

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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Hydrochelidon albobristatus Gray, 1845, *Voyage 'Erebus' and 'Terror'*, Bds: 19, pl. 21 — New Zealand.

Named for the prominent white primary-shafts and white facial streak of adult breeding plumage (Latin *albus*, white, and Modern Latin *striatus*, striped, from Latin, *stria*, line or furrow).

MONOTYPIC

FIELD IDENTIFICATION Length 28–30 cm; wingspan 65–72 cm; weight 95 g. Distinctive, small grey tern, with high rounded crown, pot-bellied but attenuated shape when perched, moderately long forked tail, very short legs, and short bill (shorter than head), decurved sharply at tip. Similar in size and, superficially, in plumage and feeding behaviour to Whiskered Tern *Chlidonias hybridus*. Adult, grey, with white rump, vent and tail-coverts; diagnostic pale-grey underwing; and bright-orange bill, legs and feet. In breeding plumage, have black cap and striking narrow white cheek-stripe; in non-breeding plumage, have mottled grey cap, black patches round eye and on ear-coverts, and black tip to bill. Juvenile like non-breeding adult but with mottled brown saddle and black bill. Sexes alike. Marked seasonal variation. Juvenile distinct. Immatures separable.

Description Adult breeding Forehead, crown and nape, black, forming neat cap extending to level with bottom of eye, bordered below by striking narrow white cheek-stripe running back from gape to sides of nape; chin and throat, grey. Saddle and upperwing, grey, with narrow white trailing-edge to secondaries and diffuse dusky trailing-edge to outer primaries, and thin black leading-edge to outerwing. Rump and uppertail-coverts, white, contrasting strongly with light-grey tail and grey rest of upperparts; tail often appears narrowly edged paler. Chin to lower belly, grey, slightly paler than upperparts and sharply demarcated from white vent and undertail-coverts. Underwing, pale grey, with narrow translucent white trailing-edge to secondaries and diffuse dark-grey trailing-edge to outer primaries. Bill, legs and feet, bright orange. Iris, black. In transition to breeding plumage show much variation in head-pattern: typically acquire black round eye and on ear-coverts, then on nape, forming U-shaped black band or half-cap; all develop narrow black band across lower forehead from lores while rest of forehead and crown still heavily mottled pale grey and black. **Adult non-breeding** As adult breeding except for pattern of head and bill. Head and neck, grey, darkest on nape and paler grey or mottled grey-and-white on crown, forehead and anterior lores, and with black patch in front of eye and black patch on rear ear-coverts, which are sometimes joined by band of blackish mottling extending from eye to ear-coverts and continuing over rear-crown and nape, forming U-shaped band; chin and throat, pale grey; white cheek-stripe less well defined and contrasting. Bill, bright orange, grading to yellow-orange near tip and with black tip. **Juvenile** Similar to adult non-breeding. Differs by: Pattern of head more contrasting; crown and nape, buff, heavily streaked or mottled black and

grading to buff forehead and anterior lores and contrasting strongly with white (not grey) chin and throat; brown-black patch in front of eye and ear-coverts sometimes joined by band of blackish streaks, which continues over nape. Buff tones lost with wear and forehead appears white. Saddle and tertials, grey, with prominent dark-brown barring and narrow buff scaling. Uppertail-coverts, pale grey, but still contrasting with mostly grey tail, which has narrow pale tip and indistinct dark subterminal band. At rest, folded wing, grey, with diffuse narrow dark-grey cubital bar and with inner few greater coverts marked as saddle; primaries, dark silvery-grey, with fine pale fringes and tips. In flight: upperwing, grey, with narrow dark cubital bar, narrow pale trailing-edge to secondaries and diffuse narrow dark trailing-edge to outer primaries. Underwing as adult except coverts appear white and contrast more with underbody. Bill, dark brown or black, often with some dull orange or red at base. Legs and feet, bright orange as adult. **First immature non-breeding** As adult non-breeding but differs by: dark bill (as in juvenile); retained juvenile wings, tertials and tail; and dark patches in front of eye and on ear-coverts tend to be darker, crown more streaked, and breast often much paler grey. Older immatures often separable from adult non-breeding by dull-orange bill, with irregular dark-brown patches, and patchy, rather than mottled, pattern of crown during moult to breeding plumage; see Plumages.

Similar species Normally distinctive. Vagrant **Whiskered Tern** has superficially similar breeding and non-breeding plumages but is: much smaller, more compact and less attenuated, with flatter crown; and with: proportionately shorter wings and much shorter, less deeply forked tail, which appears square-cut at tip when spread and without finely pointed outer feathers; slightly longer, more dagger-shaped and straighter bill lacking abrupt decurve at tip; much longer legs; deeply incised webs and longer toes (cf. fully webbed toes of Black-fronted); and very different flight call: hoarse rasping *kreerp* or *cherk*. In breeding plumage, Whiskered easily distinguished by: dark-red bill, legs and feet; much paler and uniform grey upperparts and somewhat darker grey underparts, with darker-grey or grey-black belly; broader white cheek-stripe; and white underwing-coverts. In non-breeding plumages, best distinguished by: dull-black bill, legs and feet (all ages of Black-fronted have orange legs and feet, though first-year birds have blackish bill); more uniform paler-grey upperparts and white underparts; and mostly white head and neck, with whiter crown, streaked with black, and more prominent black U-shaped band from eye round nape. **White-winged Black Tern**

Chlidonias leucopterus in non-breeding plumages can also be confused; differs in size and shape in much the same way as Whiskered Tern; also, has much finer, dark-red or black bill; and more contrasting upperwing, with obvious dark cubital bar and, often, contrasting secondary bar and dark wedge on outer primaries; and, sometimes, some black on underwing-coverts. Unlike Black-fronted Tern, neither *Chlidonias* feeds over fast-flowing streams or offshore, and rarely forage in littoral zone.

Common gregarious tern, endemic to NZ; often seen in small feeding flocks and, occasionally, in flocks of up to 150 birds. Feed inshore. Sometimes associate with White-fronted *Sterna striata* and other terns at coastal sites; feed in ploughed fields with Black-billed Gulls *Larus bulleri*. When feeding, patrol back and forth a few metres above water or ground, periodically dipping to snatch prey from surface of water or ground in manner of marsh tern; sometimes alight briefly on ground to take prey, holding wings aloft. Also plunge-dive and hawk for insects over farmland; occasionally follow plough. Flight and actions similar to those of Whiskered Tern, though much shorter legs give more awkward gait. Usual flight call repetitive high-pitched *kit* or *kit-kit*; also extended *ki-ki-kew* or *ki-ki-ki-kew*.

HABITAT During breeding season, mainly on or near braided channels of inland rivers and streams, often at high altitudes; also in nearby farmland, either under pasture or crop; infrequently in tussock grassland or scrubby vegetation. Rarely, on still terrestrial wetlands, such as lakes, tarns and farm dams. After breeding, disperse to coastal regions, where mostly occur in sheltered waters, such as river deltas, estuaries and harbours, but also at sea and in near-coastal farmland.

Often breed in high country, up to 1720 m asl, and sometimes to baseflow of glaciers. On bare shingle banks and slopes of braided river beds, consisting of large round stones set into silt and sand; usually bare, but occasionally sparsely vegetated and, infrequently, almost completely vegetated, with plants such as *Raoulia*, *Cyathodes* and *Muehlenbeckia*; rarely, breed on vegetated river terraces (Soper 1959; Lalas 1979; Lalas & Heather 1980; Falla *et al.* 1981; Pierce 1983; Oliver). Sometimes on lakeshores, or brackish near-coastal lagoons (Falla *et al.* 1981). At very high altitudes, recorded breeding in hummock or tussock terrain, in dead clumps of low-lying Alpine Daisies *Celmisia viscosa* (Child 1975, 1986).

Forage aerially over a variety of habitats. Inland, regularly over farmland, pasture and crops, especially if freshly ploughed or cultivated, or damp or irrigated (Sibson 1948; Falla *et al.* 1981; Child 1986; CSN 2, 32, 39, 41); in pasture, may prefer areas of short vegetation, including paddocks with stock (Sladden 1953; Latham 1981). Forage 3–5 m over pasture, and 1–2 m over freshly ploughed paddocks (Lalas 1977). May land to take food from ground (Lalas 1977; Latham 1981). Very rarely, forage over tussock or scrub (Sibson 1948; Pierce 1983; Child 1986). Preferred grassy areas often near rivers (Lalas 1977; CSN 7, 38). Often forage round shingle beds of fast-flowing braided watercourses, and also secondary channels that flow more slowly (Lalas 1977; Lalas & Heather 1980). Occasionally fly among rushes, sedges and bushes growing on shingle beds (Lalas 1977). Rarely use standing waterbodies (Lalas 1977; Pierce 1983). In coastal areas, often forage in sheltered waters, such as estuaries and harbours, but also open coastal waters, where they may forage near surf-zone within a few hundred metres of shore (Sladden 1953; Latham 1981; CSN 19 Suppl.), or several kilometres offshore (Lalas

1979; CSN 19 Suppl., 22, 32). Once recorded feeding 35 km from nearest land (Latham 1981). When feeding from water, may take food from surface, flying with belly 4–7 cm above water, or may plunge from heights of up to 2 m, taking food from up to c. 40 cm below surface, but mostly from 5–20 cm deep (Lalas 1977). Aerial feeding occurs from c. 5 m (Lalas 1977) to >200 m above ground or water (Latham 1981).

During breeding season, mainly roost and loaf on shingle banks in rivers (Lalas 1977; CSN 2; Oliver). In non-breeding periods, mostly on beaches, tidal sand-spits, islets or other tidal flats, often in sheltered coastal features, such as estuaries, harbours and lagoons (Sladden 1953; Lalas 1977, 1979; Pierce 1980; Latham 1981). Also use farm paddocks (Sladden 1953; Lalas 1977; Latham 1981; CSN 32, 34). Will perch on fences, both on posts and wire-strands, either surrounding paddocks or running into water (Latham 1981; Sibson 1982).

Commonly found in modified habitats, such as farmland, though rarely use artificial wetlands, such as farm dams, sewage lagoons or ornamental ponds (Lalas 1977; CSN 37, 38). Once recorded in inland gravel pits (CSN 37). Several immatures once recorded following trawler (CSN 38). Breeding sites destroyed by hydro-electric schemes and irrigation development (Robertson & Bell 1984).

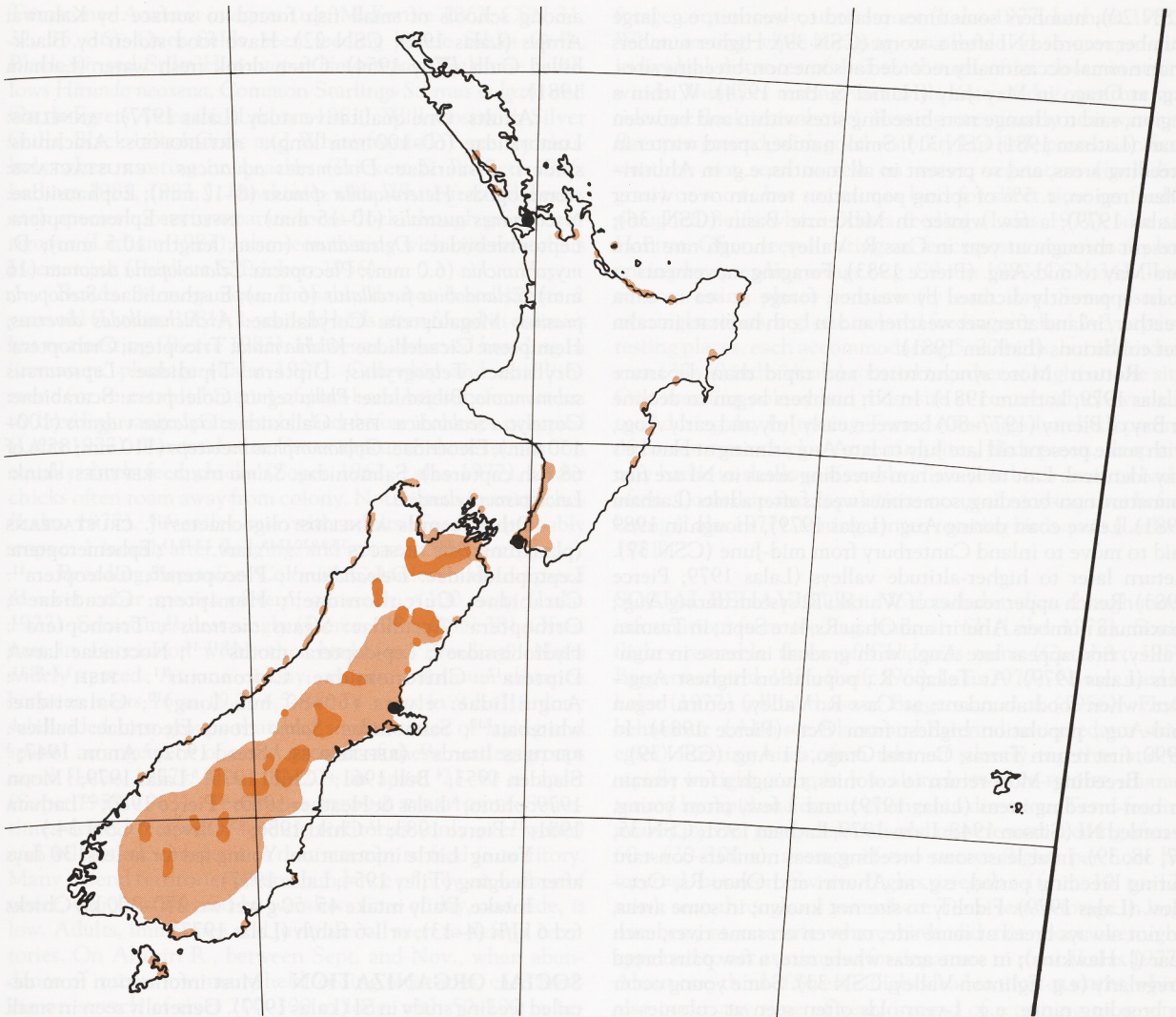
DISTRIBUTION AND POPULATION Endemic to NZ. Breed inland SI; in non-breeding periods, mostly on coasts of SI, with smaller numbers occurring regularly in coastal NI.

Breeding SI Based on Lalas (1977, 1979). Widespread in Marlborough, extending S to inland Kaikoura and Raglan Ras; and inland Canterbury, Otago and Southland, extending S from Conway and Lottery Rs and bounded to the W by Southern Alps. Breeding apparently not continuous between Marlborough and more s. breeding range (Tily 1954; Soper 1959; Pierce 1974, 1975, 1983; Lalas 1977, 1979; Owen & Sell 1985; Child 1986; CSN). **NI** May have formerly bred on Volcanic Plateau, possibly persisting till 1930s or 1940s, but no records since (Stead 1932; Sibson 1948; Latham 1981).

Non-breeding In Northland, isolated record, Ranganu Harbour, and a few scattered records in Kaipara Harbour, between Ruawai and Rangitira Beach. Occasionally recorded s. Firth of Thames. More widespread Bay of Plenty, including occasional records Mayor I., but mainly round coast between Bowentown and Waiau R. On e. coast, sparsely scattered from near Ruatoria to Porangahau, including Muriwai, Hawke Bay and Waimarama. Many records on s. and sw. coasts, from Orongorongo R. to Turakina R.; and inland at L. Wairarapa (Sibson 1945, 1963, 1965; Sladden 1953; Cunningham 1957; Lalas 1979; Veitch 1979; Latham 1981; CSN; NZ Atlas). **SI** Most in coastal regions of e. and s. coasts; some remain at scattered sites within breeding range. In Nelson and Marlborough, between Farewell Spit and Clifford Bay, including Golden and Tasman Bays and Marlborough Sounds. Most S from Kaikoura Pen. to s. Canterbury Bight (though apparently not on e. Banks Pen.) and more sporadically from Oamaru S to Otago Pen. Farther S, isolated record Nugget Pt; more widespread shores of Foveaux Str., from Toetoes Bay to Te Wae Wae Bay. On Stewart I., mostly at Paterson Inlet, and some islands of Foveaux Str. (Lalas 1979; CSN; NZ Atlas). Rarely recorded W of Southern Alps, with sparsely scattered reports between Big Bay and Break Ck Lagoon (Grant 1963; McKenzie 1963; Child 1964; CSN 19 Suppl., 36; NZ Atlas).

Chatham Is Listed by Forbes (1893), but occurrence considered doubtful (Archey & Lindsay 1924).

Snares Is Said to have occurred (Oliver).



Populations No estimates. Numbers thought to have declined since European settlement (Oliver); and possibly still decreasing: on Farewell Spit, SI, in June 1982, 120 counted, but in 1989–94 seldom >20–30 counted at same time of year (J. Hawkins).

Subject to human disturbance at coastal sites (Latham 1981). Activities of shingle-plant operations can disturb breeding colonies (CSN 30).

MOVEMENTS Dispersive; breed inland SI and move to coastal regions in NI, SI and Stewart I. in non-breeding period (Lalas 1979; Latham 1981).

Departure Most leave colonies. Juveniles first fly Dec. and Jan. (Lalas & Heather 1980). At breeding areas on Ahuriri and Ohau Rs, Canterbury, numbers drop late Dec. and Jan., with most gone by late Mar.; timing similar for populations breeding central Otago. High numbers at Cass R. Valley till Jan., rare after mid-May (Pierce 1980). Some birds appear to move first from breeding colonies to other non-coastal areas before moving to coast (e.g. Lalas 1979). Thus movement to coast mainly Dec.–Mar., but continues till Apr. and May. Move E and S from breeding grounds to coastal SI and N to NI; little movement W across Southern Alps to w. coast of SI

(Grant 1963; McKenzie 1963; Child 1964; Lalas 1979; CSN 36; see Distribution). First arrive coastal Otago, Jan. (Hamel & Barr 1974); small numbers Avon-Heathcote Estuary–Bromley, Canterbury, from late summer, with maximum numbers (1989) not till late Apr. (CSN 37, 38). Movement to N apparently leisurely. Birds moving to Bay of Plenty possibly move along e. coast of NI (see Latham 1981) but at least some passage along w. coast of NI (e.g. two seen moving N past Kapiti I., early May, CSN 32). Timing of arrival at some sites in NI varies between years, e.g. arrived Tukituki Estuary late in 1990, possibly because weather on SI was warm (CSN 38). At Bay of Plenty, between 1977 and 1980, first arrived end Mar. to mid-Apr., with maximum numbers between late Apr. and mid-May; timing at Hawke's Bay identical (Latham 1981). Increase in numbers gradual in at least some NI locations, e.g. mouth of Tarawera R., Bay of Plenty (CSN 33). Earliest arrivals at Bay of Plenty usually adults, though first immature non-breeding sometimes arrive at same time (Latham 1981).

Non-breeding Present coastal regions, from Jan. to end July, with a few in Aug.; also recorded away from coasts, offshore and inland (Lalas 1979; Latham 1981). All age-classes occur in N of range (e.g. Latham 1981). At some non-breeding sites, numbers vary from year to year (Latham 1981;

CSN 20); numbers sometimes related to weather, e.g. large number recorded NI after s. storm (CSN 39). Higher numbers than normal occasionally recorded at some non-breeding sites, e.g. at Otago in May–July (Hamel & Barr 1974). Within a region, said to change non-breeding sites within and between years (Latham 1981; CSN 31). Small number spend winter in breeding areas, and so present in all months, e.g. in Ahuriri–Ohau region, c. 5% of spring population remain over winter (Lalas 1979); a few winter in McKenzie Basin (CSN 36); present throughout year in Cass R. Valley, though rare from mid-May to mid-Aug. (Pierce 1983). Foraging movements at coast apparently dictated by weather; forage at sea in calm weather, inland after wet weather and in both habitats in calm wet conditions (Latham 1981).

Return More synchronized and rapid than departure (Lalas 1979; Latham 1981). In NI, numbers began to decline at Bay of Plenty (1977–80) between early July and early Aug., with some present till late July to late Aug.; timing at Hawke's Bay identical. Last to leave non-breeding areas in NI are first immature non-breeding, sometimes weeks after adults (Latham 1981). Leave coast during Aug. (Lalas 1979), though in 1989 said to move to inland Canterbury from mid-June (CSN 37). Return later to higher-altitude valleys (Lalas 1979; Pierce 1983). Reach upper reaches of Waitaki R. system during Aug.; maximum numbers Ahuriri and Ohau Rs, late Sept.; in Tasman Valley, first appear late Aug., with gradual increase in numbers (Lalas 1979). At Tekapo R., population highest Aug.–Oct. when food abundant; at Cass R. Valley, return began mid-Aug., population highest from Oct. (Pierce 1983). In 1990, first return Tarras, Central Otago, 11 Aug. (CSN 39).

Breeding Most return to colonies, though a few remain in non-breeding areas (Lalas 1979) and a few, often young, recorded NI (Sibson 1948; Lalas 1979; Latham 1981; CSN 35, 37, 38, 39). In at least some breeding areas numbers constant during breeding period, e.g. at Ahuriri and Ohau Rs, Oct.–Nov. (Lalas 1979). Fidelity to site not known; in some areas, do not always breed at same site, or even on same river, each year (J. Hawkins); in some areas where rare, a few pairs breed irregularly (e.g. Eglinton Valley, CSN 33). Some young occur in breeding range, e.g. 1-year-olds often seen at colonies in Cass R. Valley (Pierce 1983).

FOOD Carnivorous. Mainly insects and crustaceans; also fish and worms. **Behaviour** Diurnal. Forage in river-beds and over nearby pasture during breeding season; move to coast in winter to forage at sea; from inshore waters to 35 km offshore, and in estuaries, wet pasture and swamps depending on weather (see Habitat). Search methodically, flying into wind (Latham 1981); follow plough (Anon. 1947; Oliver). Four foraging methods: (1) SHALLOW PLUNGING (Stead 1932; Lalas 1977; Latham 1981); (2) DIPPING: to take food from surface of water; (3) GLEANING from surface of sodden paddocks, freshly ploughed ground or even stems of crops; either with or without landing briefly (Bell 1961; Grant 1963; Latham 1981; CSN 3, 22, 32); also, alight at edge of streams to glean from surface of water or plunge head into water to capture insects (Lalas 1977); and (4) HAWKING (Lalas 1977; Pierce 1980; Latham 1981; CSN 7, 34; Oliver); recorded on warm evenings (Child 1975), when insects emerging (Pierce 1980), over mown hay (CSN 32) or when wind is blowing and carrying insects offshore; observed at heights to >200 m (Latham 1981), catching 6–15 insects/min. Nearly always fly upwards to take prey, possibly because prey seen best against sky (Stead 1932). Occasionally seen with White-fronted Terns and other species of terns feeding

among schools of small fish forced to surface by Kahawai *Arripis* (Lalas 1979; CSN 22). Have food stolen by Black-billed Gulls (Tily 1954). Often drink fresh water (Latham 1981).

Adults One qualitative study (Lalas 1977): ANNELIDS: Lumbricidae (60–100 mm long). ARTHROPODS: Arachnids: spiders: Pisauridae: *Dolomedes aquaticus*. CRUSTACEANS: stomatopods: *Heterosquilla spinosa* (8–12 mm); Euphausiidae: *Nyctiphanes australis* (10–15 mm). INSECTS: Ephemeroptera: Leptophlebiidae: *Deleatidium* (mean length 10.5 mm); *D. myzobranchia* (6.0 mm); Plecoptera: *Zelandoperla decorata* (16 mm); *Zelandobius furcillatus* (6 mm); Eustheniidae: *Stenoperla prasina*; Megaloptera: Corydalidae: *Archichauliodes diversus*; Hemiptera: Cicadellidae: *Kikihia muta*; Tricoptera; Orthoptera: Gryllidae: *Teleogryllus*; Diptera: Tipulidae: *Leptotarsus submontana*; Bibionidae: *Philia segnis*; Coleoptera: Scarabidae: *Costelytra zealandica*. FISH: Galaxiidae: *Galaxias vulgaris* (100–150 mm); Eleotridae: *Gobiomorphus breviceps* (110 mm; 85% of 68 fish captured); Salmonidae: *Salmo trutta*. REPTILES: skink: *Leiopelisma zelandica*.

Other records ANNELIDS: oligochaetes^{2,10}. CRUSTACEANS (planktonic)^{6,8,10}. INSECTS^{3,5,8,9,10,12,13}: larv.^{2,3,12,13}; Ephemeroptera: Leptophlebiidae: *Deleatidium*¹¹; Plecoptera¹²; Coleoptera¹¹: Carabidae; Curculionidae¹²; Hemiptera: Cicadidae¹²; Orthoptera: Acrididae: *Sigauss australis*¹²; Trichoptera¹²; Hydrobiosidae¹¹; Lepidoptera: moths^{5,11–14}; Noctuidae larv.⁴; Diptera¹²; Chironomidae: *Chironomus*¹¹. FISH^{1,7–10,13}: Anguillidae: elvers (60–80 mm long)¹⁰; Galaxiidae: whitebait^{1,10}; Salmonidae: *Salmo* trout; Eleotridae: bullies¹. REPTILES: lizards¹³. (REFERENCES: ¹ Stead 1932; ² Anon. 1947; ³ Sladden 1953; ⁴ Bell 1961; ⁵ Child 1975; ⁶ Lalas 1979; ⁷ Moon 1979; photo; ⁸ Lalas & Heather 1980; ⁹ Pierce 1980; ¹⁰ Latham 1981; ¹¹ Pierce 1983; ¹² Child 1986; ¹³ Oliver; ¹⁴ CSN 34.)

Young Little information. Young fed for at least 30 days after fledging (Tily 1954; Lalas 1977).

Intake Daily intake 45–50 g wet wt, 270–300 kJ. Chicks fed 6 kJ/h (4–13), or 1.6 fish/h (Lalas 1977).

SOCIAL ORGANIZATION Most information from detailed feeding study in SI (Lalas 1977). Generally seen in small flocks, though congregate in large numbers after breeding, especially at roosting places on shingle banks in river beds; often found in flocks in winter (Oliver; CSN 36). In Sept., congregate at nesting sites (Stead 1932; Soper 1963, 1972; Oliver). Also seen singly or in twos throughout year (e.g. CSN 22, 31, 34, 36). In Bay of Plenty (Latham 1981): single birds seen throughout year but tend to congregate in loose groups (of all plumages) over winter; in these congregations, birds often appeared to behave independently and did not move as flock, e.g. in one roosting flock, birds continually arrived and left singly or in small groups (similar behaviour also recorded by Sladden [1953]). In NI, observed in small groups of <10 up to c. 100 (Sladden 1953; Prickett & Prickett 1956; Sibson 1963; Latham 1981, 1983; CSN 31–34, 36, 37); in SI, flocks and small groups of <10 up to c. 250 (Pierce 1983; CSN 3, 31, 32, 37). In SI, birds congregate to feed where prey abundant and are more dispersed when and where prey at low densities. Patterns of dispersion followed tidal cycles and predictable diurnal behaviour of prey in rivers. At one marine site, up to 18 birds fed together for c. 3 h round mid-tide during daylight. On Ahuriri R., many Terns held feeding territories when availability of prey low, while others foraged in flocks (Lalas 1977; see Territories). Seen with White-fronted Terns, Silver Gulls *Larus novaehollandiae*, Black-billed Gulls and Ruddy

Turnstones *Arenaria interpres* (e.g. McKenzie 1963; CSN 31, 32, 35, 36). Over fields, seen feeding beside Silver Gulls, Black-winged Stilts *Himantopus himantopus*, Welcome Swallows *Hirundo neoxena*, Common Starlings *Sturnus vulgaris* and Cattle Egrets *Ardea ibis* (Latham 1981). Will roost with Silver Gulls, Black-billed Gulls and White-fronted Terns, particularly when roosting on beaches (Prickett & Prickett 1956; Latham 1981, 1983; J. Hawkins); with White-fronted Terns, each species roosts in separate loose flock, though group contiguous (Latham 1983); also seen resting with oystercatchers *Haematopus* (Prickett & Prickett 1956).

Bonds Monogamous. Probably do not breed before 2 years old (Latham 1981); 1-year-old birds often found in colonies but not nesting (Pierce 1983). However, observed breeding in 'immature' plumage (Lalas 1977). Courtship and establishment (or re-establishment) of pair-bond begin before return to breeding range; pairs established before colonies occupied (Lalas 1977). **Parental care** Sexes appear to share incubation equally; both feed chicks (Soper 1963; Lalas 1977). Older chicks often roam away from colony. Not seen to form crèches (Lalas 1977). Juveniles rest with adults. Feeding probably stops c. 1 month after fledging, and not seen after early Jan.

Breeding dispersion Colonial. Colonies small compared to most other species of tern; generally <100 nests (Lalas 1977). Sometimes nest singly (Pierce 1983; CSN 38). Often nest in association with other birds (see Breeding). Nests widely spaced. At one colony, average minimum distance between nests 16 m (9.7; 4.5–48; 74 nests in 9 ha); colony subdivided into groups that had similar times of laying and spatial arrangement of nests; growth of these nesting groups rapid (Lalas 1977). Nests 10–20+ m apart, 23–50 m apart (Soper 1959, 1963). **Territories FEEDING TERRITORIES:** Sometimes defend temporary feeding territories (only over water) and will attack conspecifics that attempt to feed in territory. Many defend territories when abundance of prey on surface of water, which is affected by weather, time of day, and tide, is low. Adults, immatures and juveniles all seen to defend territories. On Ahuriri R., between Sept. and Nov., when abundance of insects low, many held feeding territories, each feeding on stretch of river 200–300 m long, with 50–100 m between neighbouring territories; defended about half this range against intruders, on average 4 times/h; territories abandoned when birds congregated along main braids to feed on emerging insects (Lalas 1977). At Blue Stream, Tasman Valley, in Sept., defended territories only during wet weather; feeding rate while defending territories was significantly lower than when feeding without defending territories; territories were defended only while feeding and, when owners left, other Terns usually took their places and defended territory; time spent holding territories varied from 0.3 to 4.4 h. At Wellers Rocks, first Terns to arrive each tidal cycle became territorial and defended 50–80 m of breakwater; territories broke down when >6–8 birds present. Largest territories recorded were on Ahuriri and Ohau Rs on fine days in Jan. and Feb.: 400–600 m long and included several braids across their widths (Lalas 1977). **Home-range** Generally forage near resting sites; some fly up to 15 km, and possibly up to 30 km, to feed. When breeding, forage near or within colonies. In winter, 85% of population in Otago Harbour feed at sea and rest within harbour; behaviour similar at mouth of Waitaki R.; those feeding at sea flew up to 15 km from shore (Lalas 1977).

Roosting Feed during day (Lalas 1977) but will also roost during day (Latham 1981) and at high tide (CSN 31). In some areas, intersperse feeding with bouts of resting; in other areas,

forage continuously; until sunset (Lalas 1977; Latham 1981). When resting while foraging, usually do so in groups, with individual distances of 1–2 m, though often closer in strong winds. Numbers resting vary with time of day, weather and tide (see flock sizes above). Resting sites usually near water on flat open ground, with good visibility but little protection from weather; not seen to rest on water, vegetation (including grass) or snow, but sometimes land for short time on freshly ploughed fields where others feeding (Lalas 1977); also see Habitat. Often seen roosting on fence posts, occasionally balancing by spreading wings (e.g. Sibson 1982; CSN 34). Tend to use resting places consistently each day. Some used as overnight roosts, e.g. one isolated feeding site had 2–3 daytime resting places, each accommodating 5–20 birds, but all birds in area (30–50 individuals) roosted together at night at one site. One breeding colony had roost-site at centre, which was also used during day by resting Terns. After eggs hatched, parents often rest near chicks. At resting sites, birds preen, sleep and may bathe in shallows if nearby; first-year birds seem to bathe often. Courtship and copulations occur at roosting sites before laying (Lalas 1977). During winter, roosting birds quiet (Latham 1981).

SOCIAL BEHAVIOUR No detailed studies, though much information from feeding study in SI (Lalas 1977). Social flights resemble those of *Chlidonias* terns (Cuthbert 1954; Baggerman *et al.* 1956; Swift 1960; Lalas 1977). Names used by Lalas (1977) follow those of Baggerman *et al.* (1956). **Flock behaviour** (Also see Alarm and Parental anti-predator strategies). Resting birds often take off silently together and fly rapidly in tight group in low altitude SWERVE-FLIGHT, characterized by rapid and erratic changes in direction; Terns feeding nearby join in; group disbands and most resume feeding after c. 60 s (20–100 s); average of two swerve-flights per hour but interval between Swerve-flights irregular (from 10 to 120 min); seen throughout year where Terns rest or forage in large numbers; at one site where birds did not roost overnight, appeared to act as stimulus for departure to roost (Lalas 1977). About one-third of Swerve-flights lead to HIGH-FLIGHTS, which also occur any time of year; instead of returning to ground, birds spiral upwards then glide in horizontal circle for 5–25 min at altitude of 50–150 m; time spent gliding involves little energy compared to normal flight; may be alternative to resting on ground (Lalas 1977). High-flights of other species of tern restricted to period before incubation and are part of selecting partner (Baggerman *et al.* 1956). Call when joining or leaving foraging group (Lalas 1977). Within colony, nesting synchronized within subgroups but not between them (Lalas 1977; see Breeding).

Agonistic behaviour To defend feeding territory, owner generally began calling when another Tern, which usually remains silent, approaches to within 50 m of feeding territory; if intruder flies through territory without stopping, feeding of owner not disrupted but most intruders stop and feed till they are attacked. Most attacks occur as intruder rises from water with prey: from behind, owner calls loudly and dives, often hitting intruder with bill or feet; intruder usually then leaves. Terns of all ages appear equally efficient at driving off intruders, though territorial immatures call more than adults during periods when there are no intrusions (Lalas 1977). At wintering sites, may squabble over roosting perches, dislodging one another by flying in from behind and below, then giving sitting bird a lift under the tail or settling on its back. Occasionally utter grating scolding when one bird is annoyed by

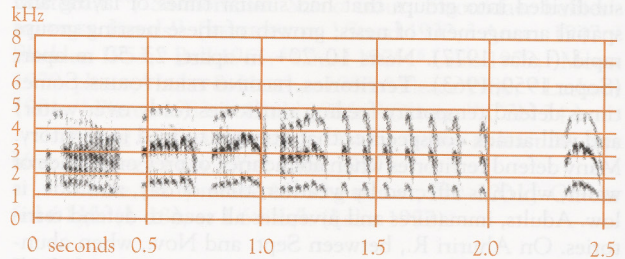
another (Latham 1981). **Alarm** When approached by people, birds in resting flock take off noisily then settle again (Prickett & Prickett 1956); foraging Terns can usually be approached to within 5–10 m. Birds only attack potential predators near colony during breeding season; resting or foraging birds generally not disturbed by Swamp Harriers *Circus approximans* (Lalas 1977), though Latham (1981) observed birds taking to air when Harrier flew over roost.

Sexual behaviour **FISH-FLIGHTS:** Birds displaying in air seen to carry many different prey items, including fish (*Gobiomorphus* and trout *Salmo*), skinks, earthworms and damselflies (but not cicadas). Two types of Fish-flight seen: Aerial Glide and Low-flight. **AERIAL GLIDE:** Two or more birds fly together; one, sometimes holding fish, adopts aerial **BENT POSTURE**, with head bent and wings held in V, and other adopts **STRAIGHT POSTURE**, with head straight and wings held horizontally; birds then glide horizontally for 2–5 s with wings held in these positions; Aerial Glide often takes place without carrying food. Occurs July to mid-Jan., but most common Oct.–Nov. (laying period); last Aerial Glides coincide with end of parental feeding. Probably plays important role in courtship and maintenance of pair-bond. **LOW-FLIGHT:** Display by unmated male to attract female; while holding fish, solitary Tern adopts Bent Posture in flight, and utters Fish Calls while making slow low pass over a nesting place; spreads tail, holds wings in V and either glides, or beats wings rapidly (but with shallow wing-beats). Tern on ground may respond by posturing and emitting Begging Call, and may take off to follow displaying Tern; Aerial Glides often follow. Seen Oct.–Jan. (Lalas 1977). **Courtship feeding** Observed only once (Lalas 1977): female landed and was fed by male that was foraging nearby; a short time later pair copulated, then immediately flew away. **Greeting** At change-over, no food or other material brought and birds rarely posture (Lalas 1977). **Copulation** Occurs when birds congregate at potential nesting areas in Sept. (Stead 1932; Soper 1972).

Relations within family groups Adults can urge chicks to move by hovering and calling overhead. When feeding young, parent usually carries only one item of food at a time, holding it crosswise in bill. Chick, which normally hides when not being fed, apparently able to recognize Fish Call of approaching parent, and responds with Begging Calls until it is fed. Transfer of food usually occurs soon after adult has landed. Regurgitation not seen. Begging Call and posture of juvenile resembles that of begging adult (Lalas 1977). One juvenile recorded flying to meet adult with food (Tily 1954). **Anti-predator responses of young** Chicks stay in nest till 1–3 days old then usually hide nearby (within 10 m of nest), in vegetation or driftwood, for another 1–3 days. Chicks said to be well camouflaged (Oliver) or not well camouflaged against grey shingle (Lalas 1977). When disturbed, chicks <3–4 days old squat and remain still; older chicks run, occasionally into water (Lalas 1977; Oliver). **Parental anti-predator strategies** Intensively and effectively attack avian predators, such as Swamp Harriers and gulls *Larus*, but not always effective against Australian Magpies *Gymnorhina tibicen* (Soper 1963; Lalas 1977; CSN 21). **WHIRL-FLIGHT:** in response to flying Swamp Harrier, all birds take flight and circle till Harrier leaves (Lalas 1977). Also recorded attacking New Zealand Falcons *Falco novaeseelandiae* (Tily 1954), dogs (Soper 1963), and Rooks *Corvus frugilegus* (CSN 22). Dive at human intruders and cry when swooping past their heads (Oliver); attack sometimes accompanied by regurgitation (Soper 1963); often strike intruder's head (Soper 1963; CSN 21).

VOICE Well known. Generally silent when foraging, giving Single Note when entering or leaving foraging flock (Lalas 1977). Take off noisily when flushed from paddock, with calls less clamorous than those of White-fronted Tern (Sladden 1953). Wintering flocks very quiet at roosts (Latham 1981). Chicks able to distinguish Fish Calls of parents from those of other adults (Lalas 1977).

Adult WHISTLING NOTE: High-pitched and staccato whistle, given at intervals (Stead 1932). Described as *ke-e* (Buller 1888), *swit-week* or *kit-week* (Sibson 1948), and sharp *ki-kit*; variations including *ki-ki-kit* and *ki-ki-ki-ki-kit* (Falla *et al.* 1981). Second, third and fourth calls of sonagram A probably show *ki-ki-kit*. When intruder approaches nest, uttered much more often while flying round (Stead 1932). Rapid *kit* or *ki-kit* given when another Tern approaches within 50 m of feeding territory (Lalas 1977). **SINGLE NOTE:** *ki* or *kit* given when entering or leaving a foraging group (Lalas 1977). Sixth (last) call of sonagram A probably shows this call. **GRATING CRIES:** Uttered when swooping in defence of nest (Soper 1972); described as harsh cry (Buller 1888), harsh scream (Stead 1932), and harsh angry *yark* (Falla *et al.* 1981). Also uttered in annoyance at other Terns (Latham 1981). First call of sonagram A probably shows this call. **CURR:** Given when disturbed (Falla *et al.* 1981). Loud *kror* when diving at intruder on feeding territory (Lalas 1977) may be same call. **CHITTERING NOTES:** Accompany display flights (Soper 1972). Fifth call of sonagram A probably shows this call. **FISH CALL:** Not described; given by unmated male in Low-flight. In only observa-



A L. McPherson; Tasman R., SI, NZ, Nov. 1975; P105

tion of courtship feeding, given before landing beside female (Lalas 1977). Often uttered when approaching with food for chick; gave 2–5 Fish Calls when within 50 m of chick in 13 of 19 feeds, but did not call at all in other feeds (Lalas 1977). Call of male offering fish to females early in breeding season described as *quis* (Guthrie-Smith 1936). **BEGGING CALL:** Not described; given by female posturing on ground, in response to

Plate 43

Whiskered Tern *Chlidonias hybridus* (page 765)

1 Adult breeding; 2 Adult non-breeding; 3 Downy young;
4 Juvenile; 5 Early stage of moult from juvenile to first immature non-breeding

White-winged Black Tern *Chlidonias leucopterus* (page 776)

6 Adult male breeding; 7 Adult non-breeding;
8 Downy young; 9 Juvenile

Black Tern *Chlidonias niger* (page 785)

Subspecies *surinamensis*
10 Adult male breeding; 11 Adult non-breeding;
12 Juvenile

Low-flight and Fish Calls of male (Lalas 1977); also given by female during only observation of courtship feeding (Lalas 1977). Early in breeding season, response of a number of females to Fish Call of a single male described as *ego* (Guthrie-Smith 1936). **SOFT CALL:** Soft *tseek tseek*, usually given in flight (Latham 1981). Soft plaintive cry given when hunting insects (Buller 1888) possibly same call.

Young Chicks utter **BEGGING CALLS**, from time of hearing Fish Call of adult approaching with food till chick fed; similar to Begging Call of female (Lalas 1977). Single Note (*ki* or *kit*) of juveniles coarser than that of immatures and adults (Lalas 1977). When defending feeding territories, immatures call for longer than adults during periods when there are no intrusions (Lalas 1977).

BREEDING Not well known; some breeding data in study by Lalas (1977). Usually nest in colonies, occasionally as isolated pairs; in river beds, occasionally at high altitude, up to 1720 m asl (Pierce 1983; Child 1986). Often nest in association with Black-billed Gulls (Oliver; J. Hawkins).

Season Laying, Oct.–Dec. (Lalas 1977); mid-Oct. or early to late Nov., sometimes into Jan.; fledging, Dec. and Jan. (Pierce 1983; Oliver); nests with eggs, late Dec. (CSN 30); at high altitude: young, 1–7 days old, in mid-Jan. (Child 1986).

Site On shingle banks or beds in rivers, varying from bare shingle to almost complete vegetated cover of *Raoulia*, *Muehlenbeckia* and *Cyathodes*; rarely on completely vegetated river terraces; among large round stones set in silt and sand (Soper 1959; Pierce 1983). Nests spaced 5–100 m apart (see Breeding dispersion). Usually nest in same sites from year to year (Pierce 1983).

Nest, Materials Scrape in sand, among large boulders to protect from wind; scratch shallow scrape or use natural depression; line nests with twigs (Soper 1959; Oliver).

Eggs Ovoid, pointed; ground-colour, dark stone, with large blotches of light and dark brown or olive-green all over (Oliver). **MEASUREMENTS:** 38 x 29.5, 41.6 x 28.8 and 42.4 x 28.6 (n=3 eggs; Oliver).

Clutch-size Two (Oliver); C/3 recorded among late nesting Terns (Lalas 1977); photo in NZRD shows nest with three eggs.

Laying Nesting synchronized within but not between groups within colony (Lalas 1977). Eggs said to be laid on separate days (NZRD).

Incubation By both sexes, beginning with first egg; change-over every 15–60 min (Lalas 1977). **INCUBATION PERIOD:** For four clutches, 22–24 days (Lalas 1977). Hatching

asynchronous, at intervals of c. 24 h (n=24) (Lalas 1977).

Young Semi-precocial, nidifugous. Leave nest within 24 h of last egg hatching; stay near nest for another 1–3 days; thereafter, roam about, often away from colony (Lalas 1977). **Parental care, Role of sexes** An adult attends nest throughout hatching period (Lalas 1977). When disturbed, chicks <3–4 days old remain still, but older chicks run and occasionally enter water (Lalas 1977). Young up to 7 days old found hiding in dead hearts of clumps of Alpine Daisy *Celmisia viscosa* (Child 1986). Do not form crèches (Lalas 1977). Both sexes feed young, holding food crosswise in their bills; one brood fed an average 6 times/h during day; mean rate at which large items brought to brood, 1.9 items/brood/h, or 1.6/chick/h (Lalas 1977).

Fledging to maturity Fledge c. 1 month after hatching (Lalas 1977). Young start to forage for themselves after fledging; feeding rate lower for fledgelings than for chicks; parents stop feeding young by mid-Jan. (Lalas 1977). Probably first breed when 2 years old (Pierce 1983; see Bonds).

Success Flooding is major cause of loss of eggs (Lalas 1977). Sheep trample some nests; mammals take eggs; Australian Magpie seen to take small chick (Pierce 1983; Lalas 1977).

PLUMAGES Prepared by D.J. James. Small tern, maturing in 1.5 years. Said to moult to juvenile plumage and fledge when 1 month old (NZRD). Have partial post-juvenile moult to first immature non-breeding plumage, followed immediately by partial pre-breeding moult to first immature breeding plumage. Thereafter, a complete post-breeding and a partial pre-breeding moult each cycle produce non-breeding and breeding plumages, with distinct seasonal variation mostly confined to head. Apparently attain definitive plumage with second breeding plumage. First breed at c. 2 years old (see Bonds). Sexes similar. No subspecies. Plumage descriptions based on skins (AIM, AM, CM, NMNZ), supplemented by published data (Lalas & Heather 1980; Latham 1981).

Adult breeding (Second and subsequent alternate [summer]). **Head and neck** Forehead, crown, nape and hindneck, black, ending in broad rounded point on lower hindneck; cap sharply cut off in straight line, level with bottom of eye. Cap bordered below by tapering white cheek-stripe, beginning narrowly on lower lores over gape, and broadening across ear-coverts to side of nape. Lower cheeks, chin, throat, and front and side of neck, light grey (between 85 and 86), becoming a little darker with wear. When fresh, feathers of nape and hindneck, and possibly crown, black at first, with narrow white edges forming conspicuous streaks; white edges wear off before moult finished and cap fully black. **Upperparts** Mantle, light grey (85) grading to mid-grey (nearer 84 than 85) on scapulars and back (no narrow white tips to rear scapulars); become slightly darker with wear. Rump, white, sharply demarcated from back. Uppertail-coverts, grey-white (between white and 86); appear white in field. **Underparts** Mostly light grey (between 85 and 86); breast slightly darker than throat or belly, but difference barely detectable. Undertail-coverts, white, cut off sharply from grey vent. **Tail** From above, appears mostly light grey (85), slightly paler than upperparts. T1–t4, light grey (85), becoming slightly darker (between 85 and 84) with wear; always contrast strongly with rump; when fresh, contrast with uppertail-coverts slight to moderate, becoming stronger with wear. T5, light grey (5) on outer web and distal inner web, grading to pale grey (86) in centre of inner web and white at base. T6, light grey (85) distally, grading through

Plate 44

Whiskered Tern *Chlidonias hybridus* (page 765)

- 1 Adult breeding; 2 Adult non-breeding; 3 Juvenile;
- 4 Early stage of moult from juvenile to first immature non-breeding

White-winged Black Tern *Chlidonias leucopterus* (page 775)

- 5 Adult male breeding; 6 Adult non-breeding;
- 7 Late stage of moult from juvenile to first immature non-breeding, first austral autumn

Black Tern *Chlidonias niger* (page 786)

Subspecies *surinamensis*

- 8, 9 Adult male breeding; 10 Adult non-breeding;
- 11 Late stage of moult from juvenile to first immature non-breeding, first austral autumn; 12 Second immature breeding

speckled pale grey (c86) centrally to white at base. All shafts, light grey (85) distally, grading to white basally. Underside, pale grey (c86), slightly reflective. Contrasts slightly with white undertail-coverts, though contrast sometimes not evident when tail back-lit. **Upperwing** Tertiaries and coverts, mid-grey as scapulars. Secondaries, mid-grey (like scapulars) at bases, grading to slightly lighter grey (slightly darker than 85) at tips, and to pale grey (86) on outer half of inner web; narrow white tips form fine tapering trailing-edge (<1 mm wide on outer secondaries, 2 mm on inner secondaries). Primaries, light grey (nearer 85 than 86) when fresh, mid-grey (c84) when worn; tips (where exposed on folded wing) darken faster than rest of primaries, producing diffuse dusky trailing-edge (from p4 outwards) that becomes more prominent with wear. P10 has contrasting grey-black (between 82 and 83) outer web. P10–p9 (and less clearly p8), have white outer half of inner web from base to c. 40 mm from tip. Shafts of p10 and p9, white; shafts of rest, cream (92); all grade to light grey (85) at tip. **Underwing** Coverts and subhumeral, pale grey (slightly paler than 86). Secondaries, pale grey (86) slightly darker than lining. Inner primaries, pale to light grey (closer to 86 than 85), slightly darker than secondaries. Outer three primaries, pale grey (paler than 86), slightly paler than inner primaries. Dark edge to p10 not visible from below. Contrast between remiges and lining not obvious (cf. juvenile).

Adult non-breeding (Third and subsequent basic [winter]). Differ from adult breeding by differences in pattern of head and neck. Wing and tail retained from adult breeding. **Head and neck** Lack neat black cap. Forehead, grey-white (between white and 86) grading to pale grey (86 or slightly darker) on crown, nape and hindneck. Lores, grey-white, with black scaling in front of eye that peters out on anterior lores. Small black patch round eye, narrowly joined to larger black patch on ear-coverts by band of black streaks, forms dark mask; apparently, masks on either side of head do not meet on nape in full non-breeding plumage, though patches on ear-coverts may be joined by narrow band of black streaks across rear crown (Latham 1981). Mask bordered below by white cheek-stripe like that of adult breeding, though upper margin of stripe not straight. Chin and throat, slightly paler grey (paler than 86), which, with grey crown and patchy mask, makes white cheek-stripe less contrasting and conspicuous. In transition from non-breeding to breeding plumage (Mar., possibly Feb., to late June; see Fig. 1), new black feathers on top of head first appear round eyes and ear-coverts (increasing size of mask), across hindneck and nape (joining patches on opposite sides of head) and in distinctive narrow black band over base of bill; black then extends forwards over crown to forehead (forehead still showing much scaling when nape and hindneck uniformly black) (Latham 1981).

Downy young Down, soft and woolly, typical of *Sterna*, unlike long silky down of *Chlidonias*. Top of head, off-white, with large irregular black-brown (119) to dark-brown (219) patches. Chin and throat lightly washed cinnamon (redder than 39). Upperparts, off-white to very pale grey-brown (much paler than 119D) heavily mottled light brown (27). Underparts, mostly white; undertail-coverts, light grey-brown (219C).

Juvenile Head and neck Forehead and lores, buff (124) with dark-brown (219) scaling on posterior lores and, usually, narrow black-brown (119) shaft-streaks; with wear, streaking becomes less distinct and develop impression of white forehead (Lalas & Heather 1980). Crown and nape, buff, with heavy black streaking; feathers have concealed white bases, black-brown (119) centres (varying individually from streaks

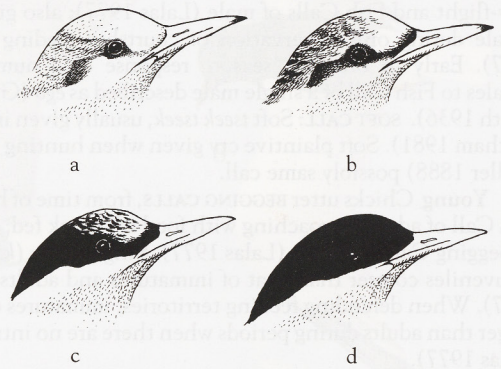


Figure 1 Change in pattern of head in transition from non-breeding to breeding plumages.

to elongate spots or ovals) and buff (124) fringes; with wear, fringes fade to cream (c92) and become narrower, crown then appearing black with messy whitish streaking. Hindneck slightly darker than crown, black-brown (119) with narrow but conspicuous buff (124) fringes. Small black-brown (119) eye-patch usually narrowly connected to larger irregular black-brown patch on ear-coverts. Chin, throat and foreneck, white, continuing onto sides of neck behind ear-patch as white forecollar, neatly demarcated from darker hindneck. **Upperparts** Mantle, grey-black (slightly paler than 82 with faint brownish tinge) with conspicuous, sharply defined buff (124) fringes (1–2 mm wide) forming neat scaly pattern; fringes and scaly pattern reduced by wear; feathers have broad white bases. Scapulars vary: mid-grey (84) with broad, slightly irregular dark-brown (119–219) subterminal crescent (3–7 mm wide) and broad buff (124) fringe (1.5–3 mm wide) at tip of each feather; width of crescents greatly affects appearance of upperparts (when widest, little or no grey at bases visible); rear scapulars have cream (92), rather than buff, fringes. Back, mid-grey (84), usually with very narrow dark-brown (219) fringes at tips. Rump, white. Uppertail-coverts, pale grey (c86). **Underparts** Breast, grey (86) with faint narrow light-grey (c85) submarginal band or chevron (causing unevenness of overall shade) and, when fresh, inconspicuous pale-buff (pale 124) fringe at tip (often lost before fledging). Flanks, sides of belly and vent, pale grey (86). Centre of belly, white, forming irregular stripe. Undertail-coverts, white. **Tail** Mostly grey, like adult. All but t1 slightly darker than in adult, mid-grey on t2–t5 (between 84 and 83), light grey and uniform on t6 (between 85 and 84); when fresh, have broad cream tips that become narrower outwards (2–3 mm wide on t1, <1 mm on t6); t1–t2 have narrow diffuse dark-grey (c83) subterminal band. **Upperwing** Marginal coverts, white inside carpal joint, mid-grey (c84) outside. Leading lesser secondary coverts, dark grey (c83). Median and rear lesser secondary coverts, light grey (c85) (slightly paler than scapulars) with narrow dark-brown (219) submarginal band, and narrow buff (124) fringe at tip (c. 2 mm wide). Greater secondary coverts, all primary coverts and alula, light grey (between 85 and 84); greater coverts have inconspicuous white fringes (<1 mm wide). Tertiaries, like rear scapulars, except distal marks less clear; cream (92) fringe at tip 2–3 mm wide. Remiges, like adult except: (1) innermost secondaries have narrow, diffuse dark-grey (c83) subterminal band and narrow cream (92) fringe; and (2) inner four primaries have very narrow crisp white fringe at tip, which is lost soon after fledging. **Underwing** Coverts and subhumeral, grey-white (between white and 86);

primaries and secondaries as adult. Coverts appear almost white in field and contrast more with grey underbody than in adult.

First immature non-breeding (First basic [winter]). Retain juvenile wing and varying amount of tail. New plumage of head and body similar to that of adult non-breeding. **Head and neck** Forehead and crown, light grey (85) with diffuse narrow dark fringes to feathers, giving forehead obscure pattern, and crown a streaky appearance. Lores like adult non-breeding. Dark grey (83) to grey-black (82) patch round eye broadly continuous with (not narrowly joined to) ear-patch, and forms more extensive oval mask than in juvenile. Patches on either side of head joined across hindneck by narrow smudgy dark-grey band. Trace of broken white cheek-stripe below mask. Chin, throat and rest of neck, grey-white (between white and 86). **Upperparts** As adult. Occasionally retain a few rear scapulars, which change with wear as tertials do. **Underparts** Very similar to adult, except centre of breast and belly paler, pale grey (86) to grey-white (between white and 86). **Tail** Replace varying number of central rectrices, from all to none. New rectrices as adult, except very slightly darker; difference most noticeable on t5, which is uniformly light grey, without paler inner web. If replaced, t6 developed as short tail-streamer (intermediate between juvenile and adult). Any retained juvenile rectrices become darker and develop brownish tinge (dark brownish-grey [dark 79]), contrasting with fresh new rectrices; eventually, dark submarginal marks obscured by darkening of whole tip of feather, and pale tips lost with wear. **Upperwing** Similar to juvenile, with narrow dark-grey (83) cubital bar, and rest of coverts fairly uniform mid-grey (84); narrow white fringes persist on greater primary, and inner greater secondary coverts and, sometimes, on inner median secondary coverts. On tertials and tertial coverts, submarginal markings become obscured by general darkening of feathers with wear and pale fringes fade to off-white and become much narrower (though persist until at least July). Retained remiges worn and darker than in juvenile, especially at tips of outer primaries; mid-grey (c84) with dark brownish-grey (brown 83) tips to outer primaries. Alula apparently darkens more rapidly than surrounding primary coverts. Occasionally replace a few inner median coverts; new coverts uniformly mid-grey (paler than 84). **Underwing** Retained from juvenile. Coverts fade slightly and become nearly white. Prominence of dark trailing-edge to outer primaries probably increases with wear.

First immature breeding (First alternate [summer] = second summer of Lalas & Heather [1980]). Replace head, body and, sometimes, some median secondary coverts, inner tertials and some or all retained juvenile rectrices; new feathers like adult, except tail like first immature non-breeding. Very similar to first immature non-breeding, except: **Head and neck** Like adult non-breeding, though feathers of forehead and fore-crown have larger blackish centres and pale-grey (86) edges, and appear much like moulting adults.

BARE PARTS Based on photos (Moon 1979, 1992; Moon & Lockley 1982; Harrison 1987; Chambers 1989; NZRD; unpubl. B. Chudleigh), published descriptions (Lalas & Heather 1980; NZRD) and museum labels. **Adult breeding** Bill, bright orange; slightly duller tip to culmen, probably from wear of ramphotheca. Iris, black-brown (often described as black). Narrow orbital ring, grey-black (c82). Legs and feet, bright orange. **Adult non-breeding** Similar to adult breeding, but bill slightly duller orange, with small dark-brown tip. **Downy**

young Bill, dark yellow with black tip. Legs, bright to dull orange. **Juvenile** Bill, dark brown with yellow to reddish base to lower mandible. Tongue, yellow (label, AIM). Iris, black-brown (c119). Orbital ring, grey-black (c82). Legs, bright orange (label; Lalas & Heather 1980; NZRD); light yellow (three labels, AIM, AM); light orange-buff (four labels, NMNZ). **First immature non-breeding** Bill, dark brown, with reddish base to lower mandible. Mouth, dull reddish. Iris, black-brown. Orbital ring, grey-black (c82). Legs, bright orange. **First immature breeding** Similar to first immature non-breeding. Transition of bill to bright orange varies greatly; apparently begins as early as Aug. of first year in some, not until at least Jan. in others (Lalas & Heather 1980; see Ageing).

MOULTS Based on Lalas & Heather (1980), Latham (1981), and examination of c. 60 skins (AIM, AM, CM, NMNZ). **Adult post-breeding** (Third and subsequent pre-basic). Complete, mostly symmetrical. Timing appears to vary little between individuals. Remiges and (sometimes) rectrices usually begin Jan. Primaries outwards; usually two active at a time; moult of primaries finished by late Apr. Secondaries moult inwards, sequentially. Details of tertials unknown. Tail, centrifugal (outwards); perhaps sometimes with irregularities; usually symmetrical or slightly asymmetrical; often finishes after primaries. Beginnings of most of moult of head visible on forehead between mid-Dec. and mid-Jan.; head in full non-breeding plumage by Feb. **Adult pre-breeding** (Third and subsequent pre-alternate). Partial moult of head and body. Begins Mar. or early Apr., soon after post-breeding moult of head and body finished but post-breeding moult of remiges and rectrices still underway; finishes early to late June, soon after end of pre-basic moult of primaries. Change in pattern of head described in Plumages (see Fig. 1). Remiges not moulted; no data on whether any rectrices moulted more than once per cycle. **Post-juvenile** (First pre-basic). Partial moult of head and body and, sometimes, tail. Begins soon after fledging, in Feb. By Mar., upperparts replaced, though sometimes retain a few rear scapulars. Beginning of moult of head visible in field by Mar. or Apr. and appears to be finished by June or July. Usually replace no rectrices, though some replace varying number from centre outwards; a few replace all rectrices. **First pre-breeding** (First pre-alternate). Partial moult of head and body; sometimes replace a few rectrices that were not replaced in post-juvenile moult and, infrequently, replace some inner median coverts. Begins about Aug. probably following short pause after post-juvenile moult finished. Full extent and finishing dates unknown. **First post-breeding** (Second pre-basic). First complete moult. Sequence similar to adult pre-breeding. Said to begin during Mar. of second year (Lalas & Heather 1980). **Second pre-breeding** (Second pre-alternate). Partial; similar to adult pre-breeding, but apparently a little later (Latham 1981).

MEASUREMENTS (1) Adults, skins; T1 = length of central rectrix; T6 = length of outer rectrix (= Tail) (AIM, AM, CM, MV, NMNZ).

	MALES	FEMALES	
WING	(1) 250.1 (6.13; 240–260; 12)	247.3 (3.35; 242–255; 15)	ns
T1	(1) 70.3 (4.42; 65–79; 13)	70.7 (3.75; 64–78; 18)	ns
T6	(1) 110.3 (5.19; 103–121; 13)	111.6 (4.66; 102–120; 19)	ns
BILL	(1) 26.8 (1.07; 25.1–29.0; 14)	25.7 (1.00; 23.6–27.6; 18)	**
TARSUS	(1) 17.1 (0.73; 16.4–18.4; 13)	16.6 (0.62; 15.4–17.5; 19)	ns
TOE	(1) 15.5 (0.75; 14.3–17.1; 13)	15.5 (0.64; 14.5–16.6; 17)	ns

(2) Skins, sexes combined and unsexed birds (as sample 1). Immatures = first immature non-breeding and first immature breeding plumages.

	ADULTS	IMMATURES	
WING	(2) 248.9 (5.15; 240–260; 31)	236.7 (4.57; 230–248; 17)	**
T1	(2) 70.4 (37.4; 64–79; 36)	68.5 (4.33; 62–74; 16)	ns
T6	(2) 110.2 (5.35; 95–121; 38)	96.5 (4.20; 91–107; 17)	**
BILL	(2) 26.3 (1.18; 23.6–29.0; 38)	25.5 (1.80; 22.4–29.0; 17)	*
TARSUS	(2) 16.8 (0.72; 15.4–18.4; 37)	16.7 (0.35; 15.9–17.3; 13)	ns
TOE	(2) 15.5 (0.66; 14.3–17.1; 35)	15.3 (0.58; 14.1–16.4; 14)	ns

Additional measurements in Lalas & Heather (1980), though mostly of same skins.

WEIGHTS (1–2) Skins, museum labels (MV, NMNZ): (1) Adults; (2) First immatures.

	MALES	FEMALES
(1)	94.2 (9.96; 81–105; 5)	97
(2)	87	87

STRUCTURE Wing, long, narrow, pointed. Eleven primaries: p10 longest, p9 11–14 mm shorter, p8 28–31, p7 48–51, p6 68–73, p5 87–93, p4 103–113, p3 118–128, p2 133–145, p1 148–158; p11 minute. Fifteen to 17 secondaries, including three to four tertials; tips of longest tertials fall between p3 and p4 on folded wing. Tail, moderately long and well forked, but tail short and fork shallow compared with medium-sized commic terns; 12 rectrices; t6 longest; in adults, tips rounded, except for tip of t6, which is pointed and slightly elongated as short tail-streamer (12–16 mm longer than t5); in juveniles, tips slightly pointed; at rest, tip of tail falls well short of wing-tip. Bill, short and slender for tern; less deep, with less pronounced gonydeal angle and stronger decurve to culmen than White-fronted, Antarctic and Kerguelen Terns. Nostril, elongated horizontal slit; perforate. Tarsus, short, slender; scutellate in single row on front of tarsus and top of toes, reticulate elsewhere. Front toes, fully webbed; webs much less incised than *Chlidonias* terns, but slightly more incised than White-fronted, Antarctic *S. vittata* and Kerguelen *S. virgata* Terns. Outer toe 98–100% of middle (but much more slender), inner 65–73%, hind 29–33%, raised. Middle claw, pectinate, much longer than others.

AGEING Latham (1981) described birds seen from late Apr. to mid-June that were separable from adult non-breeding and first immature non-breeding; these assumed to be second immatures moulting from non-breeding to breeding plumage. Apparently have: (1) patchy or mottled crown similar to crown of adults mid-way through pre-breeding moult of head, but not speckled as in adults; and (2) patchy or mottled dark-brown and dull-orange bill. However, Lalas & Heather (1980) did not recognize this age-class, and thought there was much individual variation in rate of change in patterns of bill from immature to adult; skins provided little extra data. By end of June, when moult completed, this age-class indistinguishable from adult breeding (Latham 1981).

RECOGNITION See Antarctic Tern (Recognition, Fig. 8).

GEOGRAPHICAL VARIATION None. Previously treated as subspecies of Whiskered Tern *Chlidonias hybridus* (NZCL 1970) following recommendation of Sibson (1948). Mees (1977) showed that *albostrigata* not closely related to *Chlidonias*, and belongs in *Sterna*. Evidence for relationship to Kerguelen *S. virgata* and Antarctic *S. vittata* Terns plausible but inconclusive (Lalas & Heather 1980).

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Arctic Tern *Sterna paradisaea* (page 668)

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

Kerguelen Tern *Sterna virgata* (page 692)

4 Adult breeding; 5 First immature non-breeding

Antarctic Tern *Sterna vittata* (page 677)

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

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

9 Adult breeding; 10 First immature non-breeding

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Kerguelen Tern *Sterna virgata* (page 692)

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

Antarctic Tern *Sterna vittata* (page 677)

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

Arctic Tern *Sterna paradisaea* (page 668)

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

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

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