

Order CHARADRIIFORMES

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

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

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

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

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

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

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

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

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Family LARIDAE skuas, jaegers, gulls and terns

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

Stercorariinae Skuas and jaegers; about six species; cosmopolitan.

Larinae Gulls; c. 47 species; cosmopolitan.

Sterninae Terns; c. 42 species; cosmopolitan.

Rynchopinae Skimmers; three extralimital species, pan-tropical.

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

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

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

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

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

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

Plate 23

Oriental Pratincole *Glareola maldivarum* (page 366)

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

Australian Pratincole *Stiltia isabella* (page 373)

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

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

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

See subfamily accounts for summaries of social organization and breeding.

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Subfamily STERNINAE terns and noddies

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Sterna paradisaea Arctic Tern

Sterna Paradisaea Pontoppidan, 1763, *Danske Atlas* 1: 622 — no type-locality = Christiansø, off Bornholm, Denmark (ex Brünnich, 1764, *Orn. Boreal.*: 46).

Specific name from the late Latin *paradisus*, paradise, highlighting the ethereal plumage and buoyant flight.

MONOTYPIC

FIELD IDENTIFICATION Length 27.5–35 cm; wingspan 66–72 cm; weight c. 110 g. Slender, medium-sized sea tern, with short slender bill; small rounded head and short neck; compact oval body when perched, deepest at breast and belly; long deeply forked tail; and very short legs (so that belly sometimes appears to be almost touching ground). Flight silhouette distinctive: appear slender and elegant, with head and neck tucked well into body, giving characteristic neckless jizz; long narrow wings appear to be set well forward on body, with very narrow outerwings tapering to fine points, and often strongly angled back from carpal; and tail often held tightly closed, tapering to wispy point and undulating in flight. Very similar in size and shape to Common *Sterna hirundo*, White-fronted *S. striata* and Antarctic *S. vittata* Terns. Plumages very similar to those of Common Tern. In all plumages, light grey above, with contrasting white rump and tail and dark sides to tail; uniform grey outerwing usually without contrast in primaries (except briefly when moulting in Antarctic pack-ice); and diagnostic clear-cut narrow black tapering trailing-edge to primaries. Adult in breeding plumage has black cap and white cheek-stripe, and red bill, legs and feet. In non-breeding plumages, head-pattern diagnostic: white with black band from eye to nape; also have varying dusky cubital bar, white underbody, and black bill, legs and feet. Juvenile has diagnostic pale panel on remiges contrasting with rest of upperwing. Sexes alike. Marked seasonal variation. Juvenile distinct. Immatures separable.

Description Adult breeding Forehead, crown and nape, black, forming neat cap extending to level with bottom of eye, and with only narrow white wedge between cap and gape; bordered below by narrow white cheek-stripe extending to sides of nape; chin, throat and lower cheeks, light-grey. Narrow white collar on hindneck (usually not seen in flight). Saddle and tertials, light grey, with narrow white barring on tertials and rear scapulars when fresh. Rump and tail, white, contrasting strongly with grey saddle, and with grey-black sides to tail; tips of streamers extend beyond wing-tips at rest. In flight: upperwing, uniform light grey, with narrow white trailing-edge that tapers onto inner primaries and narrow dusky trailing-edge to outer primaries, tapering towards secondaries; primaries often appear to flash paler than rest of upperwing. At rest, folded wing, light grey, as rest of upperparts; primaries slightly darker, silvery grey, with thin tapering white upper edge to folded primaries, petering out before wing-tip. Chin to lower belly, light grey, sharply demarcated from white vent and undertail-coverts. Underwing, white, with thin dark stripe on leading primary; and diagnostic, crisp narrow black trailing-edge to primaries, tapering towards secondaries; remiges, especially primaries, translucent, with distinctive thin dark streaks visible on outerwing. With wear: cap tends to become whiter from centre of crown or from forehead (similar to Common Tern); primaries lose silvery bloom, appearing

uniform dusky grey with blackish trailing-edge, and similar to rest of upperwing; and chin and throat, white. Bill, red, sometimes with black tip and black at base of bill. Iris, dark brown. Legs and feet, red. In HANZAB region, bill often darker red or black, and legs and feet may be darker or duller red. **Adult non-breeding** Differ from adult breeding by: Distinctive head-pattern: head and neck, white, with black streaking on rear-crown and black band extending from in front of eye, through ear-coverts to nape (recalling non-breeding Little Tern *S. albifrons*); from head-on, forms prominent large white oval on head. Tail, similar to breeding, but with more grey at sides, darkest on outermost rectrices; slightly shorter and less deeply forked, with tip falling level with or slightly short of wing-tips. Narrow dusky-grey cubital bar. Underbody, white. Bill, black, sometimes with tiny off-white tip. Legs and feet, dark red-brown to dull black. **Juvenile** Birds in full juvenile plumage not recorded HANZAB region. Similar to adult non-breeding; differ by: Forehead and anterior lores washed pale brown, and black covers most of crown (giving head-pattern similar to juvenile and non-breeding Common Tern); with wear, brown wash lost and crown whitens. Saddle, tertials and innerwing-coverts, finely barred pale brown or off-white, and with narrow dark-brown crescents and brown wash when fresh. Tail, shorter, less deeply forked, with tip falling well short of wing-tip. In flight, upperwing, light grey, with varying narrow dusky-grey cubital bar and diagnostic white or pale-grey panel covering secondaries and inner few primaries, always paler than rest of wing; and narrow tapering dusky trailing-edge on outer primaries; at distance, some appear to have uniform light-grey triangle on innerwing and on outerwing, with white triangle between them. At rest, folded wing has narrow grey cubital bar extending narrowly round carpal; and silvery-grey primaries, with fine white edges and tips that peter out before reaching wing-tip. Bill, orange-pink, with culmen and distal half, black; soon becomes black. Legs and feet, dark orange-red; soon become red-brown or black. **First immature non-breeding** Similar to adult non-breeding, though some have more black on crown (giving head-pattern similar to non-breeding Common) and typically lack dark cubital bar; some may have dark red at base of bill. **Second immature non-breeding** See Plumages.

Similar species Easily confused with **Common** and **Antarctic Terns**; can also be confused, especially in non-breeding plumages, with **White-fronted**, **Roseate** and **Whiskered Terns**; see those accounts for details.

Gregarious. In HANZAB region, often seen singly, in pairs or trios during austral winter; often seen in small flocks on migration or in Antarctic waters, where typically roost in small flocks on ice-floes at edge of pack-ice. In HANZAB region, normally pelagic; only tern likely to be seen in open ocean S of 45°S; sometimes inshore or seen from shore, especially during or after storms, and, occasionally, singles or small

flocks shelter on rocky or sandy ocean beaches or enter bays and harbours. Associate with other terns, especially Common and White-fronted, and with Antarctic Terns on subantarctic and Antarctic islands. Tired migrants often very tame, allowing close approach. Carriage horizontal; more upright when alert or in display. Legs, short and gait more shuffling than Common Tern. Normal flight similar to that of Common Tern, though typically more buoyant and graceful, with slower, shallower and more graceful, or deeper and more thrusting, wing-beats, always with distinct pause on upstroke. Feeding flight distinctive: Arctic has distinctive stepped-hover flight recalling that of Little or Fairy *S. nereis*. Terns: tends to hover up to 10 m above surface then descend vertically in steps, with wings held in characteristic V, pausing at each step to hover before finally plunging or dipping; aborted dives and low-level swoops may end in hovering flight followed by vertical upflight. Most distinct call a harsh *kee-arr* in alarm; also whistled or squeaked notes such as *kee* and *peet*; voice similar to Common Tern but all notes higher pitched.

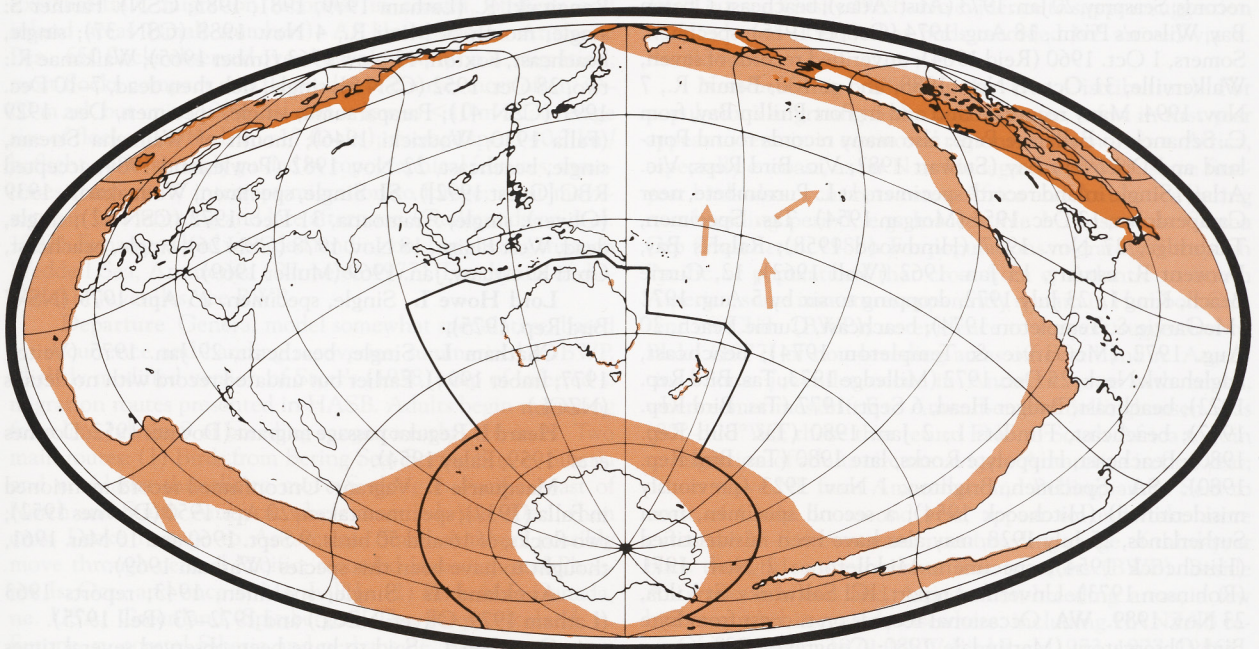
HABITAT During non-breeding period, mainly frequent edges of Antarctic pack-ice and nearshore icebergs and ice-floes; in both heavy or loose pack-ice (Falla 1937; Routh 1949; Bierman & Voous 1950; van Oordt & Kruijt 1954; Zink 1981). Rarely penetrate far over zone of pack-ice (Routh 1949; Zink 1981). Mostly absent from open water >24 km offshore from pack-ice, or seas with temperatures >0 °C, except on migration (Falla 1937; Routh 1949; Bierman & Voous 1950). At sea, generally in flight (Griffiths & Sinclair 1982).

In Antarctica, mainly feed in water near edge of pack-ice, especially in leads and channels between ice-floes (Falla 1937; Bierman & Voous 1950); also forage above brash-ice (Zink 1981). Occasionally forage in association with Minke Whales *Balaenoptera acutorostrata* in open ocean N of pack-ice (Routh 1949; Griffiths 1982; Griffiths & Sinclair 1982). Birds on passage through Macquarie I. have been recorded foraging over surf in bay (Downes 1952; Downes *et al.* 1959). In NZ, seen foraging round channels in harbour (Sibson 1982; CSN

22). Mostly take food from just below surface of water, but occasionally glean from surface (Zink 1981).

In Antarctica, roost or loaf on pack-ice (Falla 1937) and nearshore ice-floes, icebergs and ice-cakes, including those covered with powdered brash-ice (Falla 1937; Routh 1949; Bierman & Voous 1950; van Oordt & Kruijt 1954; Zink 1981; Griffiths & Sinclair 1982). On migration, rest at sea, perching on kelp, logs or flotsam (Summerhayes *et al.* 1974; Wahl 1975). Passage migrants on Macquarie I. recorded on beaches (Downes 1952). In A'asia, mostly recorded resting on estuarine beaches and spits (Storr 1956; Latham 1979, 1981, 1983; Curry 1984); also on rocky reef (McBride 1983) and structures, including jetty (Edgar 1961) and seawall (Sibson 1982). When moulting primaries, possibly restricted to narrow zone at edge of pack-ice with lots of small blocks of ice on which birds can sit and moult (D.J. James; R.P. Scofield).

DISTRIBUTION Breed British Isles and e. coasts of North Sea, E to n. Baltic Sea and Gulf of Bothnia, mainly in belt from Scandinavia through coastal Russia (though extending S to junction of Ob and Irtysh Rs), E to Chukotskiy Pen. and then S to n. Sea of Okhotsk; also on many islands in Arctic Sea. In North America, from Aleutian Is and Alaska Pen., E to Newfoundland, New Brunswick and ne. USA; extend N to n. Alaska, Banks I., Queen Elizabeth Is and Labrador, and S to c. 60°N from nw. British Columbia E to Hudson Bay; round s. shores of Hudson Bay, and in central Quebec. Also breed Greenland and Iceland (Dement'ev & Gladkov 1951; AOU 1983; BWP). During non-breeding period, mostly in Antarctic (see below); smaller numbers Humboldt Current off Chile, and some said to remain off Argentina; also off s. Africa from Namibia to Mozambique (Storr 1958; Salomonsen 1967; Summerhayes *et al.* 1974; Blake 1977; Morant *et al.* 1983; Urban *et al.* 1986; Murphy; BWP). Occur on passage off e. Pacific coasts off North and South America; in Atlantic Ocean off sw. South America and from Iberian Pen., S along w. African coasts (Storr 1958; Salomonsen 1967); rarely, occur on passage in s. Indian Ocean or across central Pacific Ocean





(Storr 1958; Mörzer Bruyns & Voous 1964; King 1967; Clapp 1975; Parmelee 1977; AOU 1983; Pratt *et al.* 1987).

Aust. All records singles unless stated. **Qld** Cairns, 25, 28 Dec. 1978; Carbrook–Redland Bay, 1980; Buchan's Pt, 28 Oct. 1980 (Aust. Atlas). Unverified record, Cairns, 3 Dec. 1979 (Wren 1980). **NSW** Single record n. coast: North Ck, Ballina, 9 Apr. 1984 (NSW Bird Rep. 1984). Many and widespread records between North Head and Eden (Brandis *et al.* 1992; NSW Bird Reps.; Aust. Atlas). **Vic.** Isolated Gippsland records: Seaspray, 20 Jan. 1973 (Aust. Atlas); beachcast, Oberon Bay, Wilson's Prom., 18 Aug. 1974 (Cooper 1975); specimen, Somers, 1 Oct. 1960 (Reid 1964); unverified records of seven, Walkerville, 31 Oct.–8 Nov. 1988, and c. 100, Bemm R., 7 Nov. 1994. Many records round and in Port Phillip Bay, from C. Schanck to Bellarine Pen.; also many records round Portland and Discovery Bay (Stewart 1982; Vic. Bird Reps.; Vic. Atlas). Single inland record, specimen, at L. Purrumbete, near Camperdown, 13 Dec. 1953 (Morgan 1954). **Tas.** Specimen, Tunbridge, 27 Nov. 1957 (Hindwood 1958); Ralph's Bay, Derwent R. estuary, 13 Jan. 1962 (Wall 1962); 12, Currie Beach, King I., 23 July 1972, dropping to six by 5 Aug. 1972 (McGarvie & Templeton 1974); beachcast, Currie Beach, 20 Aug. 1972 (McGarvie & Templeton 1974); beachcast, Eaglehawk Neck, 25 Dec. 1972 (Milledge 1973; Tas. Bird Rep. 1972); beachcast, Badger Head, 6 Sept. 1977 (Tas. Bird Rep. 1977); beachcast, Flinders I., 2 Jan. 1980 (Tas. Bird Rep. 1980); beachcast, Hippolyte Rocks, late 1980 (Tas. Bird Rep. 1980). **SA** Specimen, Brighton, 1 Nov. 1923 (previously misidentified) (Hitchcock 1954); a second specimen, from Sutherlands, 25 July 1928, may also have been misidentified (Hitchcock 1954); specimen, Middleton, 12 Nov. 1971 (Robinson 1973). Unverified report, ICI Saltworks, St Kilda, 23 Nov. 1989. **WA** Occasional records on s. coast from Eyre Bird Observatory (Martindale 1980; Congreve 1982; Curry

1984; Congreve & Congreve 1985; Dymond 1988) and Esperance (Storr 1987). Many records from C. Leeuwin and Hamelin Bay, N to L. Joondalup (Storr & Milward 1957; Curry 1984; Jaensch *et al.* 1988; *West. Aust. Bird Notes*). Once recorded Gantheaume Bay, 15 Oct. 1986 (ABBBS 1989).

NZ Regular visitor in small numbers. First recorded 1929. **NI** Scattered records on Auckland Isthmus and Bay of Plenty: in Kaipara and Manukau Harbours (Edgar 1961; Frew 1969; Sibson 1982; Oliver) and between Bowentown and Rangitaiki R. (Latham 1979, 1981, 1983; CSN). Farther S: single, mouth of Mimi R., 4 Nov. 1988 (CSN 37); single, beachcast, Foxton, 13 Nov. 1963 (Imber 1965); Waikanae R.: two, 28 Oct. 1952 (CSN 5); single, sick then dead, 7–10 Dec. 1991 (CSN 41); Paraparaumu, single, specimen, Dec. 1929 (Falla 1930; Wodzicki 1946); mouth of Waimeha Stream, single, beachcast, 22 Nov. 1982 (Powlesland 1984; accepted RBC [Guest 1992]). **SI** Single, specimen, Waimakariri, 1939 (Oliver); single, Aramoana, 31 Dec. 1972 (CSN 22); single, dead, West Plains, 18 Nov. 1978 (CSN 26); single, beachcast, Oreti R. estuary, Jan. 1969 (Muller 1969).

Lord Howe I. Single, specimen, 25 Apr. 1975 (NSW Bird Rep. 1975).

Chatham I. Single, beachcast, 29 Jan. 1975 (Veitch 1977; Imber 1994). Earlier but undated record with no details (NZCL).

Heard I. Regular passage migrant (Downes 1952; Downes *et al.* 1959; Ealey 1954).

Macquarie I. Vagrant. Unconfirmed record mentioned in Falla (1937); specimen taken, 20 Apr. 1950 (Downes 1952); two flocks, of 16 and 50 birds, 9 Sept. 1960 and 10 Mar. 1961, thought to have been this species (Warham 1969).

Auckland Is Single, specimen, 1943; reports 1963 (Latham 1979; Oliver; NZCL) and 1972–73 (Bell 1975).

Campbell I. Said to have been observed several times

(Guthrie-Smith 1936); singles, 18 Dec. 1942 and 8 and 10 Dec. 1943 (Bailey & Sorensen 1962); three, 8 Jan. 1958 (Westerskov 1960); these dates listed incorrectly in Latham (1979). Kinsky (1969) considered that all records may have been of immature Antarctic Terns.

S. Shetland Is One or two specimens said to have been taken (Watson *et al.* 1971).

S. Orkney Is Possible vagrant. Three specimens said to have been taken on Signy I. in 1956, but identity not confirmed. Also reported later but without descriptions (Rootes 1988).

S. Georgia Thought to occur regularly, but few records. Three, 7 Apr. 1977 (Jehl *et al.* 1978); a few subsequent sightings at sea off S. Georgia (Prince & Croxall 1983).

Prince Edward Is Marion I.: four, Sept. 1976; five, late Nov. 1977; 14, early Dec. 1977 (Williams & Burger 1978).

Iles Crozet Singles, 31 Oct., 17 Nov. 1978; four, 15 May 1979 (Stahl *et al.* 1984).

Antarctica Widespread in pack-ice in most coastal regions. Mainly in E, between c. 30°W and 150°E; common and widespread in central and e. Weddell Sea and numerous farther E, between c. 50°E and 120°E; also in Ross Sea (where densities equivalent to those of Weddell Sea, and much higher than those reported from other areas); generally recorded only infrequently between Ross Sea and Antarctic Pen., though several records in Bellingshausen Sea, and during cruise from 180°W to 64°W, Jan.–Mar. 1983, Arctic Tern one of four numerically dominant species of pelagic birds (Clarke 1907; Falla 1937; Bierman & Voous 1950; van Oordt & Kruijt 1954; Storr 1958; Mörzer-Bruyns & Voous 1964; Cline *et al.* 1969; Watson *et al.* 1971; Parmelee 1977; Ainley *et al.* 1978, 1984; Zink 1981; Woehler *et al.* 1990; Veit & Hunt 1991; BWP).

MOVEMENTS Migratory; undertake among longest movements of any bird (up to 20,000 km each way). Breed Holarctic; move to non-breeding areas in Antarctic pack-ice, mostly between c. 55°E and c. 150°E, though records from right round continent (Storr 1958; Salomonsen 1967; Viet & Hunt 1991; Gudmundsson *et al.* 1992; BWP; see Distribution). Extraliminally, migration recorded in coastal, offshore and inland areas (small numbers). At Horseshoe I., Antarctic Pen., 650 flocks observed over 3 days, possibly on n. migration; most flocks compact and fly on direct course; most often 30–60 m asl, but up to 100 m asl and as low as <10 m asl; average size of flocks 11.6 birds (n=17 flocks); average speed 40.7 km/h; flight-paths strongly guided by topographical features; sometimes temporarily interrupt migration to forage; most movement in late morning and late afternoon (Gudmundsson *et al.* 1992). Exhausted bird recorded landing on ship passing through Weddell Sea, Antarctica (Parmelee 1977). For details of dispersal of juveniles, see BWP.

Departure General model somewhat speculative, based on occurrence and banding recoveries; summarized in BWP. Slightly modified version of Storr's (1958) map of inferred s. migration routes presented in HASB. Adults begin migrating from late July in S of breeding range to early Oct. in N. Two main routes: (1) Birds from Bering Sea, Bering Str., e. Siberia and w. Alaska thought to move S along e. Pacific coast of North and South America, where recorded Aug.–Dec., then cross Drake Passage to Antarctica. Small numbers possibly move through central Pacific; recorded Hawaiian and Phoenix Is, Oct., and once at Marshall Is. (2) Birds from Canada, ne. USA, Greenland, Spitsbergen, The Faroes, Iceland, n. Europe, n. coastal Siberia and perhaps ne. Siberia move via

Arctic Ocean and converge on route along w. coast of Europe and Africa. Siberian birds at first move W along coasts of Arctic Ocean then S along seaboard of n. Europe; some Nearctic birds apparently move SE across Atlantic at 50°–60°N, where recorded as early as Aug., though recorded ne. USA as late as Oct. and Nov.; rare se. USA. Recoveries Scotland, England and w. France, Sept.–Oct. (Bent 1921; Johnson & Goodall 1967; Gwynn 1968; Clapp 1975; Pratt *et al.* 1987; Lee & Cardiff 1992; see Murphy; HASB; BWP). Appear to move in broad front from e. Atlantic, and movement in Atlantic separable into three broad categories: (A) small proportion thought to move SW from w. Africa, cross Atlantic and reach South America in or near Argentina (c. 35°S), then move S along e. coast from Oct.; birds leaving South America (including Pacific population) said to reach Antarctica in w. Weddell Sea, S to c. 74°S, or move E to join birds that migrate via South Africa; (B) some apparently move into and through central South Atlantic Ocean, where uncommon visitor to Tristan da Cunha, and collected Oct.–Dec.; (C) most move S along w. African coast, some reaching s. Africa, Sept., most in Oct.–Nov.; some then move S to pack-ice, though most move ESE–SE under influence of prevailing w. winds and arrive at pack-ice at 50°–110°E in Oct.–Dec. (Elliot 1957; Richardson 1984; Ryan *et al.* 1990; Murphy; BWP); records from Prince Edward Is and Iles Crozet, Sept.–Dec. (Williams & Burger 1978; Stahl *et al.* 1984). Few cross s. Indian Ocean, where recorded Nov. at Ile Amsterdam and regularly recorded at Heard I. between Oct. and Jan. (Downes 1952; Gwynn 1968; see Roux & Martinez 1987).

Regular in small numbers to A'asian waters (Aust. Atlas; Distribution). Most records Vic., 1973–86, Aug.–Dec. (Vic. Atlas). Recorded e. coast, occasionally as far N as Cairns (see Distribution); off Wollongong, between Aug. 1984 and Dec. 1990, mostly recorded during periods of passage, with records on s. passage mainly Aug.–Sept., though recorded as early as July and as late as Nov. (Brandis *et al.* 1992). Regular in small numbers to NZ; earliest Oct. (apart from winter records) (see Latham 1979; CSN 35); recorded Auckland and Campbell Is, Dec. and Jan. (Bailey & Sorensen 1962; Gwynn 1968; Bell 1975; but see Kinsky 1969). No evidence to support suggestion by Hindwood (1958) that birds recorded NZ arrived via w. Pacific route.

Non-breeding Circumpolar (see Distribution). For populations migrating S through Atlantic, a few in first year appear to remain in equatorial regions, many more in s. Africa, especially e. coast, as far N as Madagascar (BWP); some first-year birds also occur between s. Africa and Antarctica during non-breeding period, e.g. Inaccessible I., Tristan da Cunha Grp (Fraser *et al.* 1988). For populations migrating S through Pacific or populations that cross from e. Atlantic to South America, some immatures apparently remain in Humbolt Current off Chile (BWP); no evidence to support suggestion by Blake (1977) of non-breeding areas off Brazil and n. Argentina. Some juveniles occur in Antarctic zone with adults, where sometimes drift E to Amundsen and Bellingshausen Seas (80°–120°W); those that return ENE to South Africa to join n. migration of adults circumnavigate Antarctica in first year; others move NE from Amundsen and Bellingshausen Seas to coast of Chile. In second year, appear to undertake more extensive N–S movements; non-breeding range of third-year birds thought to approximate that of adults (BWP). Beside Antarctic, Chilean and African non-breeding areas, a few birds recorded irregularly elsewhere, including HANZAB region (e.g. Latham 1979; NSW Bird Reps 1973, 1977, 1986).

Return N. migration not as well understood as s. migration. Passage begins early Mar.; most thought to move W along edge of pack-ice, which has receded and lies mainly in zone of e. winds (BWP); between 1984 and 1987 groups of Terns, possibly Arctic, recorded Casey, Windmill Is, early Mar. (van Franeker *et al.* 1990); radar observations at Marguerite Bay in early Mar. 1989 suggest possible movement from Bellingshausen Sea, across Antarctic Pen., to Weddell Sea, but not known if movement part of migration (Gundmundsson *et al.* 1992). In Weddell Sea, thought to move N to NE towards South Africa; birds that moved S along coast of Chile and spent non-breeding period in Weddell Sea also thought to move to South Africa; birds in heavy moult collected S. Georgia in Apr.; on passage in s. Africa, Mar.–May (Jehl *et al.* 1978; Urban *et al.* 1986; BWP). At least part of population from non-breeding areas from Amundsen Sea to Ross Sea probably move NE to follow coast of Chile (BWP). Some also appear to move into Southern Ocean; recorded Macquarie I., Apr. (Downes 1952); recorded NZ, between Mar. and May (see Latham 1979, 1981; CSN 35) but as most in non-breeding plumage probably subadults and not on passage; Lord Howe I., Apr. (NSW Bird Rep. 1975). Birds, including at least some first-years, pass s. Aust.; off Wollongong, NSW, records between Aug. 1984 and Dec. 1990 indicate main passage, Mar.–Apr., though recorded as late as May (Brandis *et al.* 1992); during autumn in WA, collected May (see Hindwood 1958).

Movements thereafter not properly known; from South Africa, Eurasian birds possibly travel N along e. Atlantic coast, roughly retracing s. route; pass France, Apr.–May (see Dement'ev & Gladkov 1951). Small passage Somalia, Apr.–May, suggest some return via Indian Ocean and possibly then fly overland to breeding grounds. Suggested many e. American and Greenland birds at first head NE toward s. Africa, follow e. Atlantic route N to sw. West Africa, then possibly turn W towards n. Brazil and follow pelagic route through Atlantic Ocean (Urban *et al.* 1986; see BWP); more common in se. USA during n. migration (Lee & Cardiff 1992). N. passage through w. Pacific poorly known; small numbers recorded off Chile, Apr.; apparently move through central tropical Pacific in small numbers, where dated records from Hawaiian Is, Apr.–May; unverified report Japan, Apr. (Johnson & Goodall 1967; Orn. Soc. Japan 1974; Clapp 1975; Pratt *et al.* 1987). Breeding grounds reoccupied end Apr. or early May in S, sometimes not till near end June in N (Dement'ev & Gladkov 1951; see BWP).

Breeding One- and 2-year-olds have occurred on breeding grounds (Urban *et al.* 1986; see BWP); some immatures spend boreal summer on coast of Chile; many winter in s. Africa, with recoveries mainly of birds in second year (Morant *et al.* 1983; Urban *et al.* 1986; see BWP); also, recent records from Somalia, May–July (Urban *et al.* 1986; BWP). Banding suggests some n. movement in first summer (see BWP). Scattered records elsewhere during breeding period in HANZAB region (see Distribution) and extraliminally (e.g. Gulf of Mexico, Lee & Cardiff 1992).

Banding Extraliminally, substantial. At least one record of bird banded Atlantic recovered Pacific Ocean (see BWP). Four birds banded n. hemisphere (Sweden, White Sea, and England) recovered in first year in Aust.; of these, shortest period is for nestling banded Farne Is, England, June 1982, recovered 115 days later in Melbourne (Dunnet 1956; Gwynn 1968; Anon. 1982; HASB).

FOOD Carnivorous; mainly fish, crustaceans and insects.

Extraliminally, also takes worms, molluscs; twice recorded taking plant material. **Behaviour** Diurnal, with peaks in activity at dusk and dawn. Fly upwind in search of prey and hover before plunging. Mainly forage by PLUNGING, usually submerging fully (SHALLOW PLUNGING); mean immersion time 1.1 s; plunge to depth of <50 cm (BWP). Distinctive stepped-hover before diving (see Kirkham & Nisbet 1987; Field Identification); emerge with prey held crosswise in bill, and swallow on surface (or carry it to nest if breeding). Foraging affected by weather and tide, with little foraging at high tide (BWP). In Antarctica, also feed by DIPPING (Griffiths 1982). Also hover above ice, gleaning from surface (Zink 1981). Often forage in association with Minke Whales (Griffiths 1982; Griffiths & Sinclair 1982) and Adelie Penguins *Pygoscelis adeliae* (Bierman & Voous 1950). Hawk for aerial prey; glean items from pasture while on wing. Steal food from alcids and grebes. Scavenge offal and rubbish.

Adult No detailed studies. Crustaceans: copepods; amphipods: Eusuridae: *Pontogeniella*; isopods: Sphaeromatidae: *Cerceis*; Euphausiidae: *Euphausia*; *E. superba*; *Thysanoessa vicina*; fish, 5–7 cm (Falla 1937; Bierman & Voous 1950; Ealey 1954; Storr 1956; Griffiths 1982).

Intake In Antarctica, mean of 6.2 *Euphausia* per stomach (up to 16) (Bierman & Voous 1950). Mean size of fish 55.8 mm (Hulsman 1981).

VOICE Little information from HANZAB region. Shrill sharp piping *tcheek* and occasional sibilant whistle from flocks along edge of Antarctic pack-ice (Falla 1937). When resting with other terns and flushed, utter soft but harsh drawn-out *kerk*, low-pitched and with downward inflection (Storr 1956). Elsewhere, ten calls described; repertoire similar to that of Common Tern but calls softer and higher pitched (BWP).

PLUMAGES Prepared by D.I. Rogers. All moult of remiges and most moult of body occur when in Antarctic pack-ice, Dec.–Mar. First migrate S in juvenile plumage, undergoing complete first pre-basic moult when c. 6–9 months old. Resultant first immature non-breeding plumage resembles adult non-breeding, even in those birds that migrate to breeding grounds. Then undergo complete second pre-basic moult to second immature non-breeding plumage in second austral summer. Thereafter, moult-strategy as adult: attain breeding plumage

Plate 41

Fairy Tern *Sterna nereis* (page 725)

Nominate *nereis* unless stated

- 1 Adult breeding; 2 Adult breeding, subspecies *davisae*; 3 Adult breeding, austral spring, showing bill in transition to breeding; 4 Adult non-breeding; 5 Downy young, light morph; 6 Downy young, dark morph;
- 7 Juvenile; 8 Early stages of moult from juvenile to first immature non-breeding; 9 Early stage of moult from juvenile to first immature non-breeding, subspecies *exsul*; 10 Adult breeding, worn plumage; 11 Adult non-breeding; 12 Juvenile;
- 13 Late stage of moult from juvenile to first immature non-breeding

Little Tern *Sterna albifrons* (page 709)

- 14 Adult breeding, population breeding se. Aust.;
- 15 Adult showing head and bill in transition to or from breeding plumage; 16 Adult non-breeding; 17 Juvenile; 18 Early stage of moult from juvenile to first immature non-breeding; 19 Adult breeding, Asian population; 20 Adult non-breeding;
- 21 Juvenile; 22 Late stage of moult from juvenile to first immature non-breeding

in partial pre-alternate moult (overlapping with end of pre-basic moult of primaries), mainly Feb.–Mar.; then moult to non-breeding plumage (which is held only briefly) in rapid complete pre-basic moult, Nov.–Mar. A few first breed during third calendar year (when about 2 years old), most not until fourth or fifth calendar years (Cullen 1957; BWP). In all plumages, similar to corresponding plumages of Common Tern.

Adult breeding (Third and subsequent alternate plumages). Differences from subspecies *longipennis* of Common Tern. **Head and neck** Black (89) cap slightly broader, with lower edge usually running just below eye rather than through lower eyelid; above lores, lower edge is slightly convex, so that white wedge between cap and gape usually narrower. Usually have more grey on throat, reaching to above gape of some; grey separated from black cap by white cheek-stripe, which is generally narrower, more clearly defined and extends back to sides of nape. Cap said not to extend as far onto hindneck (Olsen & Larsson 1995). **Upperparts** Light grey of mantle and scapulars, slightly paler and more leaden-blue. Diffuse white tips of subscapulars slightly broader. Rump and uppertail-coverts, white, never with grey tinge. **Underparts** In fresh plumage, breast, belly and flanks, light grey (c85) to pale grey (c86) with slightly more leaden-blue tinge than Common; when worn, underparts become paler and then do not differ from worn Common Tern. **Tail** Whiter; dark markings restricted to grey (dark 84) outer web to t6, which grades to grey-black (82) at tip, and varying grey (c84) wash on outer web of t5 and, in some, t4. **Upperwing** Coverts and tertials, light grey (c85), like Common, except for slightly more leaden-blue tinge when fresh. Secondaries have broader white tips and inner edges. All primaries and secondaries retained from basic plumage, so lack characteristic moult contrast of Common; even when worn, outer primaries do not look markedly darker than inner primaries. **Underwing** Mostly white, with all exposed areas of primaries and secondaries translucent (glowing white when backlit). Dark trailing-edge of outer primaries narrower, more sharply defined and longer; tapers gradually at about p3 instead of having rather square cut-off at about p5 or p6 (see Antarctic Tern: Recognition for illustration of primary-pattern).

Adult non-breeding (Second and subsequent basic). Difference from subspecies *longipennis* of Common Tern. **Head and neck** Crown almost wholly white, except for grey-black (82) flecking at junction with blackish hindcrown caused by broad dark streaks in centres of tips of feathers; some also have sparse dark spotting in centre of crown. Half-cap only includes hindcrown, nape and band running to eye, and so looks narrower, more rakish and sharply defined. **Upperparts** When fresh, mantle, scapulars and back have slightly more leaden-blue tinge. Rump and uppertail-coverts almost wholly white, occasionally with grey fringes to lateral uppertail-coverts. **Underparts** White. **Tail** Mostly white, with outer edges of rectrices grading from grey-white on t2 to pale grey (86) on t4; pale-grey areas can bleach to white when worn. Outer edge of

t5 grades from light grey (85) at base to grey (84) at tip. Outer web of t6, dark grey (83) grading to grey-black (82) at tip; not consistently different from Common. **Upperwing** Cubital bar, narrower and paler than on Common, comprising 1–3 shortest rows of lesser secondary coverts; feathers, grey (85–84), darker and browner (brownish 84) when worn, with broad grey-black (82) shaft-streaks and subterminal bars. Outer primaries typically worn, often losing overlying pale-grey sheen, so that feathers look dull-black when wing folded; this effect seldom obvious in flight, and Aust. birds never show striking contrast between dark outer and pale inner primaries. **Underwing** As adult breeding.

Juvenile Differences from subspecies *longipennis* of Common Tern. **Head and neck** Forehead and lores have fainter buff tinge on fledging, but have faded to white on arrival in HANZAB region. Dull-black half-cap shaped like that of juvenile Common (thus extending more onto crown and sides of face than in adult non-breeding Arctic) but white eyelids rarely form conspicuous eye-ring (Olsen & Larsson 1995). **Upperparts** Mantle, scapulars and back, light grey (c85), subtly darker than in adults, and like Common Tern when worn; pale tips to feathers usually off-white to pale grey-buff, seldom with strong warm-buff or light-brown tinge seen in many fresh Common Terns. Rump and uppertail-coverts, white. In the small number of skins available, half-collar between mantle and hindneck appears broader and cleaner white (though not markedly different from half-collar of nominate *hirundo* of Common Tern). **Underparts** White. **Tail** Inner feathers (t1–t4) have more white: in palest, almost wholly white except for a crescent-shaped light-grey (c86–85) subterminal smudge on outer web; darkest individuals have more extensive pale-grey wash on outer webs (can cover most of outer web of t4). Outer webs of t5–t6, grey (84) to dark grey (83); generally lighter than in Common but much overlap. **Upperwing** Secondaries vary but predominantly white and markedly paler than rest of upperwing (cf. darker in most Common); in general, innermost, white with pale-grey (86–85) smudge on distal outer web occasionally just encroaching onto inner web; grey area larger on outer feathers and outermost mainly pale grey (86) to light grey (85) with white base and broad white tips and inner edges. Dark cubital bar usually narrower and lighter; grey (84) to dark grey (83) when fresh, becoming dark grey-brown (c83–c121). Greater secondary coverts, longest lesser coverts and, especially, median coverts, often have narrow brown or dark-brown (119B–119A) subterminal bars, broader than subterminal markings of feathers of back (these usually absent in Common or narrower than markings of back). **Underwing** As adult, but sometimes dark trailing-edge of outer primaries shorter, only extending to p5 or p6 (Olsen & Larsson 1995).

First immature non-breeding (First basic; so-called portlandica plumage [see introduction to Sterninae]). Very similar to adult non-breeding, but held from about Feb. to Aug., when older birds have much breeding plumage (see Ageing). Some seen Aust., Mar.–Aug., had more black on crown (resembling non-breeding Common Tern) and lacked cubital bar (D.W. Eades). Some said to have isolated grey feathers in white underparts (Olsen & Larsson 1995) but confirmation needed; none such examined in this study. Some show very worn body-plumage from Aug.; and white bases of median and longest lesser coverts sometimes partly exposed as diffuse white band behind cubital bar; from Oct. to Dec., crown to nape of some almost wholly white, with some dark spots on nape (Olsen & Larsson 1995).

Plate 42

Bridled Tern *Sterna anaethetus* (page 738)

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

Sooty Tern *Sterna fuscata* (page 752)

6 Adult breeding; 7 Adult non-breeding; 8 Juvenile; 9 Adult breeding; 10 Juvenile; 11 Older immature

Second immature breeding (Second alternate; so-called pikei plumage [see introduction to Sterninae]). Varies, and some may not differ from typical adult breeding (Cullen 1957). However, most differ in showing at least some non-breeding characteristics: (1) white on forehead and crown varies: from much as non-breeding to confined to narrow white band above bill or to white flecking in front of cap; (2) slightly broader white wedge between cap and gape; (3) dark cubital bar; (3) white mottling or wash on grey underparts; and (4) shorter tail-streamers. At least some of these characters can be shown by a few breeding adults (Cullen 1957) so certain ageing not possible.

BARE PARTS Except where stated, based on photos, especially in Pringle (1987), Delin & Svensson (1988), Flegg & Longmore (1995), Olsen & Larsson (1995) and unpubl. (B. Chudleigh; D.W. Eades).

Adult breeding Iris, black-brown (119). Typically, bill and feet red (12, 13) to crimson (108A, 110) except for black (89) claws. A few have grey-black (82) marking at tip of bill, largest on culmen; marking usually small but in some extends about half-way along culmen (Cullen 1957). Breeding colour of bare parts usually attained by Mar., before n. migration, but some in n. hemisphere may have dark-red ground-colour to bill or diffuse black areas at tip of upper mandible or base of bill in Apr.–May or Aug. (Olsen & Larsson 1995). **Adult and immature non-breeding** Iris, black-brown (119). Bill, black (82–89), sometimes with small (<1 mm) off-white tip; legs, dark red-brown (–) to dull black (c82). In HANZAB region, some adults (possibly in third calendar year) have attained non-breeding colours by end Aug.; most have by Oct.; some retain red traces on gape and at base of lower mandible till at least end Dec. and some may not develop wholly black bill at any stage of non-breeding period. **Juvenile** Iris, black-brown (119). At fledging: bill, orange-pink (3, 94) with distal 30–60% grey-black (82); feet, dark orange-red (c4) or orange-pink (c94); these areas usually darken to non-breeding colour within 1 month (BWP; Kemp 1982; Olsen & Larsson 1995) and last trace to be lost often a pinkish streak along cutting edge of lower mandible. Bill, black in most juveniles recorded in HANZAB region, but two specimens from Heard I. (Nov., Dec.) had red tinge at base of lower mandible. Aberrant juvenile in Denmark still had wholly orange-red bill and reddish-orange legs (like downy young) in Nov. (Olsen & Danielsen 1988).

MOULTS Based on BWP, Olsen & Larsson (1995) and data from 80 specimens from s. hemisphere (AIM, AM, HLW, MV, QM, QVM, TMAG, SAM; Eagle Clark 1907; Falla 1937; Bierman & Voous 1950; Hindwood 1958; Stresemann & Stresemann 1966; Milledge 1973).

Adult post-breeding (Third and subsequent pre-basic). Complete; primaries outwards. Usually delayed until in or near wintering areas, but a few (maybe failed or non-breeders) moult scattered feathers of body in late boreal summer. Of adults in s. temperate and subantarctic regions, Oct.–Dec.: two still in full breeding plumage, 11 had small amount of non-breeding plumage, four had much non-breeding plumage and five had non-breeding appearance except for traces of breeding plumage on forehead and flanks (also see Ageing). Moulting of feathers of head often begins on crown, sometimes on forehead (cf. on forehead in all other *Sterna*), so moulting birds often characterized by white skull-cap with black borders. Proportion of Aust. birds with much non-breeding plumages

on s. migration possibly higher than in birds migrating more directly to Antarctic. Olsen & Larsson (1995) suggest that body-moult partial, with some worn breeding plumage replaced directly by subsequent breeding plumage, but confirmation lacking and several Aust. and subantarctic adults examined had complete non-breeding body-plumage. All moult of remiges occurs at edge of pack-ice of Antarctic; the two known exceptions (undated Macquarie I. specimen with primary-moult $N^64^31^2O^1$; and NSW beachcast on 14 Dec. with primary-moult $N^14^1V^8$ on left wing, V^{10} in the right), apparently aberrant. Earliest record of primary-moult, 15 Jan., but most must begin earlier, as PMS 38–49 by last half Jan. As there are so few data on early stages of moult of wing, published estimates of duration of primary-moult (60 days [Salomonsen 1967]; 3–3.5 months [Stresemann & Stresemann 1966]) are highly speculative. Nevertheless, there are indications that moult of wing much faster than in other terns: (1) adult with primary-moult $N^64^31^1O^1$ was also moulting s1–s9 and several tertials (Bierman & Voous 1950), thus having more remiges growing concurrently than in other moulting *Sterna*; (2) said to fly reluctantly and poorly when moulting remiges (e.g. Falla 1937; Bierman & Voous 1950). Pre-basic moult ends with growth of p10, before end of Mar.; many have finished by early Feb., most by late Feb. (>1000 observations in Antarctic pack-ice; D.J. James); latest record of active moult of primaries, 23 Mar. Final stages of pre-basic moult of primaries overlap much with pre-alternate moult of body and tail. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial; involves all feathers of head and body, tail (occasionally only inner rectrices and t6) and most upperwing-coverts; retain basic remiges and greater primary coverts. Occurs while in Antarctic, mostly Feb. to early Mar., during late stages of pre-alternate moult of primaries; a few have full breeding plumage by early Feb., most by late Feb. (D.J. James). Earliest available record of active moult, 17 Jan.; latest, 27 Mar. **Post-juvenile** (First pre-basic). Complete; primaries outwards. Like adults, do not begin body-moult until in or near wintering areas; some start moult of feathers of head, underparts and some of mantle and scapulars from late Oct. (exceptionally late Aug. [Olsen & Larsson 1995]). Most passing through HANZAB region while on s. migration have full juvenile plumage or only traces of post-juvenile body-moult, based on records from Vic. (18 Oct.; MV B18627), NZ (8 Dec.; unpubl. photo., B. Chudleigh) and Heard I. (22 Nov.–1 Jan.; five MV skins). Body-moult usually finished by Feb. Moulting remiges in Antarctic; timing poorly known. Seven collected in Antarctic, 10–25 Jan., had not started moult of primaries but earliest record of active moult ($N^64^31^1O^2$ on 5 Feb.) suggests some must start at about the same time as adult post-breeding; this also suggested by birds in first immature non-breeding, June–Aug. of second calendar year, which often have primaries about as fresh as in adult breeding at same time. Timing of finishing of moult of primaries poorly known, probably Mar.–May. Beachcast, SA, 6 June, with primary-moult $N^84^1V^1$ was apparently aberrant. **First immature pre-breeding** (First pre-alternate). Many do not undergo this moult. Observations of a few birds with more black on crown than in non-breeding plumages and without cubital bar (D.W. Eades; see Plumages) suggest some may undergo partial moult during first austral autumn or winter; more information needed. **First immature post-breeding** (Second pre-basic). Apparently like adult post-breeding, but details of timing of body-moult not clear because most or all moult directly from first non-breeding to second non-breeding plumage. Active body-moult recorded in one Vic. bird in Aug.

of second calendar year. **Second immature pre-breeding** (Second pre-alternate). Like adult pre-breeding but may start slightly later and typically retain scattered traces of non-breeding plumage on head, body and upperwing-coverts (see Plumages: Second immature breeding). A few also replace inner 1–3 (rarely five) primaries; some data in Stressemann & Stressemann (1966) suggest this wave of primary-moult may be suspended (rather than arrested) through boreal summer.

MEASUREMENTS T1 = length of central rectrices; T6–T1 = depth of tail-fork, from tip t1 to tip t6; Bill D(N) = depth of bill at basal corner of nostril. (1) Breeding adults, boreal summer, with fresh p10 and alternate tail (combined from BWP and skins in MV). (2) Aust., Macquarie and Heard Is, adults with worn p10 and basic tail, skins (AM, HLW, MV, QM, QVM, SAM, TMAG). (3) Throughout range, juveniles (combined from BWP and skins in Aust. museums). (4) Aust., Macquarie and Heard Is, ages combined (Aust. museums). (5) Netherlands, adults (BWP). (6) Throughout range, ages combined (combined data from BWP and Aust. museums).

	MALES	FEMALES	
WING	(1) 276.5 (6.25; 262–290; 59) (2) 247, 257 (3) 244.7 (3.43; 239–250; 8)	272.9 (7.14; 261–288; 37) 256.0 (10.13; 244–272; 8) 244.1 (5.33; 235–254; 17)	* ns ns
T1	(1) 72.0 (3.46; 67–78; 12) (2) 64, 66, 67 (3) 57, 60, 67	71.9 (4.35; 66–82; 15) 66.5 (6.65; 56–77; 8) 67, 68	ns ns ns
T6–T1	(1) 111 (10.6; 96–130; 19) (2) 68, 70 79 (3) 46.7 (4.27; 41–52; 8)	97.8 (13.1; 72–118; 18) 70.4 (7.89; 61–79; 7) 50.0 (4.72; 44–59; 16)	** ns ns
BILL	(2) 30.0, 30.4, 33.5 (3) 28.8, 29.5, 29.6 (5) 33.0 (1.40; 31–35; 19)	30.0 (1.57; 27.2–31.7; 10) 27.5, 30.3 30.8 (1.16; 29–33; 20)	ns ns **
BILL D(N)	(4) 7.20 (0.580; 6.3–7.9; 8)	7.51 (0.252; 7.0–7.8; 9)	ns
TARSUS	(6) 15.7 (0.57; 14.5–17.0; 27)	15.5 (0.55; 14.5–16.7; 33)	ns
TOE C	(6) 21.9 (1.05; 20–23.5; 19)	22.0 (1.07; 19.5–23.4; 23)	ns

Bill and, in breeding plumage, wing and tail-fork, significantly longer in males. Length of wing in adults decreases significantly with wear, and from about Nov. to Feb., wing is c. 14 mm shorter than when breeding. Juvenile wing c. 30 mm shorter than that of adult, and may become even shorter just before moult, e.g. immature in Jan. (Heard I.) with very worn primaries had wing-length of only 226 mm. Lengths of t1 and tail-fork in breeding plumage significantly longer than non-breeding. Juveniles have significantly shorter tail-fork and bill than adults; not known when adult bill-length attained. Tarsus and toes similar to adult from c. 2 weeks old (BWP).

WEIGHTS (1–3) Adults: (1) N. hemisphere (BWP); (2) Aust. and Heard I. (AM, MV, QVM, SAM); (3) Antarctic, moulting outer primaries (Bierman & Voous 1950; BWP).

	MALES	FEMALES
May	(1) 112 (4.97; 106–119; 5)	107 (8.32; 98–118; 5)
July	(1) 102 (9.77; 87–118; 11)	109 (7.02; 99–119; 8)
Aug.	(1) 103 (6.95; 96–115; 7) (2) –	105, 117 82
Nov.	(2) –	80, 100, 110
Dec.	(2) –	85
Feb.	(3) 140	125
Mar.	(3) 145	–

Weight of breeding adults gradually declines during breeding season (Monaghan *et al.* 1989), e.g. in Shetland Is, weight declines from c. 130 g at laying to c. 116 g at hatching. For effects of shortages of food on weights of adults and growth and survival of chicks in Shetland Is, see Avery *et al.* (1992) and Monaghan *et al.* (1989, 1992). The few data available from HANZAB region suggest weight low on s. migration; above data do not include Aust. beachcasts of 67 (Oct.), 78 (Oct.) and 68 (Dec.).

Little information available for subadults. Juveniles in Europe: Sept., 95.8 (15.20; 76–110; 4); Oct., 98 (BWP). Worn juveniles, some moulting to first immature non-breeding: (1) Heard I.: Nov., male 92; Dec., male 82, females 83, 109 (MV); (2) Antarctic: Jan., female 110; Mar., unsexed, 100 (Bierman & Voous 1950; BWP). See Lemmetyinen (1972), Langham (1983), Klaasen *et al.* (1989) and Uttley *et al.* (1994) for information on growth and energetics of chicks.

STRUCTURE Very similar to Common Tern. Eleven primaries: p10 longest, p9 8–19 mm shorter (in adults), p8 29–45, p7 49–69, p6 70–97, p5 92–110, p4 112–131, p3 128–150, p2 145–162, p1 163–188; p11 minute. Differences from Common Tern include: deeper tail-fork in all plumages; slightly shorter and less deep bill; shorter toes and much shorter tarsus (see Measurements); outer toe c. 82% length of middle, inner c. 62%, hind c. 31%.

AGEING Difficult to age in non-breeding plumages unless recognizable traces of breeding plumage present (when in at least third calendar year). On present knowledge, juveniles appear to retain juvenile body-plumage till arrival in Antarctic; even if some attain non-breeding body-plumage before then, their shorter wings and tail-fork (see Measurements) should allow separation in the hand. Birds seen in HANZAB region Aug.–Dec. in full non-breeding plumage are particularly troublesome. Those with full non-breeding in Aug. assumed to be in second calendar year, as adults should show breeding plumage at this time. However, specimens that were completing moult to non-breeding plumage in late Aug. (e.g. QVM 1966/2/148 and 1972/2/65) and still with some grey feathers in flanks and black flecks on forehead, suggest that some adults (possibly only those in third calendar year) may attain full non-breeding plumage by Sept.–Oct. Birds seen in non-breeding plumage in Oct.–Dec. may therefore include adults and birds in second calendar year; no means known of reliable separation, though variation in wear of primaries may be of use: some show similar wear to confirmed adults, while primaries of others appear fresher.

RECOGNITION See Antarctic Tern: Figure 8.

GEOGRAPHICAL VARIATION Negligible. BWP noted slight differences in length of wing, bill and tarsus of breeding populations in Netherlands, Greenland and Svalbard and stressed lack of comparable information from Pacific populations. Bierman & Voous (1950) considered bills to be slightly shorter in Antarctic than in Netherlands, but samples now available (see Measurements) suggest differences not significant.

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Arctic Tern *Sterna paradisaea* (page 668)

1 Adult breeding, fresh plumage, boreal summer; 2 Adult non-breeding, austral summer; 3 Juvenile, moderately worn plumage, first austral spring

Kerguelen Tern *Sterna virgata* (page 692)

4 Adult breeding; 5 First immature non-breeding

Antarctic Tern *Sterna vittata* (page 677)

6 Adult breeding; 7 Adult non-breeding; 8 First immature non-breeding

Black-fronted Tern *Sterna albostrata* (page 699)

9 Adult breeding; 10 First immature non-breeding

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Volume 3, Plate 40

Kerguelen Tern *Sterna virgata* (page 692)

1 Adult breeding; 2 Adult non-breeding; 3 Juvenile; 4 First immature non-breeding

Antarctic Tern *Sterna vittata* (page 677)

5 Adult breeding; 6 Adult non-breeding; 7 Downy young; 8 Juvenile; 9 First immature non-breeding

Arctic Tern *Sterna paradisaea* (page 668)

10 Adult breeding, fresh plumage, boreal summer; 11 Adult non-breeding, austral summer; 12 Adult, in early stages of moult from breeding to non-breeding plumage, austral spring; 13 Juvenile, moderately worn plumage, first austral spring; 14 Second immature breeding, boreal summer

Black-fronted Tern *Sterna albostrata* (page 699)

15 Adult breeding; 16 Adult non-breeding; 17 Downy chick; 18 Juvenile; 19 First immature non-breeding