California to w. Mexico; subspecies *grönvoldi* (Mathews, 1912) South America, from Guyana to Argentina. A second subspecies, possibly *affinis* or *nilotica*, recorded as non-breeding visitor to Aust. (see Geographical Variation).

FIELD IDENTIFICATION Length 35–38 cm; wingspan 100–115 cm; weight 265 g. Large gull-like tern, with diagnostic short thick gull-like black bill; heavy rounded head and short thick neck, merging with thickest body (with rounded belly); broad pointed wings and short tail with shallow fork; and long legs. Slightly smaller and more thickset than Crested Tern *S. bergii*; much smaller and slimmer than Caspian Tern *S. caspia*. Pale silvery-grey above, with slightly paler white rump and tail, and white below, with narrow black trailing-edge to outer primaries; in breeding plumage, has black cap, in non-breeding, distinctive black mask. Slow lazy flight recalls small gull, while dipping flight when feeding recalls marsh terns *Chlidonias*. Sexes alike. Some seasonal variation. Juvenile distinct. Immatures separable. Smaller darker birds, with different bill-shape, possibly subspecies *affinis*, recorded n. Aust. (see Plumages).

Description **Adult breeding** Head and neck, white, with black cap from forehead to nape; cap peppered with white when moulting. Upperparts, pale silvery-grey, with only slight contrast between upperparts and white rump and tail; can appear almost white at distance or in strong light. When fresh, has narrow dull-black trailing-edge to outer 5–6 primaries; with wear, outer primaries become darker grey, forming contrasting dusky wedge. White below, with narrow black trailing-edge to outer 5–6 primaries; some have distinctly broader and tapering dark trailing-edge, as typical of juvenile. Bill, legs and feet, black. Iris, dark brown. **Adult non-breeding** Differ from adult breeding by: Head and neck, white, with varying faint grey wash or fine black streaking on crown and nape; and black mask through eye and ear-coverts (though in some, mask, grey, or reduced to a few black spots or a small patch on ear-coverts). Upperwing: when fresh, as in adult breeding;

when moulting, may show contrasting dark wedge on outer primaries. **Juvenile** Plumage varies. Differs from adult non-breeding by: Typically, forehead, crown and nape, streaked black and, when fresh, washed pale buff. Saddle and innerwing-coverts, boldly patterned with black bars, spots, and Vs, and with pale-buff spots when fresh (soon fading to white); in some, upper edge of mantle tinged buff; in palest birds, upperparts plainer, with smaller and fainter dark markings and with stronger buff tones when fresh. Rump and tail, white, with indistinct narrow buff terminal tail-band. Upperwing, pale grey, grading to grey on outer primaries and primary coverts, with grey secondary bar, narrow white trailing-edge on secondaries and inner primaries, and dusky trailing-edge to outer primaries. Below, trailing-edge to outer primaries broader and more diffuse, grey-black, tapering toward secondaries; some have buff wash across upper breast when very fresh. Bill,

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

legs and feet, typically as adult; in palest birds, bill, black or brown-black, with paler dull-orange or orange-brown base to lower mandible; and legs and feet, dull orange-brown. **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, like adult non-breeding, but with retained juvenile tertials, wing and tail. Later like adult non-breeding but with contrasting dusky worn juvenile outer rectrices; black-brown secondary bar; and longer black-brown wedge on outerwing (nearly reaching carpal), contrasting with new pale-grey inner primaries and coverts. **First immature (non-breeding and breeding)** Inseparable from adult non-breeding.

Similar species At all ages, short stout gull-like bill and long legs, diagnostic; also combination of large size, pale-grey upperparts and slow steady gull-like flight or, when feeding, flight actions like those of marsh terns, distinctive. In non-breeding plumages, white head with black mask also distinctive. At distance, could be confused with **Caspian Tern**, which is much larger, with longer, broader wings, and shorter, less deeply forked tail; much longer and heavier red bill; and large dark tip to underwing.

Gregarious when breeding; at other times, mostly in small groups, occasionally gathering in large flocks at a source of food. Often roost and loaf with other terns. Inhabit coastal and inland wetlands, coasts and estuaries, and croplands and grasslands. Gait, free, walking and running easily on long legs. Stance gull-like and carriage generally less horizontal than *Sterna* terns; stand much taller than other terns of similar size; folded primaries extend well beyond tip of tail. Normal flight much less active than other terns: gull-like, steady and composed, with slow stiff wing-beats; often hawk for insects and swoop down to take prey from surface of ground or water, in manner like large marsh tern. Usually silent; normal call of adult deep, two-note, somewhat guttural and laughing staccato *gek-gek-gek* or *gir-vit*; juvenile utters soft *pe-eep* or rapid *pe-pe-eep*.

HABITAT Prefer shallow, often ephemeral, terrestrial wetlands, either fresh or saline, especially lakes, swamps and lagoons, particularly those with mudflats; sometimes on inundated ground, including salt pans, clay pans and saltmarsh (Morgan 1931; Jaensch 1983; Storr 1984, 1985; Gibson 1986; Woodall 1986; Bamford 1988) or watercourses and associated floodplains (but rarely flooded woodland or pasture) (Parker 1969; Bourke *et al.* 1973). Occasionally at bores and waterholes; and artificial wetlands, including reservoirs, dams, irrigation canals, sewage ponds and saltworks. Wetlands can be fringed

Plate 36

Crested Tern *Sterna bergii* (page 605)

1 Adult breeding; 2 Adult non-breeding; 3 Downy young;
4 Juvenile; 5 Early stage of moult from juvenile to first immature non-breeding; 6 Late stage of moult from juvenile to first immature non-breeding; 7, 8 Adult breeding; 9 Adult non-breeding 10, 11 Juvenile; 12 Late stage of moult from juvenile to first immature non-breeding

Lesser Crested Tern *Sterna bengalensis* (page 597)

13 Adult breeding; 14 Adult non-breeding;
15 Downy young; 16 Juvenile, dark bird; 17 Early stage of moult from juvenile to first immature non-breeding; 18 Late stage of moult from juvenile to first immature non-breeding;
19, 20 Adult breeding; 21 Adult non-breeding; 22 Juvenile, pale bird; 23 Late stage of moult from juvenile to first immature non-breeding

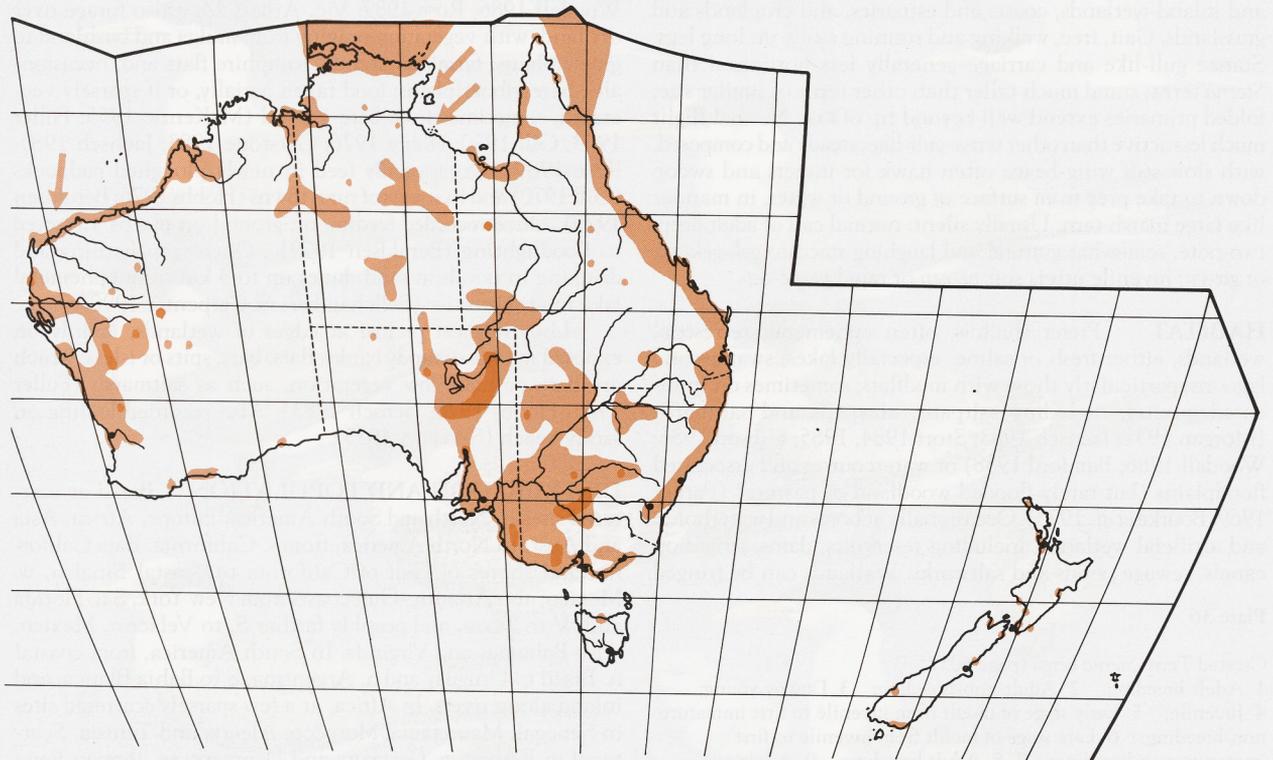
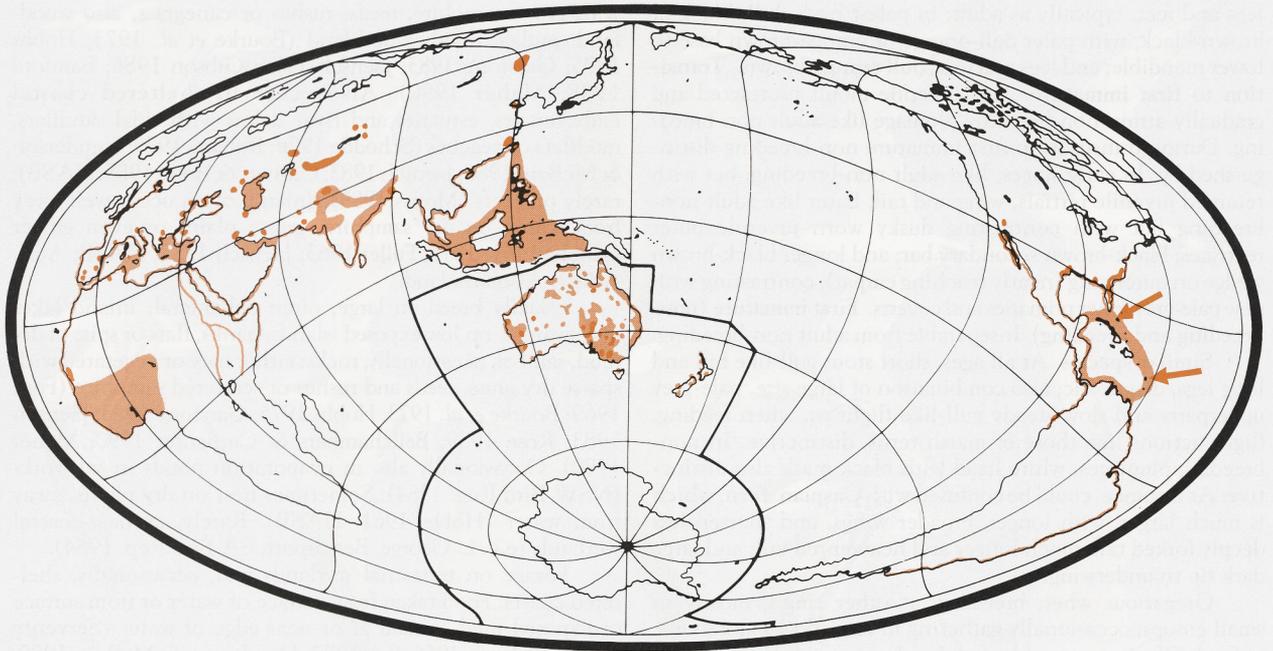
with grass, samphire, reeds, rushes or canegrass, also woodland, mulga or other bushland (Bourke *et al.* 1973; Hobbs 1975; Garstone 1983; Jaensch 1983; Gibson 1986; Bamford 1988; Maher 1990). Also occur in sheltered coastal embayments, estuaries and river deltas with tidal sandflats, mudflats or beaches (Schodde 1976; Roberts 1979; Henderson & McBain 1980; Jaensch 1983; Garnett & Bredl 1985; HASB); rarely on reefs (Morris 1989). Inland, often occur well away from water, on dry samphire, grassy plains or even gibber (Hobbs 1961, 1976; Fuller 1963; Jaensch 1983; HASB; Aust. Atlas). Also farmland.

Usually breed on large, often ephemeral, inland lakes and swamps, on low exposed islands, banks, flats or spits of dry mud, sand or, occasionally, rocks; either bare or vegetated with sparse dry grass, reeds and rushes or scattered samphire (Ford 1969; Bourke *et al.* 1973; Hobbs 1975; Garstone 1983; Jaensch 1983; Rose 1989; Bellchambers & Carpenter 1990; Maher 1990). Occasionally also in evaporation ponds in saltworks (NSW Bird Rep. 1984). Sometimes nest on dry plains, away from water (Hobbs 1961; HASB). Rarely, at near-coastal wetlands (e.g. L. George, Beachport, SA Bird Rep. 1964).

Forage on terrestrial wetlands and, occasionally, sheltered coasts. Food taken from surface of water or from surface of exposed mud or sand at or near edge of water (Serventy 1955; Lindgren 1956; Rix 1970; Henderson & McBain 1980; Woodall 1986; Rose 1989; Vic. Atlas). May also forage over dry land, with vegetation ranging from mulga and bushland to grassy plains, farmland and dry samphire flats and, occasionally, bare gibber plains; food taken aerially, or if sparsely vegetated, sometimes from bare ground (McKenzie 1955; Fuller 1963; Gill 1970; Hobbs 1976; Garstone 1983; Jaensch 1983; Rose 1989). Occasionally feed in newly ploughed paddocks (Gill 1970) and in streets of rural towns (Hobbs 1976; Beruldsen 1979). Once recorded feeding on ground on moths attracted to floodlighting (Beruldsen 1979). Once seen bathing and drinking in ponds in sand-dunes up to 3 km from ephemeral lake in arid interior (Bellchambers & Carpenter 1990).

Usually roost or loaf at edges of wetlands, mainly on exposed muddy or sandy banks, flats, bars, spits or islets, which are bare or have low vegetation, such as saltmarsh (Fuller 1963; Hobbs 1976; Jaensch 1983). Also recorded loafing on sandy beach (Serventy 1955).

DISTRIBUTION AND POPULATION Breed at scattered sites in North and South America, Europe, Africa, Asia and Aust. In North America, from s. California, Baja California and shores of Gulf of California to coastal Sinaloa, w. Mexico; also Atlantic-Gulf coasts from New York, S to Florida and W to Texas, and possibly farther S, to Velacruz, Mexico. Also Bahamas and Virgin Is. In South America, from coastal n. Brazil to Uruguay and n. Argentina, S to Bahia Blanca, and inland along rivers. In Africa, at a few sparsely scattered sites in Senegal, Mauritania, Morocco, Algeria and Tunisia. Scattered in Europe: n. Germany and Denmark; se. Iberian Pen.; Camargue, France; s. Scandinavia; Adriatic coast of Italy; Greece; w. and n. Black Sea; central Turkey; and between Black and Caspian Seas. Asian breeding sites include se. Caspian Sea; Aral Sea and tributaries; L. Balkhash and the headwaters of Irtys R.; farther S, scattered from Iraq to w. India; also n. India; n. Bay of Bengal; in nw. and ne. China, coasts of Yellow Sea and headwaters of Amur R. During non-breeding period, on Pacific coasts of North and South America, from s. California to Peru, and on Atlantic coasts from New York to s. Florida; Gulf of Mexico, through Central America to Colom-



bia and Venezuela; also from s. Florida, through Caribbean islands to Venezuela, and round coasts of Uruguay and n. Argentina. In Africa, from central Chad, W to regions bounded by n. coast of Gulf of Guinea and S of Niger R., and along coast to Morocco, round Mediterranean coast to Egypt, and inland along Nile R., S to L. Victoria (with vagrants occurring farther S); also round coasts from ne. Tanzania N to Red Sea. Occur along Atlantic coast of continental Europe, and along n. Mediterranean coasts from Spain to Italy; also s. Adriatic coast, and from Greece, E to Aegean Sea and e. Mediterra-

nean; Black Sea. Asian distribution from Arabian Pen., through Persian Gulf to n. Bay of Bengal; inland along major rivers; coasts from Burma, S along Malay Pen. to Indonesia, and E to Aust. and s. New Guinea, and N along coastal Gulf of Thailand and e. Vietnam, as well as through Philippines, to e. Chinese coast and Taiwan (Ali & Ripley 1969; Dement'ev & Gladkov 1951; Blake 1977; AOU 1983; de Schauensee 1984; Coates 1985; Urban *et al.* 1986; BWP).

Aust. Widespread. **Qld** Widespread in all coastal regions from se. Gulf of Carpentaria, N to Torres Str., and

along e. coast; scattered records farther inland on C. York Pen. and W to Great Divide. Farther inland, W of Great Divide, scattered records from Camooweal and Mt Isa, E through Julia Ck to L. Powlathanga, and S to Ballyneet Bore and Rubyvale; also in s.-central regions round Beardmore and Surat, and in SW, from Dynevor Ls, NW through Beetoota to Tiribillie Waterhole (Horton 1975; Roberts 1975; Schroder 1981; Atherton *et al.* 1985; Qld Bird Reps; Aust. Atlas). **NSW** Widespread E of Great Divide, S to Shoalhaven R. Widespread in Riverina and Upper and Lower Western Regions, especially drainage basins of major rivers (NSW Bird Reps; Aust. Atlas). **Vic.** Isolated records in E at Rotamah I. and Jack Smith's L. (Vic. Bird Reps 1985, 1987) but many records from Corner Inlet; recorded at a few other sites in Gippsland, including Sandy Pt, Anderson Inlet, Moe and in Westernport Bay. Occasionally round w. Port Phillip Bay and Bellarine Pen.; more widespread in Western Districts, from Winchelsea and Birregurra, N and W to Darlington and L. Goldsmith; also sw. coast, round Warrnambool, Narrawong, and between Portland and Nelson. Isolated records in Wimmera and s. Mallee at Ls Kimbolton, Wyn Wyn and Albacutya. Also widespread in Murray Valley, round Mildura, and from Kooloonong S to near Pyramid Hill, with single isolated record at Tatura (Vic. Bird Reps; Vic. Atlas). **Tas.** Singles: George Town, 7 Apr.–7 July 1979, 9–10 Feb. 1980 (Henderson & McBain 1980). Unconfirmed report S of Richmond (Sharland 1981). **SA** Irregular visitor to s. regions, from round Beachport, N to c. 34°S, including Murray R. valley, Yorke Pen. and s. Eyre Pen. Farther N, more widespread, especially in L. Eyre Drainage Basin, from Pandurra N to Pandiburra Bore and W to Oogawa Waterhole, Oodnadatta and Nilpinna Stn. Isolated records from NW Aboriginal Reserve (SA Bird Reps; Aust. Atlas). **WA** Scattered records on s. coast, from Eyre Bird Observatory W to Beulah Downs; also in SW. Widespread Gascoyne Region, N from 30°S to Cardabia, and E to Ls Violet and Nabberu, with isolated records at Ls Carnegie and Wells. Farther N, widespread in coastal regions of Pilbara Region. In Kimberley Div., occur on sw. coast and upstream of associated rivers; in e. Kimberley Div., occur from Cambridge Gulf, S along Ord R. to L. Argyle. Rarely, recorded in Great Sandy Desert (Storr 1984; Jaensch *et al.* 1988; Jaensch & Vervest 1990; Aust. Atlas). **NT** Widespread in coastal regions of Top End, E to Wessel Is; also on Groote Eylandt and Sir Edward Pellew Grp. Inland, records in a belt from w. Barkly Tableland, W to Tanami Desert; farther S, occasionally recorded in triangular area centred on Alice Springs and extending to n. Napabie Ls, Wood Duck Swamp (30 km N of Mt Skinner), and Ewaninga Rock Carvings Reserve, 30 km S of Alice Springs; also once at Andado Stn (Parker 1969; Schodde 1976; Roberts 1981; Gibson 1986; Aust. Atlas; H.A.F. Thompson & D.K. Goodfellow).

NZ First record, Invercargill, 26 May 1955 (McKenzie 1955). **NI** Isolated record in Northland at Ninety Mile Beach; many records Kaipara, Waitemata and Manukau Harbours, from Taporā, S to Waiuku Spit and Karaka; also several records round Westshore. Others recorded at Porangahau, Ruamahanga R.; between Plimmerton and Pukerua Bay; L. Horowhenua; Manawatu and Wanganui R. estuaries. **SI** Scattered records: Marahau; Wairau Bay; Ashley R. estuary; several records between Waituna Lagoon and mouth of Waimatuku R., including Awarua Bay and Invercargill; also recorded at Arawata R. and Eight Mile Beach (McKenzie 1955; Barlow 1965; Edgar 1971; CSN).

Breeding Scattered. In e. Aust., all but one record S of 26°S; in WA, between 23° and 30°S. **QLD:** L. Moondarra, 12

nests, 1963 (Aust. NRS). **nsw:** L. Cowal (Morris *et al.* 1981); 30 km W of Gunbar (Aust. Atlas); Tullakool Saltworks, three colonies, c. 600 pairs, 1985 (NSW Bird Rep. 1985); Wooroondara Stn, Booligal, 200–300 pairs, 1990 (NSW Bird Rep. 1990); Ticehurst Swamp, 80 pairs, 1974 (NSW Bird Rep. 1974); confluence of Lachlan and Murrumbidgee Rs (Maher 1990); The Retreat, Ivanhoe, 150 pairs, 1973 (Aust. NRS); L. Balcannia, two colonies, 150 pairs, 1974 (Aust. NRS). **vic.:** Cundare Pool, 25 nests, 1981 (Aust. Atlas); Calvert Lough, 14 nests, 1980 (Aust. NRS); L. Milangil, 73 nests, 1979 (Aust. NRS); L. Goldsmith, up to 100 pairs, 1964 (Aust. NRS); Mystic Park, 100 pairs, 1971 (Aust. NRS); L. Tutchewop, 173 pairs, 1984 (Vic. Bird Rep. 1984). **sa:** Bool Lagoon, 9 pairs, 1969 (SA Bird Rep. 1969–70); L. George, Beachport, 24 young, 1964 (SA Bird Rep. 1964); Naracoorte (Attiwill 1972); Pandurra, 22 nests, 1973 (SA Bird Rep. 1973–74); L. Torrens, 8 nests, 1989 (Bellchambers & Carpenter 1990); Coorlay Lagoon, 1981 (Aust. Atlas); L. Harry, ≥ 7 nests, 1950 (Brandon 1951); Clover L., ≥ 300 pairs, 1984 (Badman 1989); L. Marion, possible site, 1979 (SA Bird Rep. 1977–81); waterhole N of Kanowanata, 1979 (Aust. Atlas); Nilpinna Stn, 1974 (Badman 1979). **wa:** Unnamed lake, Stirling Ra., 6 nests, Nov. 1988 (Rose 1989); Hinds L., 21 nests, 1983 (Jaensch 1983); Wagga Wagga Stn, 62 nests, Sept. 1960 (Fuller 1963); Yalgoo (Storr 1985); Wooleen L., 80 pairs, Sept. 1980 (Garstone 1983); L. Annean, c. 200+ pairs, 1984 (Aust. NRS); L. Way, 88 pairs, 1988 (Dunlop 1990); L. Nabberu, >140 nests, 1965 (Ford 1969); Cardabia, 2 nests (Storr 1984); historical record from Maud's Landing, 2 nests, 1900 (Carter 1904).

Populations Indices of relative abundance from annual aerial surveys (transect counts) of wetlands in c. 12% of land area of e. Aust., Oct. 1983–93 (Braithwaite *et al.* 1985a,b, 1986, 1987; Kingsford *et al.* 1988, 1989, 1990, 1991, 1992, 1993, 1994) were: 479; 4690; 40–80; 260–400; –; 2739; 147; 1953; 1232; 260; 2249 respectively. Recorded at ten of 197 nature reserves surveyed in sw. WA, 1981–85 (Jaensch *et al.* 1988).

MOVEMENTS Nomadic and migratory forms occur in HANZAB region; migratory elsewhere (BWP). Six subspecies, two recorded in HANZAB region: subspecies *affinis*, migratory; breeds China and possibly farther W, and moves S for boreal winter to non-breeding areas as far S as n. Aust.; and subspecies *macrotarsa*, highly dispersive; breeds Aust., apparently with regular movement to n. Aust. in winter and to s. Aust. in summer (Blake 1977; Jaensch 1983; de Schauensee 1984; BWP). Below, discussion of subspecies *macrotarsa* unless stated.

Weather and rainfall may influence movements of subspecies *macrotarsa* within Aust. (e.g. recorded moving into WA in some cyclone years, Davies 1988). Transient in some inland areas (e.g. Braithwaite & Stewart 1975). In sw. NSW, movements made by low-flying flocks of c. 10 birds; when wetland encountered, birds either circled and landed on small island or maintained constant direction (Hobbs 1961). While subspecies *macrotarsa* said not to occur 'any distance' from shore (HASB), recorded on Great Barrier Reef islands (Warham 1962).

Departure In Aust., mostly breeds S of 25°S; generally move N in winter and S in summer, moving long distances from s. breeding sites (Aust. Atlas; Vic. Atlas). Some exceptions to general pattern, e.g. often breed in winter (Davies 1988; Aust. Atlas). When breeding recorded L. Eyre, winter influxes occur coasts NT and Qld; when breeding recorded Murray–Darling system, reported e. coast in winter. Unusually high number from Derby, n. WA, in winter 1981, after breed-

ing colonies at L. Annean, WA, dispersed. Said that mainly immatures and non-breeders move N; large numbers immatures in N in summers after good breeding seasons of 1978 and 1979 (Davies 1988); and at least some young move N rapidly (e.g. Fien 1971; see Banding). Dispersal from at least some colonies appears to be gradual (e.g. Cain 1933; Bourke *et al.* 1973). In s. NSW and n. Vic., breed regularly and leave in Jan. or Feb. after breeding (Hobbs 1961; Bourke *et al.* 1973); pattern not altered by unusual and plentiful supply of food (e.g. Hobbs 1976). Appear to remain on suitable floodwaters till areas dry, then disperse widely (e.g. in 1981 inland e. Aust. dry and almost deserted, many reported from N and E and vagrants recorded Great Aust. Bight). After breeding in Murray–Darling system, in year when heavy rains and floods in se. Aust., gradually concentrated on coast as se. Aust. dried in 1981 (Davies 1988). Influxes occur n. Aust. In NT, large numbers Darwin between May and Nov., where most common on coast June and July (Crawford 1972; McKean 1981); in WA, in Pilbara mostly May–Nov.; in Kimberley, Apr.–Sept. (Storr 1980, 1984). In n. Qld, recorded regularly, though not annually, in Richmond R. district, in wet season (Berney 1907) and rare visitor to other sites during wet season (e.g. Tinaroo Dam, Atherton, between Oct. and Dec.; Bravery 1970). Some continue N to s. coast of New Guinea, mostly May–Jan. (Coates 1985), Feb.–Sept. (Beehler *et al.* 1986). Records from Timor and some from se. Wallacea may be subspecies *macrotarsa* (White & Bruce 1986); recorded Simunul, Philippines (Dickinson *et al.* 1991). Recorded NZ (assumed to be *macrotarsa*) (see Distribution).

Extralimitally, subspecies *affinis* fairly common on migration in Taiwan (Severinghaus & Blackshaw 1976); main passage Hong Kong, Sept. (Chalmers 1986); recorded Philippines (Dickinson *et al.* 1991); move through Borneo from Sept., with large numbers Oct. (Smythies 1981; Edwards *et al.* 1986); recorded Sumatra from Oct. (van Marle & Voous 1988); in 1981 and 1982 on passage in Bali from Aug. (assumed to be subspecies *affinis*) (Ash 1984); recorded s. Sulawesi, from Oct. (Escott & Holmes 1980; White & Bruce 1986). Recorded ne. Irian Jaya, Oct. (Ripley 1964). Not known if records N and E of breeding grounds subspecies *affinis* or nominate *nilotica* (Orn. Soc. Japan 1974; Étchécopar & Hüe 1978).

Non-breeding In Aust., mostly in N in winter, in NT, n. WA and coasts of Qld (sometimes large summer populations) and NSW (Hobbs & Kaveney 1962; Gosper 1981; Smyth & Corben 1984; Davies 1988). Small numbers as far S as se. SA, Vic. and Tas. (Aust. Atlas). However, seasonal patterns in some areas differ between years (e.g. at Hunter and Richmond Rs, NSW; Gosper 1981) and pattern differs in some areas, e.g. at some sites in s. Aust. appear to be more abundant in winter (e.g. Jaensch 1983). Record in NZ in winter (e.g. CSN 35).

Extralimitally, subspecies *affinis* occurs Nepal (Inskipp & Inskipp 1985), se. China (de Schauensee 1984), Burma (Smythies 1986), Malay Pen. (Medway & Wells 1976), Borneo (Smythies 1981), Sumatra (van Marle & Voous 1988), Sulawesi (Escott & Holmes 1980) and Philippines (Delacour & Mayr 1946). Non-breeding range of nominate *nilotica* overlaps with that of subspecies *affinis* (Medway & Wells 1976). In Aust., small numbers of subspecies *affinis* said to occur Darwin area, Sept.–Apr. (where range overlaps with subspecies *macrotarsa*) (McKean 1981); and specimens likely to be *affinis* collected Kimberley Div., WA (Johnstone 1977; Schodde 1991). Birds, apparently *affinis*, recorded Lytton, Qld, Dec. 1990 and Nov. 1991 (Qld Bird Reps. 1990, 1991; C. Corben). Recorded year-round at some places where range of subspecies *affinis* and

macrotarsa possibly overlaps (e.g. Edward R., Gulf of Carpentaria; Torres Str.) (Draffan *et al.* 1983; Garnett & Bredl 1985).

Return In s. Aust., where most breeding occurs, appear attracted to floodwaters. Regular in s. NSW and n. Vic., where arrive Sept. and breed (Hobbs 1961; Bourke *et al.* 1973). Few noted each spring e. Gippsland, Vic. (Bedgood 1970). Some movements to breeding areas dispersive, e.g. many recorded nw. Aust. in May 1980, after cyclones delivered much rain Jan.–Apr., and subsequently bred at L. Annean; arrival in Carnarvon in 1978 and in Derby, 1980–81 correlated with distribution of cyclones in those years (Davies 1988); arrived L. Way in Nov. after cyclone (Dunlop 1990).

Extralimitally, subspecies *affinis* not recorded s. Sulawesi after Apr. (Escott & Holmes 1980; White & Bruce 1986); on passage in Bali till May in 1982 (Ash 1984); latest record Sumatra, July (van Marle & Voous 1988); peak passage Hong Kong, from early Apr. to mid-May (when commonest) (Chalmers 1986); fairly common on migration in Taiwan (Severinghaus & Blackshaw 1976).

Breeding In s. Aust., generally occur spring and summer. Reporting rates for SE, Murray–Darling and SA Ras regions highest in summer (spring 1.1%, summer 1.2%, autumn 0.5%, winter 0.9%) (Aust. Atlas). However, pattern can vary, e.g. many remained ne. Aust. coast in summer 1978–79 and 1979–80 (Davies 1988; Aust. Atlas); small numbers recorded as far N as s. New Guinea, Feb.–Apr. (Coates 1985) and small numbers recorded NZ (Falla *et al.* 1981; CSN 31, 37). Major breeding occurs episodically in inland Aust., typically after floods or heavy rain fills shallow lakes (Jaensch 1983); in se. Aust., breed regularly at a few sites (Hobbs 1961; Davies 1988). At many sites, typically breed irregularly, e.g. at L. Tutchewop, Vic., bred 1971 but not again till 1984–85 (Bourke *et al.* 1973; Mitchell 1985). In WA, large numbers only occur when breeding; when breeding occurred at L. Annean in 1980, apparently almost absent from e. coast (Davies 1988).

Subspecies *affinis* breed Shantung and s. Hopeh, China (de Schauensee 1984), possibly e. India and Bangladesh (Ali & Ripley 1969; Ripley 1982). Recorded S of breeding range during this period (e.g. Borneo [Smythies 1981]; Taiwan, [Severinghaus & Blackshaw 1976]; Hong Kong [Chalmers 1986]).

Banding Few recoveries of subspecies *macrotarsa*. Some juveniles move N rapidly: juvenile banded L. Tutchewop, Vic., 11 Jan. 1985, found dead 3072 km N in Dokib, Irian Jaya, 25 Apr. 1985 (ABBBS 1986a); juvenile banded L. Tutchewop, Vic., 11 Jan. 1985, recovered 2538 km N at Weipa, Qld, 23 Oct. 1985 (ABBBS 1986b).

FOOD Carnivorous. Insects, fish and small vertebrates, especially mice and skinks; occasionally young waterbirds.

Behaviour Generally diurnal (BWP) but also recorded feeding at night (Beruldsen 1979). Three methods of foraging observed: (1) **HAWKING**: take insects on wing (Bridgewater 1932; CSN 35); (2) **DIPPING**: fly 2–10 m above water, swooping down to take items from surface of water, mud, or pasture (McKenzie 1955; Wheeler 1959; Ford 1961; Henderson & McBain 1980; Woodall 1986). May settle on water to glean items (Bridgewater 1932; Lingren 1956). Recorded taking moths, attracted to lights at night, from ground (Beruldsen 1979); (3) **PLUNGING**: Rare; recorded circling above and diving for herring *Nematalosa*, herded by cormorants (Carruthers 1969). In central NSW, may rely almost entirely on House Mice *Mus musculus* when breeding (Hobbs 1976). May occasionally steal from other Gull-billed Terns (Hobbs 1976): one Tern, carrying Mouse, was chased by another; first Tern dropped

Mouse, which was then caught by pursuer; first bird then chased its pursuer (Hobbs 1961). Sometimes land at edge of water to swallow large prey and may wash prey before swallowing it (Watson 1955; Henderson & McBain 1980). Forage on freshly ploughed paddocks (Gill 1970). Drink and bathe in freshwater pools (Bellchambers & Carpenter 1990); also scoop water to drink while flying (Garstone 1983).

Adult Annelids: worms³; Crustaceans^{7,16}: decapods⁹: Parastacidae: freshwater crayfish¹⁵; prawns¹¹; crabs^{5,13}; Arthropods: centipedes¹⁵; Insects²: Orthoptera: grasshoppers^{1,14}; Gryllidae: *Teleogryllus*¹⁰; Acrididae^{7,9,10,16}; Hemiptera: Gerridae; Corixidae; Coleoptera: Dytiscidae¹⁶; Lepidoptera: moths¹²; Diptera: larv.¹⁵; Hymenoptera: Formicidae: *Oecophylla virescens*⁹; Fish⁸: Anguillidae⁴; Clupeidae: *Nematalosa*⁶; Reptiles: lizards¹⁵; Mammals: rodents: House Mouse *Mus musculus*⁸. Possibly take Hoary-headed Grebe *Poliiocephalus poliocephalus* chicks⁸. (REFERENCES: ¹ Berney 1907; ² Bridgewater 1932; ³ McKenzie 1955; ⁴ Watson 1955; ⁵ Wheeler 1959; ⁶ Carruthers 1969; ⁷ van Tets & Vestjens 1973; ⁸ Hobbs 1976; ⁹ van Tets *et al.* 1977; ¹⁰ Vestjens 1977; ¹¹ Smith *et al.* 1978; ¹² Beruldsen 1979; ¹³ Henderson & McBain 1980; ¹⁴ Jaensch 1983; ¹⁵ HASB; ¹⁶ FAB).

Young Carry prey to young in bill; frequency of different types of prey delivered to young varies between pairs breeding at same time (Quinn & Wiggins 1990). Grasshoppers and skinks (*Ctenotus*, up to 20 cm long) fed to chicks a few days old (Garstone 1983). Fledged young still fed by parents for some time (Fien 1971).

SOCIAL ORGANIZATION Poorly known in HANZAB area; earlier material summarized in Bourke *et al.* (1973); extralimital information in BWP. Observed singly, or in small parties (mostly <8) throughout year (Gosper 1983); when not breeding, often seen in ones and twos (e.g. Gosper 1983; Jaensch 1983; CSN 31, 32, 34; Vic. Bird Reps. 1981, 1982, 1985; NSW Bird Rep. 1986); over winter, seen in groups of up to eight (Longmore 1978) and travelling in groups of about ten (Hobbs 1961); also recorded in small (White 1919; McGilp 1925; Jaensch 1983) and large (White 1918) parties. Larger flocks (Davies 1988): several hundred, Sandfire Road House, WA; 44, Oaken Hills Stn, SA; 26 (in full breeding plumage), Warrow, SA; 20, near Swan Hill, Vic.; also, 20 (Bristowe *et al.* 1971) and 30+ in flooded country with Whiskered Terns *Chlidonias hybrida* (Howard 1986).

Bonds Monogamous (BWP). **Parental care** Both parents seem to incubate and feed young (Bourke *et al.* 1973). After hatching, many young observed travelling together over plains and away from water, with adults hovering as a large group over them (North). Young that can fly seen to be fed and defended by adults (Davis 1965; Fien 1971).

Breeding dispersion Colonial. Colonies large, up to 300+ pairs, or small, with as few as five nests (Carter 1904; see Distribution). In one colony, some nests grouped round large shrubs but otherwise evenly scattered (Aust. NRS). Distance between nests: NSW: in colony in W, from almost touching to 3–4 m apart (Aust. NRS); in one colony in SW, 0.6–0.9 m apart (North) and at another, hundreds bred so thickly it was hard to find a path between them (North). Vic.: near Swan Hill, c. 0.7 m (just beyond pecking distance) to 4 m (Bourke *et al.* 1973). SA: near Port Augusta, c. 0.4–0.9 m apart (Cain 1933). WA: at L. Hinds, 21 nests 1.5–2.5 m apart (Jaensch 1983); near Yalgoo, 0.9–1.5 m apart (Serventy & Whittell 1976); at L. Way, mean distance 118.8 cm (57–350; 61) (J.N. Dunlop). Other species may nest in or near colonies (see Breeding).

Roosting Recorded gathering to roost and preen on sandbank at swamp (Hobbs 1976). Twenty seen resting on sand-spit (Davis 1965). Said to roost with other terns, gulls and waders (NZRD).

SOCIAL BEHAVIOUR Very poorly known in HANZAB region. Better known extraliminally (see BWP).

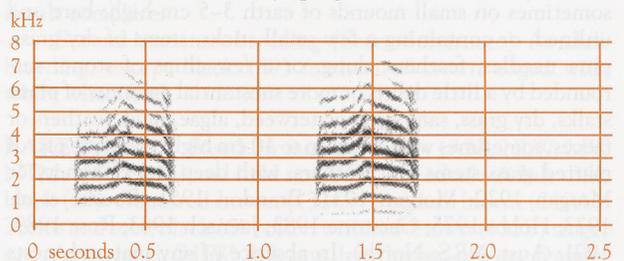
Agonistic behaviour One record of one Tern pursuing another to steal food (see Food) (Hobbs 1961).

Sexual behaviour Greeting Apparently little ceremony at change-over during incubation; when bird returned to nest and started incubating, mate arrived within 1 min, alighting 1–2 m from nest and walking up to stand close behind brooding bird for a few seconds before flying away; no calls given (Bourke *et al.* 1973).

Relations within family group Both parents seem to feed young. As parent flew in with food, juvenile (almost capable of flight) ran to it with upraised wings, head low, and bill almost on ground; on meeting, would jostle parent (Bourke *et al.* 1973); young, capable of flight, screamed and dropped wings in begging posture and was then joined by adult which fed it (Fien 1971). **Anti-predator responses of young** Both young (Cain 1933; Bourke *et al.* 1973; North) and older chicks (North) may hide or shelter with head and neck outstretched, in low scrub, grass, or among rocks; may take to water, as chicks of all ages swim well (Cain 1933; North); if overtaken while swimming, young chicks stretch out flat and remain motionless on water with eyes closed (North). **Parental anti-predator strategies** When people approach nests, adults rise and hover, or fly over nests giving alarm calls (Jaensch 1983; North); may swoop, dive (Cain 1933; Bourke *et al.* 1973), or circle overhead (Fien 1971); many move young to hiding place, or take them out on water (North). Alarm calls recorded when approaching observers as far as 750 m from colony; birds resettled on nests once observers 50 m from colony (Bourke *et al.* 1973).

VOICE In HANZAB area, anecdotal information only. Extraliminally, seven calls described (Sears 1981; BWP, with sonagrams). Quiet compared to Caspian and Whiskered Terns and other species of tern of inland Aust. Bleat only heard when breeding; up to 750 m from colony (Bourke *et al.* 1973). One change-over during incubation was silent (Bourke *et al.* 1973). Shrill cries from adults overhead when nests examined (North).

Adult BLEAT: quavering and somewhat harsh bleat, reminiscent of lamb or kid, with six quavers in almost every call; given in alarm and as threat; birds circling over intruder call at intervals of 6–8 s (Bourke *et al.* 1973). May be same as Chip Call of Sears (1981) and BWP. **SCREAM:** given while flying towards observer by bird that had just fed fully grown young (Fien 1971). May be same as Grack or Attack Call of Sears (1981) and BWP. **YELP:** yelping *kuh-wuk, kuh-wuk* (Slater



A R. Swaby: Townsville, Qld; May 1978; P36

1970; Jaensch 1983); see sonagram A. Equivalent to *chirrup* or Advertising Call of Sears (1981) and BWP. **Other calls** Bark while circling over intruder near nest (Jaensch 1983). May be same as Yelp or correspond to Grack or Attack Call of Sears (1981) and BWP.

Young Shrill quavering whistle from fledged young (Bourke *et al.* 1973). Scream from fledged young in begging posture; young then fed by adult (Fien 1971).

BREEDING Not well known, no detailed studies in HANZAB region. Well known extraliminally (e.g. Lind 1963; Sears 1978; see BWP). Some data from L. Annean, WA (Garstone 1983) and at L. Tutchewop, Vic. (Bourke *et al.* 1973); 30 records in Aust. NRS to May 1993. Will breed in response to flooding of low-lying areas (Jaensch 1983; Rose 1989) and re-nest after suitable rains (North).

Season Mostly Sept. to Jan., but records of eggs from Feb. to June indicate breeding whenever conditions suitable. **WA:** Eggs from at least early Sept. to mid-Apr. (Ford 1969; Garstone 1983; Jaensch 1983; Rose 1989; Anon. 1992, 1993; Aust. NRS); early May in n. WA (Carter 1904). **N. QLD:** Young, late Sept. (Aust. NRS). **NSW:** Eggs, Nov.–Jan. (Chenery & Morgan 1920; Hobbs 1975; Aust. NRS). **VIC.:** Eggs, Oct.–Feb. (Aust. NRS); at L. Tutchewop, laying almost completed and some clutches hatching, 27 Dec.; some clutches still being incubated, 30 Jan.; nesting finished and a few Terns present, 20 Feb.; no Terns seen 28 Feb. (Bourke *et al.* 1973). **SA:** Eggs, mid-Oct. to late Nov. (Attiwill 1972), mid-Jan. (Morgan 1931); eggs and young in June (Aust. Atlas).

Site On low islands, banks of mud and sand, sand-spits or rocky outcrops; in lakes, flooded areas, canegrass swamps, salt-ponds; on bare ground, in areas of dry grass, against dead shrubs, among scattered pieces of limestone, on scattered patches of earth among rocky outcrop, on every available bush in samphire, unless too close to next nest (Carter 1904; Chenery & Morgan 1920; Morgan 1931; Brandon 1951; Bourke *et al.* 1973; Hobbs 1975; Garstone 1983; Jaensch 1983; Rose 1989, 1991; Aust. NRS); on mineral exploration drill-pads (Dunlop 1990). At L. Tutchewop, about one-third of nests on ground, others on samphire (Bourke *et al.* 1973). At L. Way, WA, tucked into edge of *Halosarcia* shrubs (J.N. Dunlop). One hundred nests of Terns, and 200 nests of Silver Gulls *Larus novaehollandiae* on small island, with no overlap. Red-necked Avocets *Recurvirostra novaehollandiae* and Black-winged Stilts *Himantopus himantopus* nested on edge of colony of Terns (Bourke *et al.* 1973); a colony of Straw-necked Ibis *Threskiornis spinicollis* alongside Terns (Garstone 1983); Black Swans *Cygnus atratus*, Masked Lapwings *Vanellus miles*, Red-kneed Dotterels *Erythronyx cinctus*, Eurasian Coots *Fulica atra* and Caspian Terns will nest on same island (Aust. NRS). One Tern nest was found to contain three Red-necked Avocet eggs and two Tern eggs (Aust. NRS).

Nest, Materials Scrape in mud, sandy mud or sand; sometimes on small mounds of earth 3–5 cm high; bare and unlined, or containing a few small sticks, stems of dry grass, pine needles, feathers, dung, or a few chips of stone; surrounded by a little debris or more substantial amounts of plant stalks, dry grass, samphire, waterweed, algae, mud, feathers or faeces, sometimes with a rim up to 10 cm high, or a deep pad of matted grass-stems and feathers, with deep cup (Chenery & Morgan 1920; Morgan 1931; Brandon 1951; Bourke *et al.* 1973; Hobbs 1975; Garstone 1983; Jaensch 1983; Rose 1989, 1991; Aust. NRS; North). In absence of any material, nests consisted of depression in soil built up all round with lumps of

earth and faeces of other waterbirds (North). Nests in samphire made of 75% dry sticks and 25% feathers (Bourke *et al.* 1973). Cain (1933) noted balls of chick excreta round nests; Garstone (1983) found some nests on a sandy spit had elaborate paths to water. Birds form cup by rotating in sandy mud (Bourke *et al.* 1973). Construct nest by first scraping out a depression 15–18 cm across, lay first egg then collect material from round about, gradually building up nest during incubation (North). Carry material to site (Rose 1989); material picked up in bill and tossed backwards towards nest, then accumulated material built into nest (Garstone 1983); use dry grass if it is close to nest (Rose 1991). Use old nests of Black Swans, of varying height, up to 60 cm above water; one large nest 8 m in diameter had four Tern nests, one in centre between added Swan's eggs, other three on side; depressions made in Swan's nest and lined with a few feathers (Hobbs 1975). **MEASUREMENTS** (cm): diameter, 25–38; depth of cup, 5–7.5; floor of cup, a pressed mat 1–3 cm thick (Bourke *et al.* 1973); at 1+ week during incubation: diameter, 30.5–45.7; height, 10.2–15.2; cavity diameter, 15.2; depth, 7.6 (North). Nests on samphire bushes 'several inches above ground' (Aust. NRS).

Eggs Round or narrower and elliptical, some pointed at one end; finely textured, smooth, without gloss; light grey, grey or buff, with varying markings, including underlying patches of light-lavender, overlaid by heavier dark-brown to purplish blotches and marks of irregular form and line; markings evenly scattered, either dense or light, as band round egg (Bourke *et al.* 1973). North describes eggs as swollen or elongate oval, some rather pointed at smaller end; coarse-grained, dull or slightly lustrous; buff-white to white-brown and pale coffee-brown to greenish grey and light olive-green, with irregular spots of rich umber-brown, and brownish black, with intermingled faint underlying markings of inky grey; others have small rounded spots and blotches, with scattered irregular streaks of various shades of umber-brown, with the same underlying bluish-grey markings; some have light olive-green ground-colour, with lines or scratches of various shades of umber-brown and brownish black and similar underlying dull bluish or inky grey markings, particularly on thicker end, where they become confluent and form a zone of interlaced streaks and lines. **MEASUREMENTS:** 52.0 (3.30; 47–60; 20) x 36.1 (1.14; 34–38) (Bourke *et al.* 1973); 53.4 (2.67; 48.5–57.2; 9) x 37.4 (1.07; 35.8–38.9) (North); 50.1 x 34.2 to 60.0 x 40.1 (n=64) (J.N. Dunlop). **VOLUME:** 30–45.2 ml (J.N. Dunlop).

Clutch-size Usually two or three, sometimes one; some clutches of one could be from broken or incomplete sets (Carter 1904; Chenery & Morgan 1920; Brandon 1951; Bourke *et al.* 1973; J.N. Dunlop). Average 2.1: C/2 x 22, C/3 x 7 (Morgan 1931); 2.5: C/1 x 11, C/2 x 52, C/3 x 77 (Ford 1969); 2.5: C/1 x 1, C/2 x 12, C/3 x 13 (J.N. Dunlop). Garstone (1983) said clutch-size ranged from one to five, with three-egg clutches common.

Incubation Both sexes incubate, often changing over after less than 1 h (Garstone 1983). **INCUBATION PERIOD:** Said to be 16 days (North).

Young Precocial, nidifugous. **Growth** One newly hatched young (mm): culmen, 21; inner toe, 12.5; middle toe, 18.5; outer toe, 16 (Bourke *et al.* 1973). **Parental care, Role of sexes** At L. Annean, young left nest when a few days old and rested in shade or in nearby vegetation, always in company of one or both adults (Garstone 1983); young leave nest when 2–3 days old (North). One account of large numbers of young travelling across a plain, away from water, followed by adults flying overhead (North). At South Yellow L., NSW, North

reports young of all stages of growth swimming about in little droves. **FLEDGING PERIOD:** Able to fly at nearly 3 months old (North).

Success Silver Gulls and foxes take eggs and young (Cain 1933; Bourke *et al.* 1973; North). At L. Way, foxes destroyed colony (J.N. Dunlop).

PLUMAGES Prepared by R.P. Scofield. Hatch in natal down, which is replaced by distinctive juvenile plumage at breeding grounds; birds in juvenile plumage can be seen at any time of year. Post-juvenile moult to first immature non-breeding (first basic) plumage is prolonged and probably complete; starts 2–3 months after fledging; moult not finished till 16–17 months old. Thereafter, moult twice annually: a complete post-breeding (pre-basic) moult beginning straight after breeding, apparently suspended while dispersing, and finished in non-breeding areas; and a partial pre-breeding (pre-alternate) moult to breeding plumage, beginning c. 4 months before, and completed c. 1 month before, breeding. Mees (1982) and HASB incorrectly state that subspecies *macrotarsa* does not have an adult non-breeding plumage. About six subspecies: *macrotarsa*, breeds Aust. (described below); second, unknown, subspecies recorded n. Aust.

Adult breeding (Second and subsequent alternate). **Head and neck** Forehead, upper half of lores, crown to slightly below eye, and most of nape, black (89) with blue-black (c173) gloss when fresh. Rest of lores, chin, throat and foreneck, white; lower nape, pale grey (86) (*contra* Olsen & Larsson 1995). **Upperparts** Mantle, back and scapulars, pale grey (86), slightly paler on scapulars. Rump and uppertail-coverts, white. **Underparts** White; some males said to have a slight pale-grey (c86) tinge to belly (Olsen & Larsson 1995) but not seen in specimens examined here. **Tail** White, though may have grey wash on t3–t6 and bases of inner webs of t1 and t2, especially when worn; underside, white. **Upperwing** Coverts and most remiges, pale grey (c86), as scapulars, and slightly paler than mantle and back. Basal one-third of inner webs of primaries have concealed white wedges that grade to pale grey (c85) at tips. Marginal coverts, inner primaries and secondaries edged white. When fresh, remiges have silver gloss that quickly fades. Primaries, especially p4–p7, and outer secondaries wear to light grey (85), then grey (84 or 83) and, by late in breeding season, outer webs of outermost primaries may be dark grey (83) or, exceptionally, grey-black (82). **Underwing** White, with grey (84) tips to p5 or p6 to p10, forming dark trailing-edge to outerwing, broadest at tip.

Adult non-breeding (Second and subsequent basic). As adult breeding except forehead, lores and crown, white, with varying pale-grey (c86) shading. Upper nape, pale grey (86) or off-white. Sides of crown, lores and nape usually have some narrow brown-black (119) shaft-streaks. Distinct brown-black (119) patch extends from in front of and below eye to ear-coverts. Lower nape and upper mantle, white.

Downy young No specimens available; based on Fjeldså (1977) and unpublished photos. Apparently two morphs in Aust., with some intergradation between them. Down, long and soft, with smooth hair-like tips. **PALE MORPH:** Head and upperparts, mainly pink-brown (219C) with some indistinct light grey-brown (119D) speckling. Lores next to gape, eye-ring and area round eye, and ear-coverts, off-white. **Underparts**, off-white. **DARK MORPH:** Head and neck, brown (37) with three parallel lines of light grey-brown (119C) spots from crown to nape, becoming two parallel lines on back to tail. Lores next to gape, eye-ring and area round eye, and ear-

coverts, buff (123D). Underparts, cream (54). Some are extremely dark, with dark-brown (119A) spotting on crown and back, and brown-black (119) throats.

Juvenile Account based on one specimen, field notes and unpublished photos (D.W. Eades, J.N. Davies). In European populations, extent of marking of upperparts varies, though Aust. population appears to vary less. **Head and neck** Forehead, crown and nape, off-white; some feathers have pale-grey (c86) wash, and many have narrow brownish-grey (80) shaft-streaks that become broader on nape; tips of feathers edged with buff (121D) when fresh. Feathers of lores, white, with black-brown (119) tips. Small area immediately in front of eye, mostly black (89) or black-brown (119) becoming light grey-brown (119D) below and behind eye. Narrow eye-ring, white. Rest of head and neck, white. **Upperparts** Mantle, scapulars, and back, light grey (85) with large, brown (119B) subterminal chevrons and buff (121D) wash to tips; tips soon fade to white. In dark birds, many scapulars have small dark-brown (119A) rosethorns or smudges farther down shaft separated from chevron by light-grey (85) band. Uppertail-coverts, white, contrasting strongly with dark back. **Underparts** White. **Tail** Upperside of rectrices, white at base, washed with off-white or pale grey (86) toward tip, with small orange-rufous (132D) subterminal spots. Late in first non-breeding season, off-white edges (up to 2–3 mm wide) wear to leave pointed buff (123D) tips. Underside, white, with traces of buff (124) spots near tips. **Upperwing** Uniform light grey (85) grading to slightly darker on secondaries; tertiaries have large black-brown (119) subterminal chevrons; in dark birds, many tertiaries have small dark-brown (119A) rosethorns farther along shaft, separated from chevron by light-grey (85) band; lesser, median and greater coverts have small black-brown (119) subterminal chevrons and faint orange-buff (118) tips. Markings on tips of coverts only small and do not form dark cubital bar. Most primaries uniformly coloured, with white tips to inner primaries, so little suggestion of dark trailing-edge to wing. **Underwing** Like adult breeding but can have broader, more diffuse trailing-edge to primaries.

First immature non-breeding (First basic). Little Aust. material for this or subsequent subadult plumages; following in part based on European data (BWP). As adult non-breeding except: retain juvenile outer primaries, some primary coverts, many secondaries and tertiaries, and some rectrices (especially t1 and t2) till c. 1 year old; these feathers become very worn.

First immature breeding (First alternate). Similar to adult non-breeding but some show broad brown-black (119) spots on feathers of crown and nape. Retained juvenile outer primaries (if still present) darker and more worn than in adult. An immature *affinis* (or possibly nominate *nilotica*) from nw. Aust. (ANWC 17715) still retained some very worn juvenile rectrices (t2, t3 and t4); not known if this can occur in *macrotarsa*. Head, body and wing replaced by 16–17 months old; probably indistinguishable from adult when post-juvenile moult complete.

Second immature breeding (Second alternate). As adult breeding, except black (89) feathers of crown edged with white when fresh.

BARE PARTS Based on museum labels (AM, HLW, MV, NTM, QM, SAM) and field notes (D.W. Eades). **Adult** Bill, black (89). Gape, red-brown (132C). Iris, dark brown (219A). Tarsus and toes, black (89) often with red-brown (132B) tinge; one Aust. label (HLW 40) says legs brown-olive. **Downy young** Bill, dirty pink (5) or dull pink (6) usually with dusky

tip. Iris, dark brown (219A). Tarsus and foot, orange-buff (153), orange-rufous (132C) or red-brown (132B). **Juvenile, Immatures** In Europe and probably Aust., bill, orange-rufous (132D) with dusky tip at fledging, darkening to grey-brown (91) after 2 months; black (89) after 3 months but may have red-brown (132B) tinge to base of lower mandible for c. 4 months. Iris, dark brown (119A). Tarsus and toes, light rufous-brown (139) or brown (33) with orange-buff (118) or red-brown (132B) soles; tarsus and toes darken to black over c. 5 months.

MOULTS Subspecies *macrotarsa*. Information from examination of skins (AM, HLW, MV, QM, WAM), field notes (C. Corben; D.W. Eades), banding records (AWSG) and photographs (Pringle 1987; unpubl.: D.W. Eades). Timing of moults varies greatly in Aust. *macrotarsa* and cannot be described fully on present knowledge. A little evidence suggests that sequences of moult of individuals of small dark subspecies occasionally observed in Aust. similar to those described for nominate *nilotica* in BWP (C. Corben). **Adult post-breeding** (Second and subsequent pre-basic). Complete; primaries outwards. Starts with p1 immediately after breeding; many moult p2–p4 before suspending moult and moving from breeding to non-breeding areas; resume moult of remiges in non-breeding areas. May moult feathers of crown and neck during dispersion; moult mantle, scapulars and underparts when moult of remiges resumes in non-breeding areas; finish moult of head (with forehead, chin and throat) midway through moult of remiges. Then moult rest of body and wing-coverts almost immediately. Tail: sequence appears to be t1–t2–t3–t6–t5–t4, beginning about same time as moult of head and usually suspended at about t3 or t6 during movement to non-breeding areas; usually finished by time p8 or p9 lost. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial. Moult of head, tail, underparts, some scapulars and feathers of mantle begins c. 4 months before breeding; moult generally complete c. 1 month before breeding. In nominate *nilotica*, inner 2–4 primaries also moulted, in a few starting before post-breeding moult of outer primaries complete. In Aust. only occasionally perform arrested moult of inner primaries. Some data suggesting that inner primaries have been moulted questionable because protected inner primaries sometimes claimed as fresh, and unprotected (and so darker) outer primaries as old, when both are of same generation. **Post-juvenile** (First pre-basic). Probably complete but little data for Aust. Tail moulted c. 1 month later than in breeding adults. Pattern and timing of body-moult appears to be similar to that of accompanying adults. Moult of remiges begins immediately after body-moult finished. Some may briefly suspend moult of remiges. **First immature pre-breeding** (First pre-alternate). Partial. Poorly known. Dark spotted crown of some immatures in first-year (see First immature breeding) indicates some moult of head must occur while first pre-basic moult of outer primaries is still in progress; not known if there is also other moult of body causing no change in appearance. **Second immature post-breeding** (Second pre-basic). Apparently like adult post-breeding; in nominate *nilotica* can start before first pre-basic of outer primaries complete.

MEASUREMENTS Subspecies *macrotarsa*. (1) NW. Aust., adults with worn p10, live (AWSG); sexed using HUMPS–UV program of Rogers (1995). (2) Aust., skins; Bill D(G) = depth of bill at gonys; Bill D(N) = depth of bill at nostrils (AM, ANWC, HLW, MV, QM, WAM).

	MALES	FEMALES	
WING	(1) 343.9 (12.69; 26)	323.8 (11.94; 23)	**
	(2) 331.3 (12.8; 312–345; 6)	327, 338	–
BILL	(2) 43.3 (2.21; 40.4–46.0; 7)	38.8, 42.3, 43.4	–
BILL D(G)(2)	11.8 (0.60, 11.1–12.8; 7)	10.3, 10.7, 10.9	–
BILL D(N)(2)	13.3 (0.51; 12.6–13.9; 7)	11.9, 12.4, 13.0	–
TAIL	(2) 131.2 (6.50; 121–139; 5)	126, 128, 134	–
TARSUS	(2) 36.2 (1.17; 34.3–37.4; 7)	33.0, 35.8, 37.0	–
TOE C	(2) 35.0 (0.93; 33.6–36.2; 7)	32.8, 33.6, 33.9	–

Females smaller in all measurements.

Subspecies *macrotarsa*. (3–5) NW. Aust., adults, live; sexes combined (AWSG): (3) All birds combined; (4) Birds with worn p10; (5) Birds with fresh p10.

	UNSEXED	
WING	(3) 330.1 (15.26; 295–367; 56)	
	(4) 328.7 (13.30; 304–350; 45)	
	(5) 339.6 (9.31; 330–351; 6)	
BILL	(3) 44.8 (3.60; 33.9–50.5; 64)	
THL	(3) 91.7 (4.59; 78.7–101.8; 58)	

(6) Subspecies *nilotica*: Adult, skins (BWP). (7) Subspecies *affinis*: China and Java, adult, skins (BWP).

	MALES	FEMALES	
WING	(6) 326 (7.36; 309–341; 35)	319 (7.41; 307–333; 24)	**
	(7) 312 (7.12; 302–321; 10)	295 (12.50; 280–308; 8)	*
TAIL	(6) 132 (5.27; 123–143; 22)	127 (5.32; 118–136; 14)	**
	(7) 124 (8.29; 116–140; 8)	113 (5.74; 106–120; 7)	*
BILL	(6) 39.8 (1.44; 38–42; 36)	37.7 (1.37; 35–40; 28)	**
	(7) 38.4 (1.12; 37–40; 12)	35.5 (1.42; 33–37; 10)	**
TARSUS	(6) 34.8 (1.31; 33–38; 34)	33.4 (1.14; 31–35; 27)	*
	(7) 32.0 (0.85; 31–33; 13)	30.7 (0.97; 30–32; 10)	**
TOE C	(6) 31.1 (1.24; 29–33; 28)	30.2 (1.41; 28–32; 25)	**

In nominate *nilotica*, tail of adult breeding and non-breeding similar; wing of juvenile 15–20 mm shorter than in adult and tail c. 25 mm shorter; tail of immature (first basic or first alternate) averages 13 mm shorter than tail of adult (BWP). No comparable data for subspecies *macrotarsa*.

Old World vagrants to n. Aust. (subspecies *affinis* or *nilotica*, certainly not *macrotarsa*): females (ANWC): Wing, 307; Tail, 112, 122; T1–T6, 26, 41; Bill, 36.2, 36.7; Bill D, 12.0, 10.2; Bill D(G), 11.1, 10.5; Bill D(N), 10.5, 11.7; Tarsus, 31.3, 28.5; Toe C, 29.7, 28.8. Unsexed immature from nw. Aust.: Wing 282; Tail 104; Bill 38; Tarsus 30 (Johnstone 1977).

WEIGHTS Subspecies *macrotarsa*. S. Aust., skins: adult males, spring–early summer 262, 270, 345 (NTM, QM); adult female, Feb., 184 (QM). NW. Aust., live, sexes combined (AWSG): unaged: July, 241.3 (28.16; 160–285; 26); adults: Mar.–Apr., 238.3 (17.97; 206–277; 46), Aug.–Sept., 263.5 (32.2; 188–360; 24). Difference in weight between Mar. and Aug. significant ($P < 0.01$).

Subspecies *affinis*. China (BWP): males 223 (178–320; 10); females 212 (185–231; 11). Old World vagrants in n. Aust.: adult female 180 g; immature female, 162 g. For weights of nominate *nilotica* (see BWP).

STRUCTURE Wing, long, narrow and pointed. Eleven primaries: p10 longest, p9 17–25 mm shorter, p8 35–52, p7 61–

83, p6 86–105, p5 109–134, p4 135–151, p3 150–172, p2 179–193, p1 202–216; p11 minute, concealed by primary coverts. Longest tertial reaches to p4–p6 on folded wing. Central feathers of nape slightly elongated but do not form prominent crest. Tail, slightly forked (less deeply than other *Sterna*); 12 feathers; fork slightly deeper in males than females; much less deep in juveniles, which also have slightly shorter t1 (little data for Aust.; see BWP for details). In breeding plumage, t6 elongated and strongly tapering toward tip; t1 narrows toward end, with rounded tip. All become very pointed with wear. Bill, stout, deep at base, with prominent angle at gonys and deep base. In subspecies *macrotarsa*, lower mandible heavy and bill slightly longer than head. Legs proportionally longer than in other *Sterna*, with one-third to one-quarter of tibia bare; tarsus, stout and rounded; scutellate. Toes proportionately long for a tern, with front toes fully webbed. Outer toe 87% of middle, inner c. 69%; hind 33%.

GEOGRAPHICAL VARIATION Not properly known; about six subspecies, differing in measurements and colour of upperparts and wings (BWP). Aust. subspecies *macrotarsus* is largest, with especially heavy foot and bill and very pale upperparts. South American *grönvoldi* also has pale upperparts; other subspecies of North America and Old World have distinctly darker grey upperparts and upperwing-coverts, and differ mainly in size. Subspecies *nilotica* (w. Palearctic) slightly larger than e. Asian subspecies *affinis* (see Measurements). It has been suggested that geographical variation in Old World is clinal and *affinis* should thus be combined with *nilotica* (Étchécopar & Hüe 1978; Peters).

A smaller-billed and darker form, generally claimed to be subspecies *affinis*, occasionally recorded n. Aust. However, subspecific identity of these birds not certain (Johnstone 1977; McKean 1981; Schodde 1991 cf. Étchécopar & Hüe 1978). McKean (1981) provides no supporting evidence for claim of occurrence of *affinis* in small numbers, Sept.–Apr. The identity of the two specimens from NT (too small and too dark above for *macrotarsa*) also somewhat problematical (Schodde 1991): the wing of one (ANWC 16040) (one of critical measurements in separating the two subspecies) cannot be measured accurately because it is in moult but its tarsus is unusually small for *affinis*; a second bird (ANWC 17715; aged as an immature female) has shorter tarsus than any *affinis* in BWP, yet wing unusually long for *affinis*; depth of bill said to fall within range of *affinis* (Schodde 1991) but method of measurement differed from that of BWP; re-measurement of bills shows both ANWC birds had bill-depth measurements above the range given in BWP for *affinis* but within the range for *nilotica*. Description of specimen from Kimberley (Johnstone 1977) uses presence of non-breeding plumage as an identification point but, *contra* Mees (1982) and HASB, *macrotarsa* does have a non-breeding plumage. This bird did, however, have a dark rump and tail, short wing and less stout bill. Two birds that were not *macrotarsa* seen se. Qld, Dec. 1990 and Jan. 1991, observed in detail in field; both had dark rumps, small bills and short tarsus (C. Corben). More work on Asian populations needed before establishing origin of other forms in Aust.

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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