

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 striata **White-fronted Tern**

COLOUR PLATES FACING PAGES 608 & 609

Sterna striata Gmelin, 1789, *Syst. Nat.* 1(2): 609 — New Zealand.

Striata is from the Modern Latin *striatus*, striped, streaked (from Latin *stria*, line or furrow), based on the name 'Striated Tern' given to this species by Latham (1781–1801, *Gen. Syn. Birds* 3[2]: 358) with reference to the barred upperparts of the juvenile plumage.

OTHER ENGLISH NAMES Black-billed Tern, Kahawai Bird, Southern Tern.

MONOTYPIC

FIELD IDENTIFICATION Length 35–43 cm; wingspan 79–82 cm; weight c. 130 g. Medium-sized robust commic tern, with long straight slender bill; large head, with steep rounded forehead and flat crown; and very long, deeply forked tail, with tips of outermost rectrices (streamers) extending well beyond wing-tips at rest. Largest and bulkiest commic tern; proportions similar to Common Tern *Sterna hirundo*. Plumage resembles Roseate Tern *Sterna dougallii* more than Common or Arctic *S. paradisaea* Terns. In adult plumages: upperparts pale grey, with thick white line along upper edge of folded primaries, reaching to tip of wing, and white underbody; in breeding plumage, has black cap, with diagnostic narrow white band running across lower forehead, and varying pink flush on underparts. Juvenile distinctive: boldly patterned above, with distinctive blackish triangle across upperwing-coverts, and white tail, with diagnostic black corners. Sexes alike. Slight seasonal variation. Juvenile distinct. Immatures separable.

Description Adult breeding Pattern of head, diagnostic: crown, nape and most of forehead, black, forming cap, separated from bill by narrow white band across lower forehead and lores; rest of head and neck, white. Saddle and upperwing, pale grey, showing almost no contrast with very pale-grey rump and tail; upperparts appear almost white in bright light or at distance; upperwing has narrow white trailing-edge, tapering outwards nearly to wing-tip, and thin black line along leading-edge of outer primary; at rest, have thick tapering white line along upper edge of primaries, reaching nearly to tip of outermost, and thin black line along bottom edge of folded primaries. During breeding season, primaries become dark grey with wear but retain white trailing-edge and white upper edge to folded wing; upperside of remiges always appears uniform grey from austral winter to late summer, never with moult-contrast. Long tail-streamers project well beyond tips of folded wing at rest, and bend in flight, but often broken off level with or short of wing-tip. Underbody, white, often with strong pink flush during breeding season. Underwing, white, with thin dark-grey stripe on leading primary, and diffuse narrow grey subterminal marks at tips of outer 5–6 primaries, not forming obvious dark trailing-edge (though may appear as indistinct dark subterminal line bordered by white trailing-edge); with wear, white trailing-edge reduced or lost and subterminal marks darker and more prominent, forming narrow diffuse dark trailing-edge to outer primaries. When backlit, remiges translucent. Bill, black. Iris, dark brown. Legs and feet, dark red. **Adult non-breeding** As breeding except: Anterior lores, forehead and forecrown (to about level with eye), white, speckled black at junction with black crown, and with prominent squarish black patch in front of eye. Birds moulting primaries may show contrast between dark-grey outer primaries and pale-grey rest of wing. **Juvenile** Plumage varies. Typical birds (black-and-white morph; see Plumages). Many have complete dark cap, blackest on nape, ear-coverts and in front of eye, with forehead and crown slightly paler, finely mottled white and tinged brown, and with fine dark mottling along lower edge of cap from bill to rear ear-coverts. Others have off-white forehead and anterior lores grading to white mottling on crown. In all birds, forehead and anterior lores become whiter with wear. Rest of head and neck, white, including narrow collar separating dark cap from mantle. Saddle, pale grey, boldly patterned with black bars on mantle, black-brown mottling on back, and large Vs and fine streaks on scapulars, all narrowly fringed or tipped paler when fresh; dark of mantle extends onto sides of neck. Tertiaries, grey-black, with black-and-white bars. Rump and uppertail-coverts, pale

grey, lightly mottled black-brown in centre. Tail, white, with prominent blackish corners, and narrow white tip and sides; much shorter and less deeply forked than in adult (tip clearly falling short of wing-tips at rest). On folded wing: coverts, pale grey, with broad black cubital bar extending narrowly round carpal; coverts below cubital bar usually have narrow black crescents and Vs and white tips, but plainer, mostly unmarked grey on some; primaries, dusky grey with thick white line tapering along upper edge to tip of outermost. In flight, pattern of upperwing distinctive, with: broad black cubital bar and dark inner coverts forming blackish triangle from base of wing to carpal; second paler dusky triangle on outerwing, formed by dark outer primaries, their coverts and alula; third paler greyish-white triangle over rest of upperwing with apex at carpal; narrow grey subterminal bar on secondaries, darkening towards body; indistinct dusky subterminal band on outer primaries; and narrow white trailing-edge tapering outwards to tip of wing. Underbody, white. Underwing, white, with narrow dark stripe on leading primary, and dark tips to outer five primaries (as on fresh adult) forming, on some, diffuse narrow dark line along trailing-edge; when backlit, narrow white trailing-edge and inner primaries (and sometimes outer secondaries) translucent. Bare parts as adult except legs and feet, red-black to almost black. Some birds (buff morph; see Plumages) have pale-buff (not white) tips to feathers of cap, saddle, tertiaries, central rectrices and central secondary coverts of upperwing; buff quickly fades to white. **First immature (non-breeding and breeding)** Head and saddle as adult non-breeding but retain juvenile wings, tertiaries and tail and, sometimes, a few dark juvenile outer scapulars and dark feathers on upper forehead, mantle, back and rump. With wear: white upper edge and tips of outer few primaries reduced or lost and primaries become darker at tips, producing more prominent blackish trailing-edge; central innerwing-coverts paler, greyish white, with black marks and pale tips reduced or lost; and black cubital bar and dusky tertiaries contrast strongly with pale-grey upperparts. Remiges become very worn before moult to second immature non-breeding. **Transition to second immature non-breeding** During moult (spring–summer), similar to adult non-breeding, but: in flight from above, show blackish secondary bar and wedge on outerwing, reduced dark cubital bar, and black tips to outer rectrices; at rest, also show strong contrast between worn outer and new pale-grey inner primaries (with neat white upper edges and tips) and new tertiaries either uniform pale grey as adult or with varying dusky central marks. **Second immature non-breeding** When moult finished, differ from adult non-breeding only by contrasting dark-grey edges to outer four or so rectrices (visible only when close) and, in some, by varying diffuse dusky marks in centre of tertiaries.

Similar species In non-breeding plumages, often confused with **Common Tern** (q.v.). Also confused with first-immature and adult non-breeding plumages of **Roseate Tern**, which IN ALL PLUMAGES differs by: (1) much smaller and slimmer (size close to Black-naped Tern) with narrower and proportionately shorter wings, with proportionately shorter outerwing; proportionately smaller head, with shallower forehead and more rounded crown; slightly finer and more tapered bill, which often appears decurved (rarely so in White-fronted); and finer legs; (2) different flight: wing-beats noticeably quicker and shallower, recalling hurried flight of Little Tern *S. albifrons*; and (3) characteristic flight call: incisive guttural, wader-like *cher-rrick* or *chew-ick*; also grating *kraak* or *aach*. **ADULT NON-BREEDING** easily distinguished from adult and second immature non-breeding White-fronted by: (1) much brighter red legs;

(2) narrow dusky-grey cubital bar; (3) in fresh plumage, slight contrast between fresh pale-grey inner and slightly darker-grey outer three or so primaries (difficult to see in flight); and, in worn plumage, strongly contrasting blackish wedge on outer primaries. **FIRST IMMATURE NON-BREEDING** plumages very similar and apart from differences in size, structure, flight and call, Roseate best distinguished by: (1) retained juvenile tail, which is white, with narrow subterminal dark Vs and all-white outer-most rectrices; (2) retained juvenile upperwing, which has narrower black cubital bar, and does not have dark triangle on innerwing-coverts; also, dark subterminal bar on secondaries tends to be darker grey and more prominent; and (3) black legs and feet. **FIRST IMMATURE NON-BREEDING** Roseate very similar to second immature non-breeding White-fronted. Best distinguished by size, structure, flight and call and: (1) narrow dusky-grey cubital bar; (2) prominent large dark spot in centres of tertials (equivalent markings on White-fronted much smaller and less distinct); (3) black legs and feet; and (4) white tail. Adult and second immature non-breeding plumages can also be confused with adult non-breeding and worn juvenile **Arctic Tern**, which differ by: (1) much smaller and slimmer, with smaller more rounded head, shorter neck, and much shorter bill and legs; (2) in flight, have slimmer 'neckless' jizz, and narrower wings, with finer and more tapered outerwings often strongly angled back from carpals; flight more buoyant, less steady and purposeful, with more thrusting wing-beats and distinct pause on upstroke; (3) white extends farther back from forehead onto rear-crown, giving pattern like non-breeding Little Tern; (4) upperparts slightly darker grey, with narrow dusky-grey cubital bar; in juvenile, diagnostic white (or very pale-grey) secondaries paler than rest of upperwing; (5) white rump and tail contrast strongly with grey upperparts, with contrasting dark edges to outer rectrices; (6) diagnostic clear-cut tapering black line along trailing-edge of primaries above and below; (7) remiges more translucent, especially primaries, with characteristic dark streaks on outerwing and crisp tapering dark trailing-edge standing out; from above, primaries often flash paler than rest of wing; (8) stepped-hover feeding flight also different, recalling that of Little or Fairy *S. nereis* Terns: tend to hover at greater height (up to 10 m) then descend vertically in stages, with wings held in steep V, and pausing and hovering each time, before finally plunging or dipping to surface.

Common tern of NZ coastal waters, also occurring on some subantarctic islands and in waters off se. Aust. Marine, inhabiting coastal and offshore waters; typically forage close inshore over surf-zone or turbulent water close to rocky shores or reefs but ranging offshore to shelf-break; also occur on reefs, sandy and rocky shores of ocean beaches and within large bays and harbours. Normally seen in pairs or small groups, though form larger flocks when feeding and gather in hundreds at favoured roosting sites. Often roost and feed with other terns and join mixed-species feeding flocks of other seabirds, especially gannets, shearwaters and gulls. Horizontal carriage and trotting gait similar to that of Common Tern and other medium-sized terns. Young birds often tame, allowing close approach. Flight graceful and buoyant, with deep regular wing-beats; similar to Common but steadier and less buoyant, without slight pause on upstroke. When foraging, fly well above water; on sighting prey, either hover and descend in stages, with wings held level or only slightly upswept, or plunge directly into water, often submerging completely for a few seconds; also fly just above water and dip to snatch prey from surface. Normal flight calls include *keck-keck* and *kee-eck kee-*

eck, also high-pitched abrupt *zeat* or *kee-it* and muffled *krrr*.

HABITAT Coastal seas and exposed rocky coasts, often with islands or stacks; and sandy beaches of sheltered coasts, including bays, harbours, estuaries and lagoons, especially those with banks, spits or flats of sand or shingle. Less often in sheltered environments in Aust. On Otaki–Ohau coast, recorded on beaches and estuaries but density greater round estuaries; ratio of numbers at estuaries and beaches, 151.1:21.6 (Powlesland & Robertson 1987). In NZ, rarely >5–10 km from shore (Vooren 1972; Bartle 1974; Wilson 1980). In Aust. waters, off Wollongong, recorded more often in offshore and pelagic seas than inshore; ratio of sightings in inshore, offshore and pelagic waters, 8:24:12 (Wood 1991). Rarely inland: on islet in thermal lake; sometimes in braided rivers (Stead 1932; Cunningham 1949; Falla *et al.* 1981; Oliver).

In NZ, breed on rocky offshore islands, stacks, exposed reefs or isolated rocks, on ledges on vertical cliffs or steep crags (Stead 1932; Hodgkins 1949; Merton 1955; Thoresen 1967; Munro 1971; Powlesland & Robertson 1987; CSN 1, 7). Also on Nelson Boulderbank (Owen & Sell 1985). May be bare or vegetated with grasses, prostrate succulents or stunted shrubs. Also breed on banks, spits or beaches of sand, shell or shingle in more sheltered environments, such as coastal lagoons, estuaries and harbours (Stead 1932; Stidolph 1950; Munro 1971; Foreman 1973; Pierce 1980; CSN 1); often among beachcast driftwood (Cunningham & Wodzicki 1948). Rarely in sand-dunes (CSN 1), but will use low sand-hummocks associated with lagoon spits (Cunningham & Wodzicki 1948). Also nest on banks of shingle in beds of braided streams (Stead 1932; Stidolph 1950; Oliver); these sites degraded by infestation of Yellow Lupin (Stead 1932). In harbours, may nest on artificial structures, including groynes, piles and dredge-spoil (Merton 1955; Cowan 1967; Munro 1971; CSN 7). In Aust., breed on exposed rocky islets, stacks or exposed reefs, vegetated with grass and mats of succulents (Wakefield 1981; Napier 1982; Skira & Brothers 1987a,b, 1988a; Brothers & Skira 1988).

Forage from surface or just below surface of water; in coastal seas, mainly round turbulent breaking water in or just beyond surf-zone, and <3 km from shore; also close to shore, near reefs or rocks (Hindwood 1946; Edgar 1961; Cox 1977; Marchant 1977; Powlesland & Robertson 1987; CSN 1, 7). Will forage behind boats 15 km or more from shore (Cox 1977; Wood 1991; Brandis *et al.* 1992). Occasionally in harbours and coves; in river systems, mainly estuaries, but may forage farther upstream in tidal systems, preferring junctions of streams with turbulent water (Stead 1932; Hindwood 1946; Falla *et al.* 1981; Secker 1985; Harrison & Petch 1990).

Roost or loaf on sandy beaches without wide mudflats, or on spits and bars or peninsulas of sand, shell or shingle. Also on bare rocks, exposed wave-cut platforms or rocky reefs (Stead 1932; Fleming 1939–40; Hindwood 1946; Edgar 1961; Foreman 1973; Pierce 1980; Wilson 1980; Vic. Atlas). Occasionally on jetties or posts in water (Pierce 1980; Vic. Atlas). One bird, sitting on sea, outside breakers, was thought to have just arrived after migration (Hindwood 1946).

DISTRIBUTION AND POPULATION Much of NZ coast and some offlying islands; se. Aust.

Aust. Only se. coast. **Qld** Uncommon visitor to SE, mostly round Bribie, Moreton and Stradbroke Is (e.g. Agnew 1921; Mayo 1931; Smyth & Corben 1984; Stokes & Corben 1985; Qld Bird Reps; Aust. Atlas), and occasionally farther N to Fraser I. (Sutton 1990; Aust. Atlas). Old specimen (MV)

said to have come from Rockhampton but confirmation of site needed (Hindwood 1946). **NSW** Widespread along much of coast, from Kingscliff (Guthrie 1972) S to Green C. Less often on n. coast (Morris *et al.* 1981; NSW Bird Reps; Aust Atlas). **Vic.** Scattered coastal records: East Gippsland, W to Rotamah I.; Wilsons Prom. W to C. Liptrap; from off Phillip I., W to w. Bellarine Pen., including Port Phillip Bay; and between Portland and Nelson; sparse records elsewhere (Vic. Bird Reps; Vic. Atlas). Inland record at Wyperfeld NP, 20 Sept. 1960 (McKean 1960). **Tas.** Widespread, from s. Furneaux Grp, S along e. coast of mainland to Boat Harbour and Cockle Ck on s. coast. Occur Devonport most winters. Rarely, farther W to Smithton and Robbins and Albatross Is in the NW (Tas. Bird Reps; Aust. Atlas; Aust. Seabird Atlas). **SA** Before 1970s, four records, all singles: specimen, Encounter Bay, 1 Sept. 1929 (Anon. 1930); specimen, Sellick's Beach, 4 Aug. 1935 (Sutton 1935); specimen, Outer Harbour, 1 Sept. 1956 (Glover 1956); beachcast, The Coorong, May 1968 (SA Bird Rep. 1967–68). Six records between 1971 and 1977 (Cox & May 1977). Aust. Atlas (1977–81) has 12 records, from Long Beach (The Coorong), S to coast W of Glenelg R. mouth. Unconfirmed record of several in e. Great Aust. Bight, 8 Aug. 1985. **N. and w. Aust.** Several historical records, e.g. North West C. (Carter 1904) and Torres Str. (Mathews 1914), either Roseate or Common Terns (Hindwood 1946). Recent unconfirmed or doubtful records include three, Eclipse I., 8 Aug. 1973 (Fullagar & van Tets 1976) and single, Wellstead Estuary, 22 Dec. 1985 (Anon. 1986).

NZ Most widespread tern. **NI** Virtually entire coast. Most extensively distributed round Auckland Isthmus, Coromandel Pen. and Bay of Plenty. Widespread but more sparsely distributed along e. coast, S to Cook Str.; on w. coast, widespread S to C. Egmont, but very sparsely recorded coasts of s. Taranaki and Wanganui. Widespread on coasts of Manawatu and Wellington (CSN; NZ Atlas). Rarely, recorded inland, e.g. Rotorua (Cunningham 1949, CSN 24, 25). **SI** Much of coast. Often recorded coasts of Nelson and Marlborough and widely distributed coastal Canterbury and Otago; also Southland and Stewart I. On w. coast, occur S to round Awarua Bay, with a few records in nw. Fiordland, but many in sw. Fiordland (CSN; NZ Atlas). Occasionally recorded inland, e.g. in Rakaia R. to L. Coleridge; near Gore in Southland (NZ Atlas).

Norfolk I. Single, winter 1978 (Hermes *et al.* 1986).

Chatham Is Widespread breeding visitor (Plant 1989; CSN).

Snares Is Straggler; recorded before 1930 (Oliver); single, Rua I., 19 Feb. 1984 (Miskelly 1984).

Auckland Is Common breeding visitor (Penniket *et al.* 1986; Oliver).

Campbell I. Recorded before 1930 (Oliver); also: two, 24 Jan. 1946 and single, 28 Nov. 1946; unconfirmed record of single, 30 Dec. 1959 (Bailey & Sorensen 1962).

Macquarie I. Straggler (Oliver); recorded before 1930.

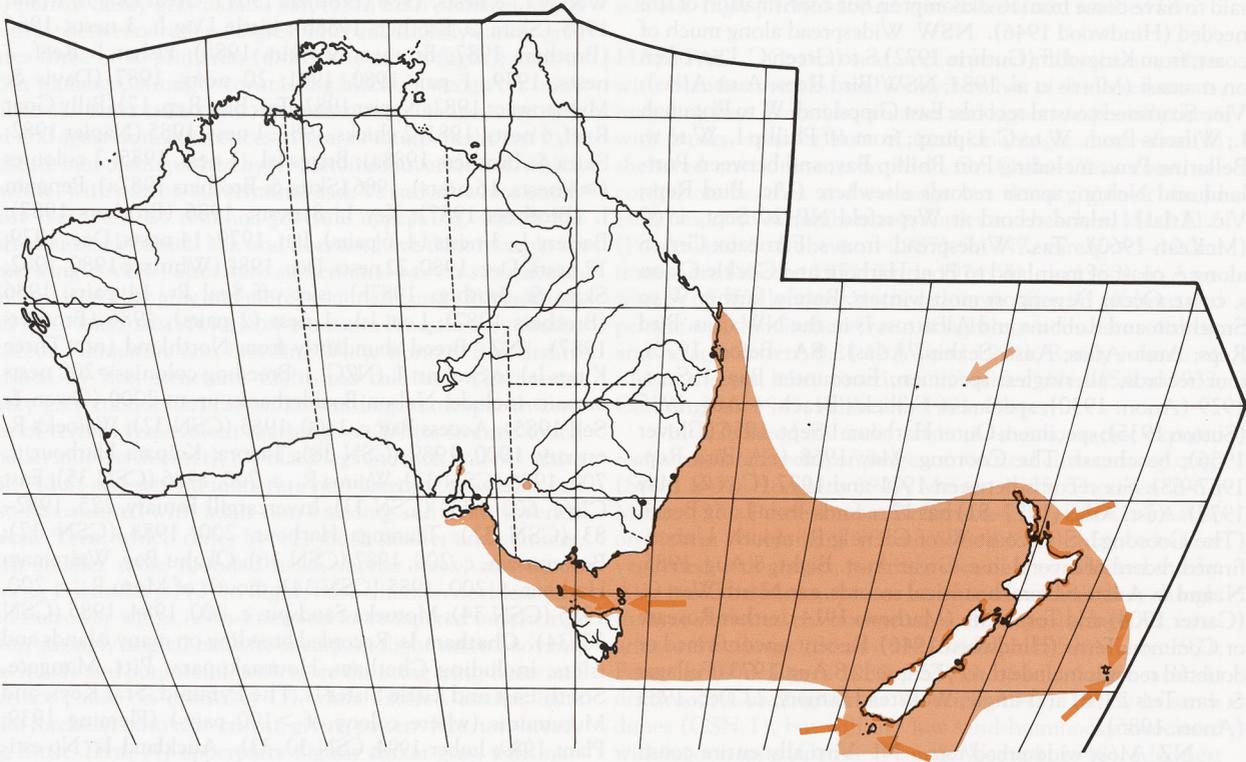
Breeding Aust. **TAS.**: Only in Furneaux Grp, Bass Str., where thought to be recent colonist. First recorded breeding on Little Woody I. in 1924, though record overlooked till mid-1950s (Green 1985). However, earlier, unconfirmed or discredited records from Actaeon I., 'The Friars' and in Bass Str. (Hindwood 1946; Wall 1980; Whinray 1981). Breeding population in Furneaux Grp estimated at 30 nests in 1982 (Tas. Bird Rep. 12) and 53 pairs in 1986 (Brothers 1987): Mile I., 1 nest, 1979 (Wakefield 1981); Oyster Rocks, 6 nests, 1983 (Tas. Bird Rep. 13); Neds Reef, 2 nests, 1986 (Brothers 1987); Mid

Woody I., 3 nests, 1986 (Brothers 1987); Great Dog I., 1 pair, 1985 (Skira & Brothers 1988b); Little Dog I., 3 nests, 1986 (Brothers 1987; Brothers & Skira 1988); Fisher I. Reef, 2 nests, 1979; 1 pair 1980, 1981; 20 nests, 1987 (Davis & Mykutowycz 1982; Napier 1982; Tas. Bird Rep. 17); Billy Goat Reef, 6 nests, 1981; 2 chicks, 1982; 1 nest, 1985 (Napier 1982; Skira & Brothers 1988a); Briggs Isl., 1 nest, 1985; 2 colonies (≥ 4 nests, 16 nests), 1986 (Skira & Brothers 1987a); Penguin I. (Brothers 1987); Key I., 8 nests, 1986 (Brothers 1987); Battery I., 3 nests (4–6 pairs), Jan. 1979; 14 nests, Dec. 1979; 12 nests, Dec. 1980; 22 nests, Dec. 1982 (Whinray 1980, 1982; Skira & Brothers 1987b); islet off Seal Pt, 14 pairs, 1986 (Brothers 1987); Low Isl., 1 nest (2 pairs), 1986 (Brothers 1987). **NZ** Breed abundantly from Northland (not Three Kings Is) to Stewart I. (NZCL). Breeding colonies ≥ 200 nests or pairs include: Nelson Boulderbank, up to 2000 (Owen & Sell 1985); Access Bay, c. 1400, 1983 (CSN 32); Waioeka R. estuary, 1000, 1989 (CSN 38); Tabora, Kaipara Harbour, c. 700, 1988 (CSN 37); Wairoa R., c. 700, 1986 (CSN 35); East Clive, 600, 1984 (CSN 33); Invercargill Estuary, 225, 1982–83 (CSN 31); Tauranga Harbour, 200, 1988 (CSN 37); Bowtown, c. 200, 1987 (CSN 36); Okahu Bay, Waitemata Harbour, c. 200, 1985 (CSN 34); mouth of Motu R., c. 200, 1985 (CSN 34); Motueka Sandspit, c. 200, 1984, 1985 (CSN 33, 34). **Chatham Is** Recorded breeding on many islands and islets, including Chatham, Houruakopara, Pitt, Mangere, South East and Little Sister Is, The Pyramid, Star Keys, and Murumuru (where colony of >100 pairs) (Fleming 1939; Plant 1989; Imber 1994; CSN 30, 33). **Auckland Is** No estimates of population.

Irruptions, Wrecks Aust. After gales in Aug. 1959, 52 beachcast on Vic. coasts from Ls Entrance to Portland, including Port Phillip Bay; >1000 birds seen off Windang, NSW, at same time (McKean 1960); inland specimen from Wyperfeld NP thought to have come from same gales. In 1975, small wreck NSW, with beachcasts from Ulladulla to Tweed Heads (Holmes 1976) and se. Qld (Roberts 1979). Large numbers occasionally seen off coasts: e.g. off Moon I., NSW, 400 in Oct. 1963, and 350 in Oct. 1965 (Morris 1975); 200–300 round Montagu I., Oct. 1988 (Whiter 1989); 100 at Long Reef, NSW, Sept. 1982 (NSW Bird Rep. 1982); c. 100, C. Bridgewater, Vic., June 1982 (Vic. Bird Rep. 1982); c. 100, C. Nelson, Vic., July 1984 (Vic. Bird Rep. 1984). **NZ** Irruption at Avon–Heathcote Estuary, 28 Apr. 1989, when 1272 Terns counted (usually <40 present) (CSN 37). While wrecks can occur after gales, virtually unaffected by severe 'Wahine Gale', Apr. 1968; only ten beachcast birds recovered, compared with heavy losses of other species (Kinsky 1968).

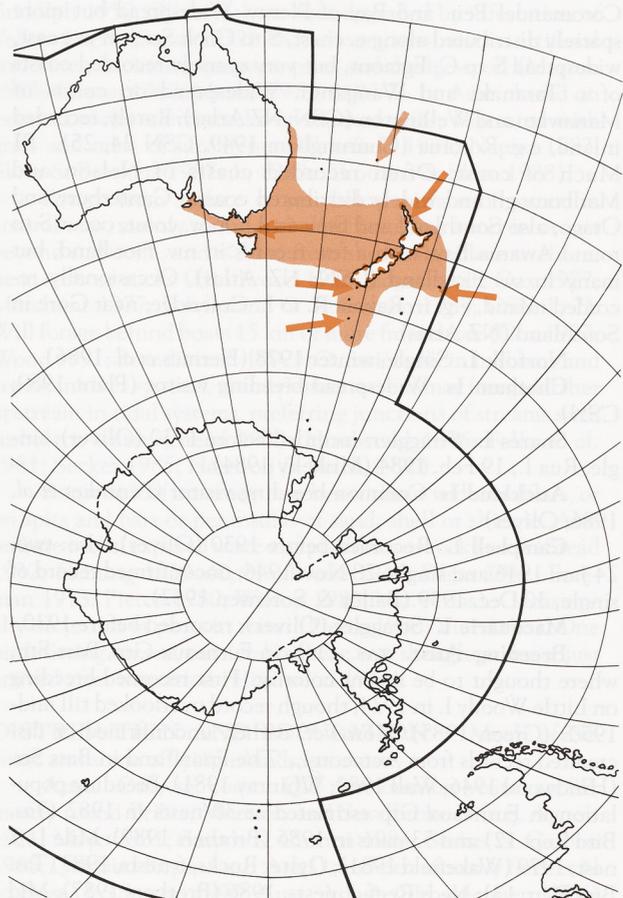
Populations NZ breeding population estimated between 100,000 and 1,000,000 breeding pairs (Robertson & Bell 1984). On sw. coast NI, NZ, Mar., 55 birds/km (Powlesland & Robertson 1987). Estimates of size of some colonies above.

Breeding colonies occasionally vandalised (CSN 32); at one colony, Gisborne Harbour, 1950, adults shot or driven away, eggs smashed and young killed (Merton 1955); breeding at colony at Ohope disrupted by motorcycle traffic several times (CSN 32, 37). Volkner Rocks, Bay of Plenty, where Terns breed, was intermittently used as a bombing target by RNZAF and RNZN (Falla 1970). Occasionally caught on fishing lines (Clark & Dawson 1957). Eggs and chicks sometimes trodden on (Stead 1932; Clark & Dawson 1957). Formerly eaten by Maori. Eaten by introduced predators, including cats, dogs, stoats, rats and mustelids (Stead 1932; Fleming 1939–40; Robertson & Bell 1984).



MOVEMENTS Dispersive, possibly partly migratory. Most breed NZ, dispersing to seas round NZ after breeding; some disperse or possibly migrate NW across Tasman Sea to spend austral winter in se. Aust.; most appear to return to NZ in austral spring (Harrison 1983; HASB). Movements of population breeding Tas. not known. Route across Tasman Sea not known, though lack of records from Lord Howe I. suggest birds pass to S of there. Recorded aboard ships in Tasman Sea (Clark & Dawson 1957; Jenkins 1973). Most movements at sea. Recorded flying across Auckland Isthmus (CSN 26). Move locally between estuaries and up to 25 km offshore (Wodzicki 1946; Jenkins 1969; Bartle 1974). Some inland records associated with bad weather (CSN 19, 25). Seasonal trends at some NZ locations vary between years, e.g. at Manukau Harbour, NI, none recorded in winter in some years (e.g. CSN 38), more recorded in winter than in summer in some years (e.g. CSN 35, 36, 37) and more recorded summer than in winter in other years (e.g. CSN 32, 33).

Departure In Gisborne Harbour, most left apparently successful colony by 13 Mar. 1950 (Merton 1955); chicks still present at some colonies into Feb. or even Mar. (CSN 26, 37, 39). Timing of departure at some colonies varies between years (e.g. at East Clive, CSN 32, 34). Some colonies, possibly where breeding not successful, deserted as early as Oct. or Nov. (CSN 34). Passage apparent at Wellington Harbour, NZ, where usually most abundant in Feb.; in 1984, maximum numbers in Jan. (Secker 1985). At Waikanae Estuary, s. NI, maximum numbers (including many young birds), Nov.–Jan. (Wodzicki 1946), which may represent influx after breeding. Generally arrive se. Aust. in May and June (Smith 1989). Some variation in timing of arrival between years, e.g. in Sydney area, earliest dates, between Apr. and June (NSW Bird Repts 1981, 1986). Recorded as early as Apr. in Vic., though first records usually later (i.e. May); highest reporting rates from May



(Vic. Bird Reps 1983, 1984, 1986–87; Vic. Atlas).

Non-breeding Significant numbers remain in NI and SI during winter (Smith 1989; CSN 39). Present year-round in some areas, e.g. off w. coast of SI (CSN 34); in Auckland district in 1939 and 1940, no apparent movement from area, though numbers appeared to vary with weather (Fleming 1939–40). In some breeding areas, most common during non-breeding season, e.g. largest numbers Noises Is, Hauraki Gulf, Apr.–Aug. (Cunningham & Moors 1985). Move away from some areas, e.g. seldom seen round Nelson coast, SI, June–Oct. (CSN 36, 37, 38); at Waikanae Estuary, almost none from June or July to Nov. (Wodzicki 1946). Said to desert some breeding areas, e.g. Chatham Is, Mar.–Aug. (Fleming 1939), though records in Mar. and Apr. (CSN 38). Lowest numbers occur at some areas near breeding colonies during non-breeding season, e.g. at L. Wainono, winter (Pierce 1980); at Waimau Inlet, Feb.–June 1977 and Apr.–July 1978 (Owen & Sell 1985). Occur irregularly in many non-breeding areas. In NZ, sometimes absent from sites where usually occur in winter, e.g. Porangahau, NI (CSN 39). Juveniles and adults recorded in Tasman Sea during winter (Jenkins 1973).

In Aust., regular to NSW, Vic. and e. Tas., straggle to Qld as far N as Rockhampton and to SA; numbers visiting Aust. vary from year to year (HASB; Aust. Atlas). Considerable variation in timing and duration of occurrence between areas, e.g. in NSW, recorded Newcastle, off Wollongong (1984–90) and in Eurobodalla Shire (1990), Mar.–Sept. (Morris 1975; Brandis *et al.* 1992; NSW Bird Rep. 1990); County of Camden, Mar.–Oct., with largest flocks Aug.–Oct. (Gibson 1977); Botany Bay, June–Oct. (Morris 1989); Montagu I., Feb.–Oct. (NSW Bird Rep. 1988); in Sydney area, between Apr. and late Nov., with laggards till Jan. (Hindwood 1946; NSW Bird Rep. 1986). SA records, Apr.–Sept. (Cox 1977; Cox & May 1977). Generally rare off se. Qld, between June and Oct. (Roberts 1979). Suggested most visiting Aust. are subadults (HASB; Aust. Atlas), though proportion of subadults and adults poorly known and varies greatly between counts; during Aust. Seabird Atlas 59% of aged birds adults; in 1959, c. 50% of influx to Vic. and Illawarra, NSW, adults; at Long Reef, NSW, <5% adults (see McKean 1960); large numbers off C. Nelson, Vic. in July and Aug. 1984 were mostly young birds (Vic. Bird Rep. 1984). In Aust., occur irregularly in some areas (e.g. between Crowdy Head and Evans Head, NSW Bird Rep. 1975).

Occasional influxes occur in non-breeding areas, both in NZ (e.g. in 1989 at Avon–Heathcote Estuary, SI, CSN 37) and Aust. (e.g. in 1959 in s. NSW and Vic., HASB). Influxes even occur in areas where considered rare (e.g. se. Qld, Roberts 1979). Winter storms cause deaths of many birds in Aust. waters and sometimes force birds from normal non-breeding areas (e.g. 320 km from coast, McKean 1960).

Return In Vic., latest records, June–Oct., and as late as Nov. (Vic. Bird Reps 1981, 1982, 1983, 1985; Vic. Atlas). Most leave Sydney area late Oct. or Nov.; laggards present till Jan. (Hindwood 1946); also recorded elsewhere in NSW in Nov. (McGill & Lane 1955). In NZ, passage apparent in Wellington Harbour mostly between Sept. and Nov. (Secker 1985). Start to revisit nesting grounds in n. NZ in Aug. (Falla *et al.* 1981); also recorded arriving in parts of SI in Aug. (Mt Aspiring, Pembroke; Moncrieff 1928). One record of arrival in SI in July (Annual Locality Rep. 1). Arrive later in other areas, e.g. at Boulder Bank, Nelson (where breed most years) first birds arrived 16 Oct. 1986 (CSN 35); recorded congregating and nesting at East Clive in Oct. (CSN 32, 33).

Breeding In some areas, breeding considered intermittent

(e.g. Chickens Is, NZ, McCallum *et al.* 1984). Where breed annually, numbers of breeding birds vary greatly between years (e.g. at Kaikoura Pen., Mills & Shaw 1980). In Tas., recorded breeding at one location in consecutive seasons (Davis & Mykytowycz 1982; Napier 1982; Whinray 1982). Almost completely absent from some parts of NZ during nesting season, e.g. Waikanae Estuary (Wodzicki 1946). At some sites near breeding colonies numbers highest during breeding season, e.g. summer and autumn at L. Wainono (Pierce 1980); at Waimea Inlet, Dec.–Jan. 1976–77 and Dec.–Mar. 1977–78 (Owen & Sell 1985). No strong tendency to breed at natal locality, though some return to natal site; of 134 recovered breeding at Kaikoura Pen., 63% were banded as nestlings at Kaikoura, and rest came from colonies within 104 km, including 25% from mouth of Clarence R., 33 km N of Kaikoura (Mills & Shaw 1980). Appear to return to general breeding area rather than specific breeding sites, e.g. one adult banded as nestling at Kaikoura Pen. recovered breeding in subsequent seasons at mouth of Clarence R., then again recovered breeding at Kaikoura. Few remain Aust. over summer, where recorded Tas., Vic., NSW and Qld (Vic. Bird Rep. 1985; Aust. Atlas); some areas deserted in most years (e.g. Vic., Dec.–Feb., Vic. Atlas). A few recorded e. Bass Str. in summer, where breeding occurs (Green 1985; Tas. Bird Reps).

Banding, Colour-marking Longest recovery, 2970 km from Kaikoura, NZ, to Carpenters Rocks, SA (ABBBS 1979). Birds banded NZ recovered in first year and as adults in Aust. (Clark & Dawson 1957; McKean 1960; Cooper 1970). Chicks banded in NZ and recovered in first year in Aust. came from NI and SI (e.g. Cooper 1970; McKean 1960). Within NZ, birds banded as chicks at Waitaki R. mouth recovered only in SI, as far N as L. Ellesmere and as far S as Dunedin (Clark & Dawson 1957); birds banded NI and recovered within NZ were all recovered in NI (e.g. Robertson 1972; CSN 26).

FOOD Carnivorous. Mostly fish. **Behaviour** Diurnal, though observed flying from coast in evening, presumably to forage, and to return in the morning (Jenkins 1969). Forage mainly by PLUNGING (SURFACE or SHALLOW) from 6–10 m above surface, submerging to c. 50 cm (Hindwood 1946; CSN 19 Suppl.); also said to feed occasionally by DIPPING (NZRD). In Aust., mainly forage offshore; in NZ and during breeding, commonly forage in surf-zone (HASB). Follow schools of predatory fish that drive smaller species to surface, often in association with other species of birds, such as Fluttering Puffinus gavia, Sooty P. griseus and Flesh-footed P. carneipes Shearwaters, Australasian Gannets *Morus serrator*, Crested Terns *Sterna bergii* and gulls (Smith 1989; Oliver; CSN 19 Suppl., 25). In NZ, accompany schools of Kahawai *Arripis trutta* (Arripidae) and Kingfish (Carangidae) (Oliver; CSN 21). Have food stolen by Arctic *Stercorarius parasiticus* and Long-tailed *Stercorarius longicaudus* Jaegers (Stidolph 1931; Edgar 1961; Crockett 1962; Barton 1982; CSN).

Adults No detailed studies. Fish^{2,3,4,5,7,8,10,12}: Clupeidae: *Spratelloides robustus*¹¹; Engraulidae: larv.¹²; *Engraulis australis*⁹; Galaxiidae: whitebait¹²; Petromyzontidae: lamprey¹¹; Salmonidae: *Ancorhynchus tshawytscha* larv.¹; Retropinnidae: *Retropinna anisodon*⁶. Offal⁸. (REFERENCES: ¹ Stead 1932; ² Stidolph 1939; ³ Fleming 1939–40; ⁴ Hindwood 1946; ⁵ Cunningham & Wodzicki 1948; ⁶ McMillan 1961; ⁷ Edgar 1961; ⁸ Cox 1977; ⁹ Secker 1985; ¹⁰ Smith 1989: photo; ¹¹ HASB; ¹² CSN 20, 34, 38). NZRD also report: shrimps; sand fish; pilchards; Hemiramphidae; *Aldrichetta forsteri*; *Rhombosolea retiaria*.

Young Fish (Edgar 1961; Whinray 1980); Clupeidae: pilchards (Stead 1932).

SOCIAL ORGANIZATION Poorly known, but some information from study at Kaikoura Pen., NZ (Mills & Shaw 1980). Gregarious; usually breed, feed, and rest in flocks. May also disperse in groups (HASB). NZ: Usually in large flocks of c. 60 to 300 birds. Courtship observed in flocks before breeding, sometimes at sites of breeding colony (e.g. Buller 1888; Stead 1932; Oliver; CSN). Up to 2000–3000 recorded courting and feeding at mouth of Waitaki R. when whitebait running (CSN 1). After breeding, form flocks of adults, immatures and fledgelings (e.g. of 200–250 and smaller; Fleming 1939–40; Gillham 1960). In mid- to late summer, seen in foraging flocks of 50–500 birds, as well as singly (Secker 1985). Other examples of flock sizes: flocks of tens (Wilson 1973; CSN 37, 38) or hundreds (CSN 32, 34, 36, 37, 38); in winter, large flocks of c. 1000 (CSN 24); one roost of c. 1000 (including only three juveniles) (CSN 39); another roost with 1500 resting birds (CSN 37). AUST.: Flocks can be large (see below) but often seen singly or in small groups (e.g. Hindwood 1946; Cox 1977; Gosper 1981; NSW Bird Reps 1981, 1984–86, 1988, 1990; Tas. Bird Reps 19–21) particularly after most birds have left for breeding areas (Hindwood 1946). Seen all year at sea off Wollongong, NSW; average flock size 1.8 (1.3; 1–6; 21) (Wood 1991). Flocks usually seen during winter (May–Oct.) (MacGillivray 1927), e.g. at Long Reef, 200–300 resting (Hindwood 1946); Illawarra district, flocks of 90 and 123 resting (McKean 1960) with maximum of 500 (Clark & Dawson 1957; Gibson 1977); Port Kembla, resting group of c. 60; at Boat Harbour, S of Sydney, c. 25 resting (Clark & Dawson 1957); off Cronulla, 10–12 fishing (Clark & Dawson 1957); Botany Bay, small flocks of 4–10 (Morris 1989); at Portland, 10 (McKean 1960). Off s. coast NSW, in Aug., >1000 concentrated offshore, with almost 50% adults (McKean 1960).

Often seen with other species of birds, e.g. Crested Terns (Smith 1989; HASB), Silver Gulls *Larus novaehollandiae* (CSN 1), Black-fronted Terns *Sterna albobriata* (Latham 1981), Pomarine *Stercorarius pomarinus* and Arctic Jaegers (e.g. Jenkins 1969; CSN 36) and other shorebirds (Buller 1888). Often feed beside other species, usually congregating over schools of small fish (Hindwood 1946; Edgar 1961), e.g. with Fluttering (CSN 25) and Sooty Shearwaters (Oliver), Crested Terns and Silver Gulls (Hindwood 1946). Sometimes rest with other species (Oliver), e.g. Black-fronted Terns (Latham 1983), Crested Terns, Silver Gulls (Hindwood 1946, CSN 34) and Black-winged Stilts *Himantopus himantopus* (CSN 19).

Bonds Monogamous. Said to pair for several years, possibly for life (NZRD). At Kaikoura Pen., most pairs (73%) had partners with age difference of ≤ 1 year but one pair had difference of 7 years; some breed at 3 years old but most do not breed until >6 years old; date of laying and size of eggs varies with age of parent (Mills & Shaw 1980). Mating begins Sept. (Oliver). Courtship behaviour and copulation seen in pre-breeding flocks, which usually form spring to early summer (e.g. Stead 1932; CSN 23; also, see above and Sexual behaviour). Pair recorded courtship feeding, 11 June (CSN 37). **Parental care** Both sexes build nest (Smith 1989), incubate (Falla *et al.* 1981; Smith 1989; Oliver) and said to brood young (NZRD). Chicks said to sometimes form crèche 4–6 days after hatching, either gathering loosely over wide area, or packing tightly together (NZRD); Gillham (1960) refers to young gathering at a common standing ground. Young helpless for 2–3 weeks after hatching and fed by parents for some time after

leaving nest (Oliver); at one colony, in mid-Jan., some young able to fly, already caught food for themselves but most were still being fed (Edgar 1961). Parents said to feed young for several months after leaving colony (NZRD).

Breeding dispersion Colonial. In NZ, some colonies contain many hundreds or many thousands of breeding pairs, others as few as 10–20 pairs (Clark & Dawson 1957; Falla *et al.* 1981; Mills & Shaw 1980). In Aust., colonies much smaller (e.g. Whinray 1980; Napier 1982; Skira & Brothers 1987a). For details of size of some colonies, see Distribution. Solitary nests occasionally recorded (Moncrieff 1928; Wakefield 1981; CSN 19, 33, 36, 37). Tend to return to natal area but not consistently philopatric (see Movements): 63% of 134 tagged birds recovered at Kaikoura Pen. were tagged there as nestlings and 25% came from 33 km to N (Mills & Shaw 1980). Capricious in choice of site of colony (e.g. Gillham 1960; Mills & Shaw 1980; Falla *et al.* 1981; Cunningham & Moors 1985; Oliver). Often nest in association with other species; see Breeding. Within colony, sub-colonies sometimes apparent (e.g. Cunningham & Wodzicki 1948). NZ: Nests closely packed (Buller; Oliver); at Porangahau, most nests c. 1 m apart, closest being 31 cm from centre to centre (Cunningham & Wodzicki 1948); on Rusoe I., nests average 30 cm apart; on Motuharaka I., average 1.5 m; on David Rocks, nests up to 1.5 m apart; in some breeding locations in Hauraki Gulf, a few nests scattered among numerous nests of Silver Gulls (Gillham 1960). AUST.: Fisher I. Reef, Furneaux Grp, two nests 7 m apart (Davis & Mykytowycz 1982).

Roosting Few details. Often seen resting in groups on spits and beaches (see above). Once observed resting on water, possibly having arrived after migration (Hindwood 1946; HASB). Usually, birds land near edge of water and stand, closely packed, facing wind (Buller); also face wind when sitting (Oliver); birds crouching into strong wind occasionally move forwards in short flights (CSN 23). Between fishing bouts at breeding colonies, most adults rest on rocks or on sand (Edgar 1961). After breeding season, young and adults congregate and sit at high tide; in one large resting flock in Apr., small flocks periodically left and joined larger flock, some birds arriving with fish (Fleming 1939–40). Possibly rest ashore at night (Fleming 1939–40), though birds seen to move away from coast in evening, >16 km from shore (possibly to feed), then return at first light (Jenkins 1969). Once, bird seen resting with Black-winged Stilts, moving along line of Stilts pinching their tails with its bill (CSN 19). Rest and preen on rocks, sand-spits (Hindwood 1946; Oliver), shell banks (CSN 19), beaches (CSN 38; Buller; Oliver); at New Brighton Bay, SI, flocks often roost on roofs (CSN 38, 39).

SOCIAL BEHAVIOUR Not well known. Some details of displays in Cunningham & Wodzicki (1948). Many features of display and sexual behaviour similar to those of Common Tern (Cunningham & Wodzicki 1948). **Flock behaviour** In colonies, all adults attending young seen to take to air simultaneously, with no apparent cause for alarm, rising high and circling for a few minutes; flying young behave similarly but generally do not fly as high (Edgar 1961). During incubation, panic flights also said to be common, especially round dusk when whole or part of flock rises (NZRD). Gillham (1960) noted, in colonies, all sitting birds faced same direction with head to wind. Within colony, breeding does not appear synchronized (e.g. Edgar 1961; CSN 33, 34; Oliver; see Breeding).

Agonistic behaviour Not aggressive towards other birds (HASB). **Alarm** In Aust., outside breeding areas, sometimes

timid, but at other times can be approached fairly closely (Hindwood 1946); one was caught by hand (Clark & Dawson 1957). In NZ, when approached closely outside breeding season, flocks take off suddenly (Clark & Dawson 1957); when fired at, or otherwise alarmed, whole flock takes off at same time and flies about confusedly, calling over same spot; if approached quietly take off in more orderly fashion, starting with those nearest to intruder, and rising in wave (Buller 1988).

Sexual behaviour **Courtship, Courtship feeding** Mating, courtship feeding, High Flights, loud calling, and copulation observed in pre-breeding flocks (CSN 23, 31, 33, 34, 37, 39). To attract female, male flies over site where birds have congregated for breeding, carrying small fish in bill and calling; if he lands, one or more females may approach him with their necks stretched out (Fig. 1); male rises in air, followed by females, and flies about until only one follows him; he may then settle and feed female. Male may eat fish himself (Stead 1932). After initial courtship feeding, pair seem to be mated,

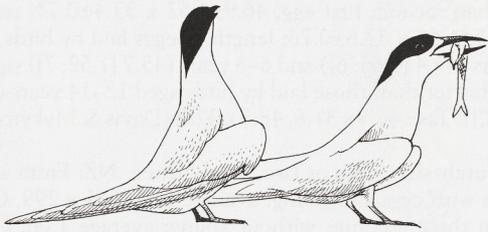


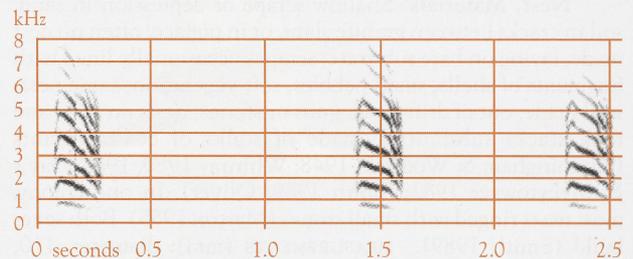
Fig. 1 Courtship feeding

and thereafter perform display flights (Stead 1932). In early stages of nesting, mated pairs seen to display to each other both at nesting site and at DISPLAY GROUND c. 30 metres from nest-sites on bare edge of river. FISH-CARRYING by presumed male said to be main display in paired birds: calling restlessly, male lands on Display Ground or near nest, assumes a stretched posture, and holds fish, sometimes for several minutes, before presenting it to mate; if female pays no attention, male flies away with fish or eats it (which possibly only occurs when two birds as yet unpaired). When fish passed to mate, male assumes an erect posture: neck stretched up, with bill nearly vertical and wings lowered until wing-tips almost touch ground; he then walks slowly round female. Likely that this display continues after laying (Cunningham & Wodzicki 1948). Mated terns recorded playing with fish while in flight: one drops fish and other catches it in mid-air (Oliver). **Copulation** Often takes place after displays (Smith 1989). Observed several times in one small pre-breeding group; once male mounted just as female moved forward, leaving him squatting on ground where he attempted to copulate with a stone (CSN 23). Cunningham & Wodzicki (1948) found copulation seemed to take place only on Display Ground, where up to ten pairs may be copulating at same time; also said to occur at nesting site or roost (NZRD). Copulation initiated by PARADE, where male, in Stretching Posture, follows female; after a while female stands with head down and male jumps onto her back; for up to 3–4 min male calls before attempting cloacal contact by pressing cloaca through middle of female's tail and balancing by flapping wings; he remains on female's back for up to 4.5 min, making cloacal contact 2–15 times. Attempts may be frustrated by female moving or by other males on Display Ground. After copulation, male again assumes Stretching Posture and Parades once round female (Cunningham & Wodzicki 1948).

Relations within family groups Parent said to recognize chicks, first by voice and then by sight (NZRD). Both parents brood and feed young (Napier 1982). Young that are yet to fly spend their time on rock ledges, swimming, or squatting on beach (Edgar 1961). **Anti-predator responses of young** Move off and hide (Napier 1982). Young chicks froze; old chicks, which had left nests, fluttered over edge of groyne (2.4 m drop) into water and, as danger passed, climbed up again (Merton 1955). **Parental anti-predator strategies** Threaten Swamp Harriers *Circus approximans*, Kelp Gulls *L. dominicanus*, Pacific Gulls *L. pacificus*, Silver Gulls, ducks and other birds coming too near colony. Harass Caspian Terns *Sterna caspia* on the wing but ignore them on ground (Moncrieff 1928; Davis & Mykytowycz 1982; Napier 1982; Oliver). Often succeed in chasing Kelp Gulls away (Oliver); members of colony will mob Kelp Gulls (Edgar 1961). Said to threaten Silver Gulls by GAKKING: point bill at Gull, stretching neck forward and ruffling plumage; do not actually attack (NZRD). One Sooty Oystercatcher *Haematopus fuliginosus* was struck and knocked from rocks into water (Napier 1982). Defend vigorously against people (Davis & Mykytowycz 1982; Napier 1982). When people approach to within c. 20 m, birds often leave nests, though once left when observer 70 m away (Whinray 1982); at other times, allowed close approach, to within 1–2 m of nest, and remained on nest (Davis & Mykytowycz 1982; Oliver). One or both members of pair call and dive to within 2–3 m (Wakefield 1981) or a few inches (Oliver) of observer's head; may fly towards intruder's face, till within arm's length, then turn sharply while giving a sharp cry; sometimes strike (Buller 1888; Whinray 1980; Napier 1982). As nest approached more closely, occasionally start to land near nest then walk to it and sit for a few seconds before mobbing observer again (Wakefield 1981).

VOICE Not well known. Varied vocabulary. Most vocal before and during breeding. Noisy at colony (Stead 1932; McKenzie & Sibson 1957; CSN 34). Birds returning up river to large colony stopped calling and travelled in silence once darkness fell (Stead 1932). Parent said to recognize chick first by voice and secondly by sight (NZRD).

Adult ADVERTISING or CONTACT CALLS: Monotonous *crek* (three shown in sonagram A). Uttered by male carrying fish; also used by both birds on ground after Courtship Flights (Stead 1932). Once colony established, short intermittent *crek* calls of thousands of birds combine to produce continual babble of sound. If colony suddenly disturbed, all take off without calling, but then call much in flight; calling returns to normal levels when birds land (Stead 1932). Said that *crik*, *krra*, *grrik* or *krack* given as Contact Call (NZRD). Buller (1888) describes call in air as *ke-ke-ke*, and refers to constant twittering on the ground. **ALARM or ATTACK CALLS:** Rasping yawn in alarm. Angry screams if Swamp Harrier neared colony



A J. Kendrick; P100

(Stead 1932). Mate of bird at solitary nest screamed after swooping at nearby Kelp Gull (Moncrieff 1928). Harsh grating *ka-a-a* when swooping at intruder (Stead 1932); snapping cry while swooping (Buller 1888) may be this call. **FEEDING CALL:** single short, sharp *zeat*, *tsit* or *zitt*. **BEGGING and COPULATION CALLS:** Not described. Male, once mounted, called for 3–4 min before copulation (Cunningham & Wodzicki 1948). **Other calls** Give crooning call, circumstances not described. Muffled *krrrr* or *kgrrra* when carrying fish. Prolonged grating *ar-r* by bird missing fish (Stead 1932). Short high-pitched *pit-zwit* when leaving flock.

Young High-pitched trill from fledgelings. Calls of flying young more sibilant than those of adults (Buller 1888).

BREEDING Breed NZ; recently discovered nesting Bass Str. (Whinray 1980, 1982). North described eggs from Actaeon I., Bass Str., though collection locality not considered reliable (Hindwood 1946). Studied at Kaikoura Pen., NZ (Mills & Shaw 1980). Nest in colonies.

Season NZ NI: Laying, mid-Oct. and Nov.; some eggs found in Jan.; young fledge, Dec. and Jan. (Cunningham & Wodzicki 1948; Smith 1989; Oliver). **Aust.** TAS.: Laying, Oct.; hatching, Nov., early Dec.; fledging, Jan. or Feb. (Whinray 1980, 1982; Davis & Mykytowycz 1982; Napier 1982).

Site On stacks, islets, reefs, cliffs, top of rocky precipices, on sand-dunes, beaches in estuaries, spits or shingle bars in lagoons, shingle river beds, old groyne in harbour, on banks of shell; line of sand hummocks c. 30 cm high, c. 9 m apart, on highest point of reef, vantage points towards centre of reef; in vegetated areas of islets, among pigface *Carpobrotus rossii*, *Disphyma australe*, grasses, and sometimes under low bushes (Moncrieff 1928; Fleming 1939; Cunningham & Wodzicki 1948; Merton 1955; Gillham 1960; Foreman 1973; Davis & Mykytowycz 1982). Average distance between nests on islets in NZ, 30–150 cm (Gillham 1960); two nests, 7 m apart (Davis & Mykytowycz 1982). Presence of driftwood appears important in choice of site (Cunningham & Wodzicki 1948), though observed nesting in area clear of driftwood (Foreman 1973). Observations by Whinray (1982) suggest replacement clutches laid on same islet. May return to nest at same site in next season, as whole colony or just a few pairs, or may change sites after successful season, or after a few years (Mills & Shaw 1980; Davis & Mykytowycz 1982; Oliver). Nest in close association with Pitt Shag *Phalacrocorax featherstoni* (Fleming 1939); nest next to Pacific and Silver Gulls (Brothers 1987); with Little Pied Cormorants *P. melanoleucos*, Silver Gulls, Black-billed Gulls *L. bulleri* and Fairy Terns (Merton 1955; Gillham 1960; Whinray 1980). Kelp Gull nested on adjacent rocks (Moncrieff 1928). Nest of Caspian Tern found between two White-fronted Tern nests (Davis & Mykytowycz 1982), and within 4 m of White-fronted nest (Napier 1982); nest of Sooty Oystercatcher 12 m away from Tern nest (Napier 1982).

Nest, Materials Shallow scrape or depression in sand, soil in cracks between granite slabs, or in pigface; often no nest made, laying on bare substrate; scrapes occasionally lined with fragments of shells, small pebbles, soft vegetation; some nests well made, out of driftwood, grass or stones; nests on cliffs and rock stacks substantial, made of stalks of coastal plants (Cunningham & Wodzicki 1948; Whinray 1980, 1982; Davis & Mykytowycz 1982; Smith 1989; Oliver). In one colony, most nests ringed with small stones (Merton 1955). Both sexes build (Smith 1989). **MEASUREMENTS** (mm): diameter, 110; depth, 20–30 (Davis & Mykytowycz 1982).

Eggs Oval, elongate oval, or ovoid, some rather pointed

at smaller end; close-grained, smooth, slightly lustrous; ground-colour varies: faint yellowish-stone, very pale greenish-grey or greenish-white to light brown; or yellowish brown, pinkish white, dark stone and, rarely, bluish white or pale red, with irregular dots, spots, blotches and fine lines of sepia and brownish black or dark amber, with underlying markings of faint inky-grey. Blotches may be blurred or confluent and form patches on part of shell, others evenly distributed; markings on pale coffee-brown eggs are olive or amber-brown, with underlying markings of different shades of inky grey; in NZ, greenish stone said to be most common ground-colour (North; Oliver). Ground-colour of 118 eggs in NZ: light-blue 22.1%, dark blue 20.3%, light brown 25.4%, dark brown 32.2% (Cunningham & Wodzicki 1948). **MEASUREMENTS:** NZ: Porangahau: 46.5 (1.55; 43.2–50.6; 118) x 32.5 (0.88; 30.5–35.3); Waitaki: 46.3 (1.72; 42.0–50.8; 97) x 32.6 (1.02; 30.2–38.1) (Cunningham & Wodzicki 1948); 46.8 (1.59; 43.9–49.5; 9) x 32.5 (1.02; 30.7–34.0) (North). At Kaikoura (Mills & Shaw 1980): in C/1 (n=112) average 46.4±1.81 x 33.4±1.00; in C/2 (n=36) 46.3±1.62 x 33.1±0.80; in C/2 (n=34), first egg significantly larger than second: first egg, 46.9±1.52 x 33.4±0.73, second egg, 45.7±1.61 x 32.8±0.76; length of eggs laid by birds aged 3–5 years (45.4 [0.65; 6]) and 6–8 years (45.7 [1.52; 7]) significantly shorter than those laid by birds aged 12–14 years (47.0 [1.58; 20]). **Tas.:** 46.5 x 31.6, 48.5 x 32.8 (Davis & Mykytowycz 1982).

Clutch-size One or two, rarely three. NZ: From seven colonies with eggs and young: average 1.07: C/1 x 299, C/2 x 23; from three colonies without young: average 1.06: C/1 x 195, C/2 x 13 (Cunningham & Wodzicki 1948). At Kaikoura Pen.: average, 1.19: C/1 x 146, C/2 x 34; average clutch-size said to increase as season progressed: 1.12 (0.35; 17) between 30 Oct. and 3 Nov., 1.66 (0.50; 9) between 14 Nov. and 24 Nov. (Mills & Shaw 1980). **Tas.:** From nests with eggs or young: C/1 x 19, C/2 x 23 (Whinray 1982).

Laying Highly synchronized. At Kaikoura Pen.: timing differs between age-groups, older birds tending to breed earlier than younger ones; birds 3–5 years old bred on average 10.7 days later than those 12–14 years old (Mills & Shaw 1980). In a colony on a sand-spit, laying began near base of spit and progressed towards tip (Cunningham & Wodzicki 1948). Almost certainly re-lay after failure; heavy losses can result in laying continuing for more than 3 months (Falla *et al.* 1981); eggs and flying young found in colony (Cunningham & Wodzicki 1948).

Incubation By both sexes (Smith 1989; Oliver). Incubate with tail cocked high (Moncrieff 1928). Sitting birds in colony orientate in same direction, with head to wind (Gillham

Plate 39

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 albobriata* (page 699)

9 Adult breeding; 10 First immature non-breeding

1960). **INCUBATION PERIOD:** 25–27 days (Smith 1989); c. 24 days (Falla *et al.* 1981).

Young Precocial, semi-nidifugous. Both adults feed and brood young (Napier 1982); fed for some time after leaving nest (Oliver). One 2-day-old chick observed being brooded under rock ledge 1.5 m from nest (Davis & Mykytowycz 1982).

Fledging to maturity **FLEDGING PERIOD:** 29–35 days (Smith 1989). At Kaikoura Pen. some first breed when 3 years old but few begin breeding until >6 years old (Mills & Storr 1980).

Success High tides and floods in rivers can wash away nests (Cunningham & Wodzicki 1948; Oliver); at one colony, vandals killed adults, broke eggs and killed young (Merton 1955). Eggs may roll from sites where no nest made, into places where they cannot be incubated (Gillham 1960). Young hatched from eggs laid late in season said to be often abandoned before they fledge (Falla *et al.* 1981).

PLUMAGES Prepared by D.J. James. Medium-sized tern maturing over 3 years, with five recognizable plumages and 3–5 moults between downy and adult plumages. Moults to juvenile plumage and fledge when c. 35 days old. Then undergo partial post-juvenile moult to first immature non-breeding plumage soon after fledging, and then partial pre-breeding moult to first immature breeding plumage. Thereafter, undergo a complete post-breeding and partial pre-breeding moult each cycle, producing non-breeding and breeding plumages, with distinct seasonal variation (mostly of head). Attain definitive plumage with third non-breeding plumage. At Kaikoura Pen. some first breed when 3 years old but few begin breeding until >6 years old (Mills & Storr 1980). Individual variation in plumage distinct in downy young and juvenile but not subsequently. Sexes similar. No subspecies.

Adult breeding (Third and subsequent alternate [summer]). **Head and neck** Upper forehead, crown, nape and hindneck, down to level of bottom of eye, black, forming neat, sharply defined black cap, separated from bill by straight and even white band across lower forehead and lores. Lower hindneck, white, forming narrow band between black cap and grey mantle. Rest of head and neck, white. **Upperparts** Upper mantle, white, grading to very pale grey at tips of feathers. Rest of mantle, scapulars and back, pale grey (closer to 86 than 85); rear scapulars have thin white tips, forming small scapular crescent. Rump and uppertail-coverts, pale grey (86) to very pale grey (pale 86) (slightly paler to rear) but not white;

contrast little with saddle. With wear, saddle becomes slightly paler and duller, but difference slight and subtle. **Underparts** White, often with strong but evanescent roseate tinge during breeding season. **Tail** Rectrices, very pale grey (paler than 86) grading to white at bases of inner webs; shafts, white. Outer webs become a little darker with wear (pale grey [86]). Occasionally, tip of outer web of t6 or t5 has small darker area. From below, tail, white, with faint silvery reflection in some light. **Upperwing** Uniform grey except for white trailing-edge; only show contrasting dark outer primaries when moulting (cf. Common and Roseate Terns). Coverts and alula, pale grey like upperparts except: (1) inner greater primary coverts very slightly paler than outer greater primary coverts and greater secondary coverts; (2) greater primary coverts and alula have narrow white tips (<1 mm wide). Tertiaries, grey, like scapulars, grading to very pale grey (almost white) at tips; forms obvious white tertial crescent. Secondaries, mostly white, with very pale-grey (between white and 86) area on middle of inner web and adjacent outer web near shaft. Inner primaries, white on outer two-thirds and tips of inner webs, sharply demarcated from pale-grey (paler than 86) outer webs and inner third of inner webs (grey c. 5 mm wide on inner webs, which is about the width of outer web). P7–p10 similar but with diffuse grey band wrapping round tip of inner webs; these never clearly separated from centre of feather by narrow white tongue, so do not form hookbacks. Pale grey of primaries slightly darker outwards (between white and 86 on p1; between 86 and 85 on p10); grey becomes rapidly darker with wear as silvery bloom wears off, becoming dark grey (c83) on most feathers and grey-black (82) on outer web of p10. White tips of secondaries and inner primaries form indistinct white trailing-edge, which narrows outwards. At rest, white inner edges of primaries form white line (which narrows to rear) along top of folded primaries; when worn, blackish outer web of p10 forms narrow dark line under folded primaries. **Underwing** White except for: (1) faint ill-defined dusky tips to outer 5–6 primaries, which do not form distinct trailing-edge; and (2) dark-grey (blackish) leading-edge to outer primary. Remiges translucent.

Adult non-breeding (Third and subsequent basic [winter]). As adult breeding except cap smaller: **Head and neck** Mostly white, with hindcrown (from about level with eye), nape and upper hindneck, black, extending down to about level of eye; mid-crown very pale grey (pale 86) with narrow black fringes to feathers forming speckled zone between black hindcrown and white forehead; square black patch in front of eye extends round eye and joins cap. Usually have some indistinct black scaling in front of eye-spot and beneath eye. Birds with more black on head (i.e. large black patches on forecrown) in moult. Black across upper hindneck broader than that on Antarctic Tern. **Underparts** White; lack roseate tinge.

Downy young Much individual variation, tentatively treated here as two morphs, though variation possibly continuous. Down spiny on crown and upperparts. **PALE MORPH:** Top of head and upperparts, off-white to very pale grey-brown (very pale 119D), blotched dark brown (c219) on head and mottled dark brown (c219) elsewhere. Chin, cream (92). Throat, off-white, with dark-brown (219) mottling (finer than on dorsum). Underbody, white to cream. **BUFF MORPH:** As pale morph, but ground-colour (tips of down) on top of head and upperparts, buff (124); chin, buff (124).

Juvenile Considerable variation; treated here as two morphs, but intermediates occur; not known if juvenile morphs match morphs of downy young. **BLACK-AND-WHITE MORPH:**

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 young; 18 Juvenile; 19 First immature non-breeding

Has dark cap, white underparts, and grey upperparts heavily marked with black. **Head and neck** Cap, dark and speckled with white, but varying in darkness and extent; usually includes forehead, lores, crown, nape and hindneck. Feathers of forehead and anterior lores, white basally with dark-brown (219) tips that vary in size; darkest birds appear to have nearly all-dark forehead, palest appear to have white forehead, mottled or speckled with dark brown; dark tips to feathers lost with wear, making forehead mottled (on darker birds) or mostly white (on palest). Feathers of crown, nape and upper hindneck, white basally, with broad black-brown (119) subterminal bar or chevron, and narrow white tip; tips broader (so more persistent) anteriorly and narrower (and quickly lost) posteriorly so forecrown more strongly speckled white than hindcrown and nape; width of tips varies individually and reduced with wear, so much variation in amount of white speckling on cap; some blackish smudges extend farther down hindneck; cap extends lower on sides of face than in adult, and not clearly defined, with black smudges extending onto cheeks. Fairly distinct black spot in front of eye (within cap), where feathers lack white tips. Small dark smudge or streak extends from cap down behind ear. Chin, throat, lower cheeks, foreneck, sides of neck and lower hindneck, white. **Upperparts** Upper mantle, white, with narrow streaky dark-brown (119A) subterminal bands to feathers; towards rear-mantle, bands become more solid, producing strongly barred pattern. Scapulars, boldly barred dark brown (121) and white; pale grey (86) basally with faint grey-brown (28) bar across middle of feather, and white distally with broad sharp dark-brown (121) subterminal chevron; larger rear scapulars have two dark-brown (121) chevrons. Pattern of bars varies: in some rather straight, in others more V-shaped. At least some have narrow dark shaft-streaks on some scapulars. Back and rump, pale grey (slightly darker than 86) with narrow diffuse black-brown (119) subterminal bars and narrow white tips to feathers, appearing finely mottled. Uppertail-coverts, similar to rump, but subterminal bars often more crisp and distinct. **Underparts** White except for varying, narrow partial collar of dark-grey mottling extending from mantle to sides of upper breast. **Tail** Pale grey (c86) with dark bars across tips of feathers. T1–t3, pale grey (86 when fresh) grading to white distally, with broad dark-brown (219) subterminal chevron-shaped bar with irregular jagged outline, and narrow white fringe at tips. T4–t6 darker and more patterned: inner web, white basally, grading to dark grey (83, sometimes near 82) distally, with narrow white tips; outer web darker, grading from pale grey (86) at base to grey-black (82) at tip, with dark-brown (219) diagonal subterminal bar and narrow white tip; bar most pronounced on t4. From below, appears pale grey basally grading to dark grey distally, with dark-brown mottling at tips of central feathers visible when tail spread. **Upperwing** Marginal coverts, white. Prominent dark-grey cubital bar tapers outwards: leading five rows of lesser secondary coverts, dark grey (between 83 and 84) with narrow white to cream (92) tips (quickly lost with wear); outer feathers of rear three rows of lesser coverts, pale grey (paler than 86) with narrow dark-brown (121) streaks near tips; rest of inner lesser coverts, like inner median coverts. Median coverts, very pale grey (paler than 86) with broad but inconspicuous white tips and dark-brown (121) subterminal crescents, which are broad and conspicuous on inner feathers and become narrower outwards. Greater secondary coverts similar to median coverts but with only narrow subterminal crescents, confined to inner feathers. Alula, mid-grey (c84) with silvery bloom and narrow

white fringes; becomes dark grey (83–82) with wear. Lesser primary coverts, mid-grey (c84), becoming darker with wear. Greater primary coverts, light grey (85) with narrow white tips when fresh, becoming mid-grey (84) with wear. Tertiaries, mid-grey (84) to dark grey, with broad white tips (widest on inner webs) and narrow, sharp, irregular dark-brown (121) subterminal bars, appearing strongly barred at tips. Secondaries, mostly white; inner secondaries have light-grey (85) panel in middle of outer web (from shaft to edge, c. 25 mm long); on spread wing, extend c. 20 mm from greater coverts towards trailing-edge, forming secondary bar that becomes less clear towards outerwing. Inner primaries, pale grey (c86) with narrow white tip on outer web and white strip c. 10 mm wide (two-thirds width of web) along edge of inner web to tip. Pattern of outer primaries similar but grey becomes darker towards outer primary, and primaries darken towards tips, producing faint smeary subterminal band across tip of outerwing, that becomes more prominent with wear. At rest, dark cubital bar prominent; folded primaries, dark grey, with broad white stripe along upper edge. **Underwing** Similar to that of adult. When worn, some have grey tips to inner webs of outer primaries, forming diffuse dark trailing-edge to outerwing (recalling Roseate Tern). Inner secondaries less translucent than in adult. **BUFF MORPH:** Similar to black-and-white morph, except buff (124) to buff-brown (c123C) instead of white on: tips of feathers of cap; ground-colour of mantle, scapulars and tertiaries; tips of feathers of rump; tips of hindmost three rows of lesser secondary coverts; and tips of central few rectrices. Buff morph, with distinct chevrons (not straighter bars) on upperparts, somewhat similar to juvenile Antarctic Tern, but White-fronted always has pure-white underparts.

First immature non-breeding (First basic [winter]). Retain wing and tail from juvenile; morphs no longer distinguishable. **Head and neck** Like adult non-breeding, except: cap, black-brown (119), not black, especially on hindneck; and with slightly more smudging of cap under eye. **Upperparts** As adult; occasionally retain a few juvenile scapulars. **Underparts** White. **Tail** Grey areas become much darker with wear, especially tips of outer feathers. Pale tips reduced or lost. Sometimes tips of outer rectrices break off, leaving very worn, nearly pure white feathers. **Upperwing** Pale fringes wear off leading lesser coverts; cubital bar becomes darker (dark brownish-grey [brown 83 to 119A]), less mottled, and more prominent. Tertiaries, and some inner median, greater and rear lesser secondary coverts retain worn white fringes and faint bleached (grey-brown [28]) subterminal bars. However, dark triangle on leading-edge of wing appears narrower than in fresh juveniles because dark cubital bar contrasts with faded rear coverts. Lesser primary coverts and, especially, alula become darker and more conspicuous. Remiges wear quickly, becoming mid-grey (84) basally and dark brown-grey (c79) distally; white tips and inner edges become frayed and reduced; dark subterminal bar on outer few primaries becomes very prominent and nearly or actually terminal. **Underwing** Dark trailing-edge to outer primaries more prominent, broad and diffuse (recalling Common Tern).

First immature breeding (First alternate [summer]). Apparently differ little from first immature non-breeding; wing very worn.

Second immature non-breeding (Second basic [winter]). Very similar to adult non-breeding, differing by: (1) tail: outer two rectrices like adult but with dark-grey (c83) band or smudge 10–30 mm wide near tip, on both webs or just inner web; outer rectrices do not develop into full-length tail-stream-

ers; and (2) tertials vary: pale grey as adult, or with varying diffuse dusky longitudinal bar or patch in centre of feathers.

Second immature breeding (Second alternate [summer]). As second immature non-breeding, probably with non-breeding head-pattern.

BARE PARTS Based on photos (Moon 1979, 1992; Moon & Lockley 1982; Harrison 1987; Pringle 1987; Carter 1994; NZRD; unpubl.: B. Chudleigh; D.W. Eades; G.A. Taylor) and label data (AIM, NMNZ), except as stated. **Adult non-breeding** Bill, black, with tiny pale translucent tip. Mouth, dull orange-red or red. Iris, dark brown. Orbital ring, inconspicuous, black. Legs and feet, black to black-red or dark red mottled with black. **Adult breeding** As adult non-breeding, except legs and feet slightly redder, and never black; sometimes dark red-brown mottled black. **Downy young** Bill, grey-black (82) at first; rapidly turns dull pink (c5) with mottled black tip, ridge to culmen and bottom edge to lower mandible. Gape and mouth, salmon (c6). Iris, dark brown. Orbital ring, dark grey (c83). Legs, pink-grey to dark pink-grey and mottled grey. **Juvenile** Bill, black. Iris, dark brown. Orbital ring, grey-black (c82). Legs and feet black, with little tinge of red. **First immature non-breeding and subsequent plumages** As adult.

MOULTS **Adult post-breeding** (Third and subsequent pre-basic). Complete, mostly symmetrical. Begins with p1 and ends with p10; appears to span an average 6 months between Jan. and late June to early Aug.; timing varies little between individuals. Primaries sequentially outwards; one or usually two active at a time; moult of outer primaries apparently much slower than inner primaries. Greater primary coverts moult with corresponding primaries. Secondaries moult inwards, sequentially; probably begin when moult of primaries at about p4 or p5 and finish when primaries at about p8 or p9. Details of tertials unknown. Tail, centrifugal (outwards), sometimes with irregularities (t5 often before t3, t6 sometimes before t5); usually symmetrical or slightly asymmetrical; tail begins when primaries at about p4 or p5. Head and body begin with first primaries and finished well before flight-feathers. **Adult pre-breeding** (Third and subsequent pre-alternate). Partial moult of head and body. Begins about May or June, immediately or soon after post-breeding moult of head and body finishes, and when post-breeding moult of primaries still under way; finishes shortly after post-breeding primary-moult, July to Aug. Full extent of moult of body unknown. Remiges not moulted. Rectrices apparently not moulted (certainly no seasonal change in colour). **Post-natal** Starts with scapulars; then remiges and alula and back; tail, crown and ear-coverts, underparts, and wing-coverts; retain down longest on forehead, throat, neck and vent. **Post-juvenile** (First pre-basic). Partial moult of head and body. Begins soon after fledging, in Mar. or Apr., and finishes in June or July. Sometimes retain a few scattered juvenile scapulars. **First pre-breeding** (First pre-alternate). If present, restricted partial moult, similar to post-juvenile moult, from which it would continue without pause. **First post-breeding** (Second pre-basic). First complete moult. Sequence similar to adult post-breeding. Lesser secondary coverts finish early, so cubital bar lost quickly; median coverts begin when lesser coverts finished. Begins towards end of first year, but timing varies considerably, e.g. PMS: Sept., 21; Oct., 0, 3; Nov., 25; Jan., 0; Feb., 44; Mar., 11, 29; May, 49. **Second pre-breeding** (Second pre-alternate). Partial; similar to adult pre-breeding.

MEASUREMENTS (1–3) Skins; T1 = length of central rectrix; T6 = length of outer rectrix (AIM, AM, CM, NMNZ): (1) NZ mainland islands, adults; (2) Auckland Is, adults; (3) NZ mainland islands and NSW, first-year birds, with juvenile outer primaries and tail.

	MALES	FEMALES	
WING	(1) 282.1 (5.74; 270–288; 13) (2) 279, 287 (3) 269.8 (7.76; 260–282; 6)	277.5 (11.7; 261–288; 4) 289 270.0 (6.68; 261–277; 7)	ns ns
T1	(1) 77.2 (4.21; 68–82; 14) (3) 80.0 (4.93; 72–90; 8)	79.0 (7.12; 73–94; 7) 79.6 (3.29; 74–82; 5)	ns ns
T6	(1) 182.7 (6.33; 172–195; 14) (3) 142.0 (7.46; 132–152; 8)	184.3 (20.9; 143–198; 6) 139.5 (3.99; 132–144; 6)	ns ns
BILL	(1) 42.0 (1.84; 37.8–45.6; 29) (2) 46.8 (1.88; 43.8–48.7; 6) (3) 38.7 (2.81; 33.0–42.5; 10)	40.9 (1.68; 37.9–44.7; 18) 41.0, 43.8, 45.2 36.9 (3.19; 31.5–41.6; 15)	* * ns
TARSUS	(1) 20.3 (0.88; 18.3–22.3; 27) (2) 20.9 (0.76; 19.4–21.5; 6) (3) 20.4 (0.72; 19.1–21.6; 20)	20.1 (0.72; 18.0–21.1; 18) 20.5, 20.7, 21.0 20.5 (0.84; 19.2–22.4; 15)	ns ns ns
TOE	(1) 18.5 (0.51; 17.3–19.4; 26) (2) 19.3 (0.57; 18.5–20.0; 6) (3) 18.5 (0.53; 18.0–19.2; 4)	18.9 (1.08; 17.2–20.7; 14) 18.7, 19.1, 19.4 18.7 (0.47; 17.9–19.2; 7)	ns ns ns

Little difference between sexes, but larger samples of wing and tail needed. Adults significantly larger than first-year birds ($P < 0.01$) for Wing, T6 and Bill (sexes combined). Adults from Auckland Is appear to have significantly longer Bill ($P < 0.01$) and Toe ($P < 0.05$) than NZ adults, but more data needed.

WEIGHTS (1–2) Label data from skins (AIM, AM, CM, NMNZ): (1) NZ mainland islands, adults; (2) Auckland Is, adults.

	MALES	FEMALES	
(1)	125.8 (14.4; 108–155; 9)	131.9 (22.5; 103–160; 8)	ns
(2)	192, 200	191, 198	

Auckland Is birds significantly heavier than NZ birds ($P < 0.05$, sexes combined) but more data needed.

STRUCTURE Wing, long, narrow and pointed. Eleven primaries: p10 longest, p9 15–20 mm shorter, p8 35–40, p7 58–63, p6 78–85, p5 98–109, p4 119–130, p3 140–148, p2 158–168, p1 174–185; p11 minute. Eighteen to 19 secondaries, including 3–4 tertials; tips of longest tertials fall between p4 and p5 on folded wing. Tail, long, deeply forked (depth of fork varies with season and age); 12 rectrices; in adults, outer rectrix (t6) elongated to form narrow tail-streamer; second-year birds have shorter streamers than adults; first-year birds lack streamers; when present, streamers project well beyond tip of wing at rest; juvenile tail falls short of tip of wing. Head, large and rounded for commic tern. Bill, fine and slender, about length of head; comparatively slightly longer than that of Common and Arctic Terns; nearly straight, though sometimes appears gently decurved; small gonydeal angle about half-way along lower mandible; nostril, elongated oval to short slit. Tarsus, short, though fairly long for commic tern; scutellate on front of tarsus and top of toes, reticulate elsewhere. Outer toe 88–99% of middle, inner 71–86%, hind 4–6%, raised.

RECOGNITION For distinction from other medium-sized terns, see Antarctic Tern: Recognition. **DOWNY YOUNG:** Black-fronted Tern differs by: (1) blotches on head much larger than those on upperparts (similar in size in White-fronted); (2) throat washed cinnamon but lacking mottled band; (3) undertail-coverts, slightly mottled (not pure white); and (4) yellow bill and orange legs. Antarctic Tern differs by: (1) ground-colour of upperparts distinctly browner; (2) more dark-brown mottling on upperparts; and (3) underparts dull brown, encircling off-white patch on belly.

GEOGRAPHICAL VARIATION None described. Auckland Is birds may have longer bills, toes and be heavier than birds from NZ mainland islands (see Measurements, Weights) but samples small and more data needed.

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Volume 3, Plate 37

White-fronted Tern *Sterna striata* (page 632)

1 Adult breeding; 2 Adult non-breeding; 3 Downy young; 4 Juvenile, black-and-white morph (= typical birds); 5 First immature non-breeding, first austral winter; 6 First immature non-breeding in late stage of moult to second immature non-breeding, first austral spring to second austral summer

Common Tern *Sterna hirundo* (page 655) Subspecies *longipennis* unless stated

7 Adult breeding; 8 Adult breeding, subspecies *hirundo*; 9 Adult non-breeding; 10 Juvenile, moderately worn plumage; 11 Early stage of moult from juvenile to first immature non-breeding, first austral spring; 12 Mid-way through moult from juvenile to first immature non-breeding, late Jan. of first austral summer

Roseate Tern *Sterna dougallii* (page 621)

13 Adult breeding, while feeding chicks; 14 Adult breeding, developing red bill during incubation period; 15 Adult non-breeding; 16 Downy young; 17 Juvenile; 18 Late stage of moult from juvenile to first immature non-breeding

Black-naped Tern *Sterna sumatrana* (page 645)

19 Adult; 20 Downy young; 21 Juvenile; 22 Early stage of moult from juvenile to first immature non-breeding; 23 Late stage of moult from juvenile to first immature non-breeding



Volume 3, Plate 38 [caption error corrected from original]

Common Tern *Sterna hirundo* (page 655)

Subspecies *longipennis* unless stated

1 Adult breeding, fresh plumage, austral autumn; 2 Adult breeding, subspecies *hirundo*, worn plumage, boreal summer; 3 Adult non-breeding, early Jan.; 4 Juvenile, moderately worn plumage; 5 Mid-way through moult from juvenile to first immature non-breeding, late Jan. of first austral summer

White-fronted Tern *Sterna striata* (page 632)

6 Adult non-breeding; 7 First immature non-breeding, first austral winter; 8 First immature non-breeding in late stage of moult to second immature non-breeding, first austral spring to second austral summer

Roseate Tern *Sterna dougallii* (page 621)

9 Adult breeding; 10 Early stage of moult from juvenile to first immature non-breeding; 11 Late stage of moult from juvenile to first immature non-breeding

Black-naped Tern *Sterna sumatrana* (page 645)

12 Adult breeding; 13 Early stage of moult from juvenile to first immature non-breeding; 14 Late stage of moult from juvenile to first immature non-breeding