

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 alcid 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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Order CHARADRIIFORMES

Family SCOLOPACIDAE sandpipers and allies

Small to large shorebirds (12–66 cm) with long bills and legs. Largest family of suborder Charadrii, with some 88 species in c. 24 genera; most species only breed in higher latitudes of Holarctic, but migrate long distances and occur almost worldwide in non-breeding period. In HANZAB area, 51 species in 18 genera: two breeding species, 27 regular non-breeding migrants, 19 accidentals and three doubtfully recorded. All are transequatorial migrants except for the two species of *Coenocorypha* that breed NZ, which are sedentary. The family is usually split into six subfamilies (e.g. Jehl 1968; BWP): Scolopacinae, Gallinagoninae, Tringinae, Arenariinae, Calidridinae and Phalaropodinae; we place the dowitchers *Limnodromus* in a separate subfamily, Limnodrominae (q.v. for details). All except Scolopacinae (woodcocks) represented in HANZAB region. Though they are convenient groupings, these subfamilies may not be wholly monophyletic (e.g. Strauch 1978; Dittman *et al.* 1989; Sibley & Ahlquist 1990; BWP); until phylogeny within the Family is understood, sequence of genera and species followed by different authors is likely to remain unsettled. Sequence and taxonomy used here follows Christidis & Boles (1994). Studies of allozymes (Christian *et al.* 1992), DNA hybridization (Sibley *et al.* 1988; Sibley & Ahlquist 1990), osteology (Strauch 1978) and patterns of downy young (Jehl 1968) generally agree in treating Scolopacidae as monophyletic, with distant links to Jacanidae, Rostratulidae, Thinocoridae and Pedionomidae.

Body-form diverse, from slender to stocky. Females slightly to considerably larger than males, though in a few species males are larger (Jehl & Murray 1986). Wings, long and pointed; p10 longest; 15–22 secondaries, including elongate tertials, which, with scapulars, cover back and rump when at rest. Tail, short; 12 feathers except in *Gallinago*, which have 14–28, and *Coenocorypha*, which have 14. Neck, long. Shape of bill varies considerably, though generally long and slender; usually straight to decurved, but recurved in a few Tringinae; tip of bill, fine or only slightly swollen (cf. Charadriidae) with sensory pits. Compared to Charadriidae, eyes small and head narrow. Unlike Charadriidae, have numerous fine pores in premaxillary bone to accommodate Herbst's corpuscles, which are assumed to be associated with more tactile, less visual, methods of foraging; some species have been shown to be capable of sensing buried prey, either through chemoreception (van Heezik *et al.* 1983) or mechanical detection of vibrations or self-induced pressure signals (Gerritsen *et al.* 1983; Gerritsen 1988; Piersma *et al.* 1994). Skeleton and musculature of jaw distinctive (Burton 1974). In most species, rynchokinesis of skull highly developed, enabling flexible upper mandible to be opened or retracted at tip only (to grasp prey while probing). Tarsi and tibiae, short to long, with transverse scales (except in *Numenius*). Four toes in all species except Sanderling *Calidris alba*; toes fairly long with lateral membrane (webbed in some); hindtoe, small and raised (except in Arenariinae). No crop. Caeca present. Apparently no other waders have spiral sperm cells (similar to those of Passeriformes).

Non-breeding plumage mostly dull and cryptic: mottled greys and browns above, and paler or white below, with or without streaks and spots. Breeding plumage generally much brighter (except in curlews, snipes and woodcocks), with more rufous or black. In HANZAB region, adults seen mainly during austral summer in non-breeding plumage, though breeding plumage can be seen on birds just before n. migration or on arrival after s. migration. Sexes usually similar. Bills, legs and feet variously, sometimes brightly, coloured. Adults generally have two moults per cycle: (1) a partial pre-breeding (pre-alternate) moult of most feathers of body, and, often, some tertials and upperwing-coverts; and (2) a complete post-breeding (pre-basic) moult; both usually performed in non-breeding areas or while staging on migration. Primaries moult outwards, usually after s. migration; some subspecies of Dunlin *Calidris alpina* (q.v.), Purple Sandpiper *C. maritima* and Rock Sandpiper *C. ptilocnemis* moult all primaries on or near breeding grounds before s. migration, a strategy rare in *Calidris*; Bristle-thighed Curlew *Numenius tahitiensis* moult remiges rapidly, inducing flightlessness in 50–70% of birds, apparently uniquely among Charadriiformes. Precocial young nidifugous; most feed themselves. Down varies greatly in structure and pattern; pattern mainly of spotted or striped type (Fjeldså 1977). Juvenile plumage usually distinctive; most like that of non-breeding adults, but often a little brighter, especially in Calidridinae. Moults of subadults complex and vary considerably with species, route of migration and age of first breeding. Adult plumage attained when 3–21 months old; most scolopacids of our region (except snipes) first attain adult plumage through partial first pre-alternate moult when c. 8–11 months old, or through complete second pre-basic moult when c. 12–16 months old (see discussion of Moults in General Introduction). Swift runners; wade expertly and some species swim habitually (Phalaropodinae). Stance often upright. Flight, fast and direct, often in tight flocks.

When breeding, most scolopacids (except some snipes and woodcocks) are birds of open habitats, including tundra. At other times, use a variety of habitats, including forests (woodcocks) and open sea (phalaropes), though most prefer shallow, fresh, brackish or intertidal wetlands. Greatest concentrations occur on intertidal mudflats,

especially estuaries. Feed mainly by touch, and the mandibular skeleton has distinctive features associated with tactile methods of foraging. When feeding, most probe into soft, moist substrata to catch invertebrates; some (e.g. Arenariinae) forage on rocky shores; surface-tension mechanism for feeding on plankton, recently described for Red-necked Phalaropes *Phalaropus lobatus* (Rubega & Obst 1993), may prove to be widespread among scolopacids with fine bills. Mixed-species foraging flocks common.

Migration the most striking feature of scolopacids. All but some Gallinagoninae, Scolopacinae and two aberrant Tringinae migrate (though some Tringinae partly resident in Europe), usually from breeding grounds in higher latitudes of n. hemisphere to lower latitudes of n. or s. hemispheres; many undertake extremely long migration steps, with non-stop flights of several thousand kilometres preceded by dramatic increase in weight. Scolopacids of HANZAB region breed mainly in e. Russia, Mongolia, n. China and Alaska; Latham's Snipe *Gallinago hardwickii* breeds Japan and in small numbers in e. Russia.

Migratory routes vary dramatically depending on the relationship between breeding and non-breeding ranges, and the ability to undertake long-distance non-stop flights. Some species migrate overland, some via coastal routes and others cross oceans; many species use a combination of these routes. Some species return to breeding grounds by the same route used in s. migration while others return by different routes, and make a loop migration (e.g. Curlew Sandpiper *Calidris ferruginea*). Timing of departure from breeding grounds often varies between sexes (e.g. Bar-tailed Godwit *Limosa lapponica*) and between ages; juveniles often leave at slightly different time (e.g. Bar-tailed Godwit *Limosa lapponica*) or migrate via a different route (e.g. Sharp-tailed Sandpiper *Calidris acuminata*). Most regular non-breeding migrants to Aust. migrate via East-Asian–Australasian Flyway; others to Aust. and, especially NZ, cross Pacific Ocean. Generally, in Aust. and NZ, s. migration Aug.–Nov. and n. migration, Feb.–May. Individuals of most species display a high degree of site-fidelity at breeding, non-breeding and even staging areas; others have little fidelity to breeding site and populations mix much (e.g. Curlew Sandpipers; P.S. Tomkovich). In HANZAB region, displays sometimes seen before migration, e.g. Red Knots in tight single-species flocks in nw. Aust. before migration (Lane & Jessop 1985). Pre-migratory flighting observed during Mar. in NZ (McKenzie 1967).

In non-breeding areas, most species undertake regular local movements between feeding and roosting sites or between different feeding sites. Most local movements are in response to tides, which affect exposure of feeding grounds (e.g. Hindwood & Hoskin 1954; Carter *et al.* 1976; Saunders & de Rebeira 1985; Smith 1985; Lane). Some roosting and feeding sites are close together, birds gradually dispersing from or returning to roosting sites as tides fall and rise (e.g. Robertson & Dennison 1979). At other sites, roosting and feeding sites farther apart, with birds even flying between islands or between islands and mainland (Saunders & de Rebeira 1985); in Capricorn Grp, Qld, Ruddy Turnstones and Grey-tailed Tattlers *Heteroscelus brevipes* fly at least 4 km from Tyron I., where roost at high tide, to North West Reef, where thought to feed (Prendergast *et al.* 1985); at Cairns, Qld, Whimbrels *Numenius phaeopus* move to mouth of Barron R. every evening (Amiet 1957) and can travel up to c. 20 km between roosting and feeding sites (McKenzie 1967; Garnett 1989). In poor weather, such as days of high winds or in storms, may move to sheltered areas other than normal roosting sites, such as near-coastal wetlands or pools in dunes (e.g. Crawford 1972; Forest 1982; Aust. Atlas). Some species dispersive, either locally or over longer distances (see accounts), sometimes in response to availability of food or availability of suitable wetland habitat. In NZ, Common Greenshanks *Tringa nebularia* tend to move round within harbours rather than returning to roosting site each day (Sibson 1965) and, in Tas., Common Greenshanks appear to move between coastal sites (Wall 1953); Curlew Sandpipers apparently move from Westport Bay, Vic., in Aug. when daily exposure of intertidal feeding grounds reduced (Loyn 1978; see also Hindwood & Hoskin 1954; Alcorn 1988).

Mainly feed and roost in single-species flocks. All species are strong fliers and those that form flocks often perform spectacular and complex aerial movements, which are performed with remarkable precision. Many species territorial during breeding season, but others lack specific territorial boundaries and are semi-colonial. Courtship displays, elaborate, including spectacular song-flights, often associated with formation of pairs. Distraction displays include repetitive display-flights, rodent-runs, and feigning injury.

Mating systems extraordinarily diverse, including monogamy (some species pair for life), polygyny (in some species, males display on leks, mating with females that visit their territories; in others, males maintain simultaneous pair-bonds with more than one female but provide no parental care) and polyandry (including double-clutching monogamy, where female lays two successive clutches, each of which is incubated by single adult; and classical polyandry, where female maintains pair-bonds with more than one male). Reasons for diversity of mating systems not clear but short breeding seasons and ability of single parent to incubate clutch and brood and raise chicks probably involved; possibly also related to phylogenetic history. For reviews of mating systems, see Ligon (1993) and Pitelka *et al.* (1974).

In CALIDRIDINAE, mating systems remarkably varied, including monogamy, polygyny, polyandry; most species monogamous (e.g. Pitelka *et al.* 1974). Role of sexes in parental care as diverse as mating systems. Apparently solely by female in the four polygynous species; roughly equally shared in some (e.g. Dunlin *C. alpina*), though female tends to leave chicks earlier; in others, male undertakes more of work and females leave before chick-rearing (or even

incubation) complete. Behaviour more complex in successive polyandrous species, with males raising first brood while females may lay and raise another clutch. In GALLINAGONINAE, mating systems poorly known but several species monogamous; Great Snipe *Gallinago media* promiscuous, mating at leks, and apparently unique among snipe in performing courtship display on ground; others have crepuscular or nocturnal display-flights accompanied by distinctive calls and non-vocal sounds (see Gallinagoninae). Mass flights of displaying snipes have been said to be aerial leks in several species, but confirmation needed (could be result of unsettled territorial boundaries early in breeding season) (Byrkjedal 1990). In TRINGINAE, most species monogamous but successive polyandry can occur in Spotted Redshank *Tringa erythropus* and Spotted Sandpiper *Actitis macularia*. Parental care shared about equally or females leave breeding grounds early while males undertake or finish rearing chicks. ARENARIINAE are monogamous; Ruddy Turnstone territorial and aggressive. LIMNODROMINAE, poorly known; apparently monogamous; territorial but *L. semipalmatus* nests in small colonies. Both sexes incubate; males undertake most of chick-rearing. In PHALAROPODINAE, many sex roles reversed when breeding; females almost unique among Scolopacidae in undertaking courtship behaviour, contesting access to mates in 'scramble displays' (Reynolds 1987; Colwell & Oring 1988a). Phalaropes usually monogamous, though polyandry recorded in all three species; incidence of polyandry may vary between populations but reasons not yet clear (e.g. Colwell & Oring 1988b). Males undertake virtually all incubation and raise chicks alone (see Colwell 1986; Colwell & Oring 1988a,b).

Most scolopacids breed first at 2 years old, though some species can breed in their first year and maturity may be delayed for more than 2 years in some large long-distance migrants. Usually nest on ground, often concealed in herbage. The scrape, often made during a scraping ceremony by the male in the presence of female, is often lined, usually after laying the first egg and more lining is added during incubation. Unusually, Solitary *Tringa solitaria*, Green *Tringa ochropus* and some Wood *Tringa glareola* Sandpipers recorded nesting in trees, usually in nests of other birds (see BWP). Usually four eggs per clutch, in some cases two or three. Eggs usually pyriform, with dark-brown and black markings, over paler ground-colour; all are cryptically coloured. Incubation normally starts with laying of last egg and chicks hatch almost simultaneously. Both sexes usually share incubation, though one bird often takes greater share. Downy young leave nest within 1 day of hatching and generally accompanied by brooding adult till able to fly. Social organization, social behaviour and breeding not discussed further in subfamily accounts.

In East-Asian–Australasian Flyway, hunting and destruction of wetland habitats major threats to shorebirds; this Flyway said to be probably the most threatened migration system in world (Lane & Parish 1991). Outside Aust. and NZ, hunting widespread, mainly for food, but little information available on impact on populations (Lane & Parish 1991). For example, in Thailand and n. Vietnam, both Great Knot and Red-necked Stint on passage or overwintering are eaten, and captive birds are kept to act as decoys to catch other waders; band-recoveries of Red-necked Stints in n. Vietnam have come from birds taken for food (Starks 1987; J.R. Starks). Many wetlands destroyed by reclamation for agriculture, aquaculture, salt-production, and urban or industrial development, including wetland habitats in Aust. and NZ (Lane & Parish 1991). Aust. is signatory to the Ramsar Convention and to bilateral treaties with Japan (JAMBA) and China (CAMBA) to protect migratory birds.

In many n. hemisphere breeding areas, breeding success cyclical and thought to be linked to population cycles of lemmings, which in turn influence levels of predation of breeding birds (Underhill *et al.* 1993). For example, in breeding areas of Curlew Sandpipers, decreased populations of lemmings *Lemmus sibiricus* and *Dicrostonyx torquatus*, the regular prey of Arctic Foxes *Alopex lagopus*, results in increased predation of eggs and young of Curlew Sandpipers (Roselaar 1979). Reproductive success in n. hemisphere in preceding breeding season reflected in numbers and proportion of juveniles and immatures in populations in non-breeding areas, such as Aust. and NZ.

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28 Gallinagoninae

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Subfamily TRINGINAE godwits, curlews, 'shanks' and allies

Diverse and widespread assemblage of shorebirds, varying markedly in size and shape; include small species (*Actitis*, 19 cm) and largest waders (*Numenius*, up to 66 cm in *madagascariensis*). Mostly migratory, breeding from low Arctic to Temperate regions of n. hemisphere. About 30 species, in three tribes (see Table 1) (Jehl 1968; Zusi & Jehl 1970); Prosobiniini restricted to islands of Pacific Ocean. In HANZAB region, 22 species in seven genera recorded: 13 regular non-breeding migrants, seven accidentals, and two doubtfully recorded.

Table 1

TRIBE	GENUS	NUMBER OF SPECIES (NUMBER RECORDED HANZAB REGION ¹)
Numenini	<i>Limosa</i> (godwits)	4 (2NB, 1A)
	<i>Numenius</i> (curlews and whimbrels)	8 (3NB, 1A, 1D)
	<i>Bartramia</i>	1 (1A)
Tringini	<i>Tringa</i> ('shanks')	10 (4NB, 4A, 1D)
	<i>Xenus</i>	1 (1NB)
	<i>Actitis</i>	2 (1NB)
	<i>Heteroscelus</i> (tattlers)	2 (2NB)
	<i>Catoptrophorus</i>	1 (0)
Prosobiniini	<i>Prosobonia</i>	2, including 1 recently extinct (0)

1 NB = regular non-breeding migrant; A = accidental; D = unacceptably claimed.

Monophyly of Subfamily not established. Phalaropes and dowitchers sometimes included, though treated separately here (see Phalaropodinae and Limnodrominae). Other unresolved taxonomic problems include: (1) various features of anatomy, biochemistry and mallophagan parasites (Timmerman 1957; Ahlquist 1974; Strauch 1978) suggest relationship of *Limosa* and *Xenus* to dowitchers; (2) anatomical studies suggest that curlews, godwits and some allies might be better placed in separate subfamily (Lowe 1931; Kozlova 1962) (Numeninae not Limosinae; Jehl 1968), which agrees with phylogenies constructed from allozyme data (Christian *et al.* 1992); (3) affinities of *Prosobonia* are not clear; anatomy supports inclusion in Tringinae (Jehl 1968; Zusi & Jehl 1970) but some features of muscles of jaw and tongue resemble Calidridinae (Burton 1974); there are no studies of downy young, biochemistry or DNA of *Prosobonia*; (4) there is little agreement about whether *Actitis*, *Heteroscelus* and *Xenus* (recognized here after Christidis & Boles 1994) should be included in *Tringa*.

Females larger than males, especially in Numenini. Great diversity in structure of bill: in Numenini, long and highly rhynchokinetic, decurved to straight or slightly upturned; in most Tringini, shorter and straighter, and only moderately rhynchokinetic in many; difference in bills associated with variety of methods of feeding. Differ from Calidridinae in cranial structure (Lowe 1915) and musculature of jaw (Burton 1974). Body-form diverse; typically have narrow, deeply keeled sternum (associated with powerful flight) and upright stance associated with oblique plane of *foramen magnum* of occiput. Twelve rectrices. Tarsus, long, not greatly compressed; in Tringini, scutellate in front and usually behind; in Numenini, reticulate behind and scutellate or reticulate in front. Hallux, small and raised; small to minute webs between bases of anterior toes; most species can swim.

Most species undergo marked seasonal change in appearance of plumage; *Numenius*, *Bartramia* and *Prosobonia* do not. Sexes usually alike in breeding plumage, except in *Limosa*, in which males brighter. In general, plumages typical of Scolopacidae and sequences of moult resemble those of Calidridinae. Down of precocial young, soft and ramose; at least three patterns (Jehl 1968; Fjelds  1977; BWP): (1) In most Numenini, down buff to cinnamon, with partially exposed grey bases, marked above by discontinuous dark-brown blotches and bands; in mid-dorsal region bands and blotches arranged in elongate (*Limosa*) or compact (*Numenius*) diamond-shape. (2) In most Tringini, pattern includes three prominent dark bands along length of back, as well as prominent dark blotches on wing-pad, thigh, lower leg and crown and cap; underparts off-white. (3) In *Heteroscelus*, *Actitis* and *Xenus*, dorsal pattern, pebbly, superficially like that of Charadriidae but with bold black mid-dorsal line; underparts off-white. *Bartramia* has unusual stiff down with densely mottled pattern like adult; downy young of *Prosobonia* apparently undescribed.

Inhabit wide range of wetland habitats, including intertidal mudflats, reefs and atolls, damp grasslands and (especially in Tringini) shallow, brackish or freshwater pools; except in high Arctic, Tringinae at almost all sites

where waders congregate. Feeding behaviours diverse; feed at night and during day, using sight and touch; in general, visual foraging more important than in Calidridinae. Probe for prey or pick small invertebrates from surface of water or mud; *Limosa* and some *Numenius* specialized to probe mud deeply for large invertebrate prey; Tringini recorded using 'mowing' action, though few observations in HANZAB region.

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Scolopax cinerea Gldenstaedt, 1774, *Sex Avium Descriptiones, Novi Comm. Sci. Petropol.* 19: 473, pl. 19 — shores of Caspian Sea near mouth of Terek River.

Xenus is from the Greek ξένος, stranger, foreigner (the species being described from a migrant bird). The specific name is from the Latin *cinereus*, ash-coloured, ash-grey (from *cinis*, ashes), referring to the colour of the upperparts.

The English name refers to the type-locality.

MONOTYPIC

FIELD IDENTIFICATION Length 22–24 cm; wingspan 36–45 cm; weight 95 g. Small but robust and deep-chested wader with steep forehead, distinctive long upcurved bill, and rather short orange legs. Noticeably larger and deeper-chested than Common Sandpiper *Tringa hypoleucos*; distinctly smaller than Grey-tailed Tattler *Tringa brevipes*, with shorter wings and legs and much longer bill than either. Wing-tips fall level with tip of tail at rest; in flight, tips of toes protrude beyond tail. Pale brownish-grey above and on sides of breast and white below. In flight, show diagnostic pattern across inner upperwing and distinctive combination of bold white trailing-edge to wing and grey rump and tail. Sexes alike. Slight seasonal variation. Juvenile and immatures separable.

Description Adult breeding Head and neck, grey-brown, finely streaked darker and grading to white on chin, throat and foreneck, with white forehead, short white supercilium tapering rapidly behind eye (variably obscured by dark streaking), and varying dark stripe extending across lores to behind eye. Rest of upperparts, grey-brown, streaked with black and finely scaled white when fresh; streaks broadest on upper scapulars, forming conspicuous long blackish lines; some birds also have black wedges in centres of feathers of mantle. Rump, uppertail-coverts and tail often slightly paler than rest of upperparts, with whitish tips when fresh, and some black barring on longest uppertail-coverts. Innerwing-coverts, grey-brown except for blackish lesser coverts, which, at close range, form blackish carpal patch extending round bend of wing (often partly or fully concealed by scapulars). Underbody, white, with grey-brown wash across breast, palest in centre and forming dusky patches at side of breast, which are finely streaked dark brown. In flight, show narrow white sides to grey-brown rump and tail, and distinctive pattern on upperwing: mostly blackish, with grey-brown central coverts, narrow white tips to greater coverts forming faint wing-bar and broad white

trailing-edge to secondaries continuing narrowly on to tips of inner four primaries. Underwing, white with dark-brown leading-edge and median coverts, and dusky trailing-edge to outer primaries. Bill, black, tinged dull red at base. Iris, brown. Legs and feet, bright orange or orange-yellow, occasionally dull red. **Adult non-breeding** As breeding except: upperparts plainer and slightly paler brownish-grey, with finer less distinct dark streaking; only trace of or no black lines on upper scapulars; forehead and fore-supercilium often cleaner white and more obvious; patches at sides of breast, smaller, slightly paler uniform grey-brown. Bill, black with dirty-orange basal third. Legs and feet, duller orange, orange-yellow or greenish yellow. **Juvenile** Like adult breeding, but differing by: upperparts and patches at sides of breast slightly darker and warmer grey-brown, with less distinct dark streaking on head, neck and sides of breast; blackish scapular lines less prominent; feathers of upperparts and innerwing-coverts have narrow buff fringes and varying dark anchor-shaped markings, clearest on lower scapulars, tertials and innerwing-coverts. Bare parts as adult non-breeding, though base of bill duller olive-green or yellow to orange-yellow, and legs and feet duller greenish-yellow to bright yellow. **First immature non-breeding** Distinguished from adult non-breeding by retained juvenile innerwing-coverts and tertials (clear to Oct. and still visible on most to Dec.); from late Dec. to Apr., many moult outer 4–5 primaries, showing strong contrast between worn inner and fresh outer primaries (primaries of adult uniform, fresh to slightly worn); a few undergo complete post-juvenile moult and are indistinguishable from adult non-breeding. **First immature breeding** Varies. Many attain partial breeding plumage similar to adult breeding but retain varying amount of first non-breeding plumage. Others acquire plumage intermediate between adult breeding and non-breeding, with strong contrast between worn inner and fresh outer primaries. Wintering birds have dull

plumage identical to adult non-breeding, but with contrast between worn inner and fresh outer primaries.

Similar species Distinctive; easily distinguished by long upcurved bill (usually with some dull orange or yellow at base); rather short and conspicuous orange legs; dark carpal patch and distinctive black lines on scapulars; dashing gait; and in flight, by diagnostic pattern across inner upperwing and combination of broad white trailing-edge and grey rump and tail.

Occur singly or in small parties, on tidal mudflats, estuaries, reefs or sandy beaches, sandbars or mudflats at mouth of rivers, coastal swamps and saltfields; seldom seen inland. Small numbers usually seen among large feeding flocks or roosts of other waders, such as Red-necked Stint *Calidris ruficollis* and Curlew Sandpiper *C. ferruginea* and, in NZ, Wrybills *Anarhynchus frontalis*; also form communal roosts, sometimes in hundreds; when roosting, commonly perch on mangroves, partly submerged posts or breakwaters, often with Grey-tailed Tattler. Distinctive bustling gait when feeding, combining rapid run or brisk walk with frequent changes of direction, abrupt halts and sudden starts; move faster than Wrybill, and much faster than *Calidris* and *Tringa* species among which usually feed. Feed mainly by chasing mobile prey on surface, but also probe deeply; sometimes feed in shallow water, using sideways sweeping action like that of avocets. Normal stance less erect than *Tringa*, with head lowered, and chest held low and well forward of legs, which appear to be set well back on body; stand more upright when alert, nervously bobbing head and jerking tail. Flight strong and direct, usually skimming low over water or mud like Common Sandpiper; wing-beats rather shallow and flicking. Typical flight call sharp fluty *wit-wit-wit-wit*, recalling that of Common Sandpiper or Whimbrel *Numenius phaeopus*, with each syllable rising slightly in pitch; also *wit-e-wit*, *tuu-du* and softer *hu-hu-hu*; sharper *tu-li* in alarm.

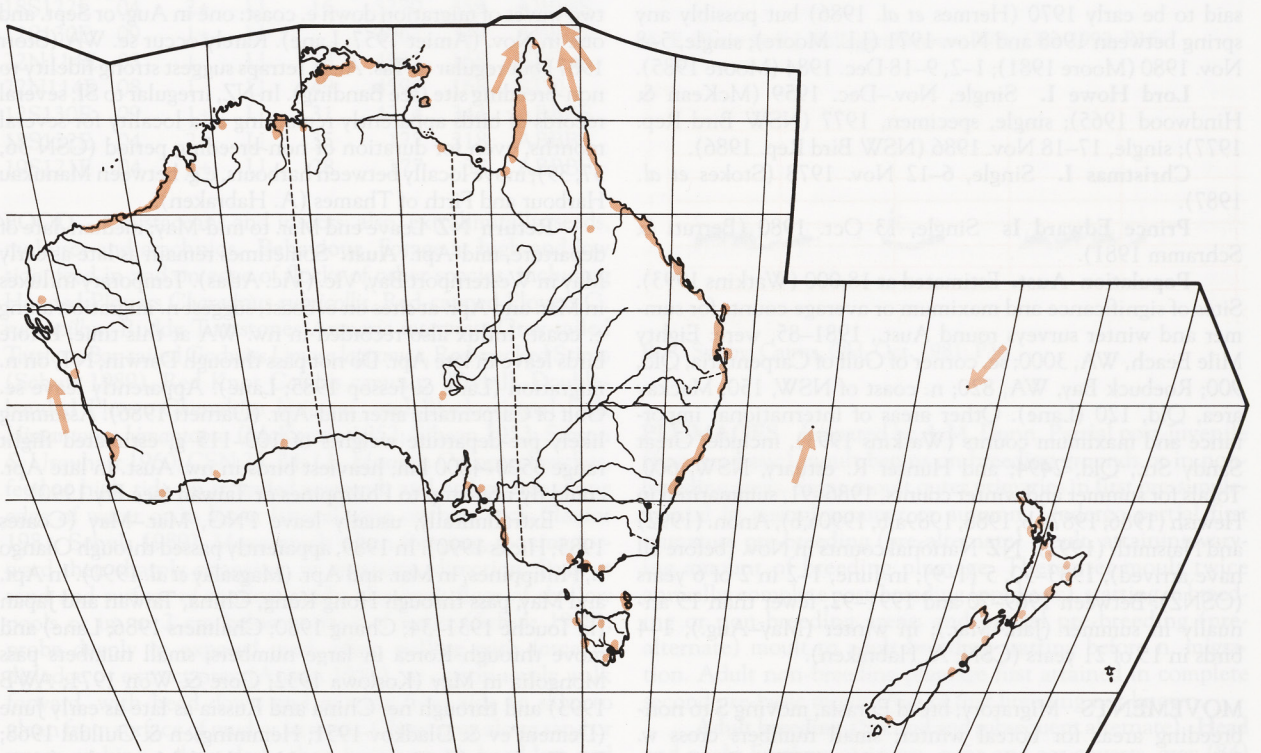
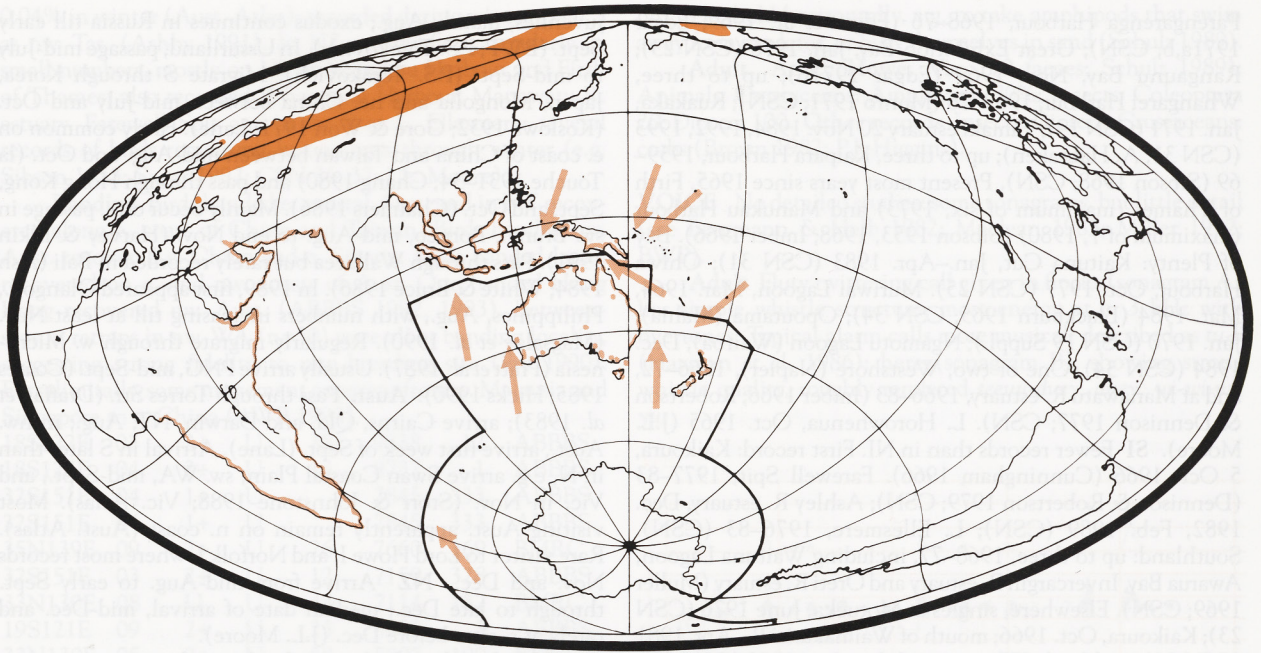
HABITAT Coastal. Mostly saline intertidal mudflats in sheltered estuaries, embayments, harbours and lagoons; on islets, mudbanks or sandbanks and spits; often round mangroves. Less often on sandy or shingle beaches, or on rock or coral reefs or platforms (Eckert 1968; Crawford 1972; Roberts 1979; Taylor 1981; Bamford 1988; Schulz 1989). Occasionally round drying sewage ponds and salt pans if surrounded by mudflats (Daley 1968; Storr 1984; Vic. Bird Reps; Vic. Atlas); round brackish coastal swamps, lagoons and dune-lakes (Schulz 1989; J.L. Moore) and gravel or rocky edges of estuarine pools and freshwater river-pools (Storr 1980); single bird recorded on saltlake on Pelsart I., Houtman Abrolhos (Storr *et al.* 1986). Very occasionally use swampy, grassy or cultivated paddocks near coast (McKenzie 1952; Sibson 1968).

Mostly forage in open on soft wet intertidal mudflats, especially near mangroves (Ewart 1973; Lane; Vic. Atlas); occasionally in samphire (Chafer 1984). Seldom near edge of water (Lane); may wade into water (Eckert 1968). Occasionally on sandy beaches, among seaweed and other debris; in rocky areas, will use supralittoral or upper littoral zone, where a film of water covers the sand (Eckert 1968; Taylor 1981; Schulz 1989). However, on exposed rock platforms, forage in lower littoral zone and not the supralittoral or upper littoral zones (Schulz 1989). Prefer to roost in or among mangroves; may perch in branches or roosts up to 2 m from ground, or beneath them in the shade on hot days (Crawford 1972; Garnett 1989; Lane); may occasionally roost in dead trees or among tangled driftwood (Sibson 1968; CSN 24, 35; H.A.F. Thompson & D.K. Goodfellow). In Westernport Bay, Vic., prefer to roost on isolated banks of mangroves, surrounded by

water (Loyn 1978; Dann *et al.* 1994). Elsewhere, may roost with other waders on flat shores, on muddy spits, islets or banks; sometimes on sandy and pebbly beaches (Eckert 1968; Garnett 1989; Vic. Atlas; Aust. Atlas; R.H. Loyn).

DISTRIBUTION AND POPULATION Breed in central-w. Finland (at n. coast of Gulf of Bothnia), se. Finland round Pielinen, and in Ukraine, on mid-Dnieper R., near Chernobyl. Main breeding range is in n. Russia: n. boundary extends from e. Estonia, N to e. shores of White Sea at Arctic Circle; extends N of Arctic Circle to Pechoua R. mouth, s. Yamal Pen., S round s. Obskaya Gulf, then N to near Khatangskiy Zaliv, then maintains level of c. 69–70°N, E to mountains near Chaun Gulf and then round basin Anadyr R. S. boundary extends from se. Latvia in almost direct line to Krasnoyarsk at Yenisei R.; s. boundary E of Yenisei R. not known but breeding recorded central Yukutia (middle reaches of Lena R.), Koryak Highlands, S to Kamchatka Isthmus and NE to Anadyrland. W. extremities of this main breeding range are e. regions of Estonia and Latvia; E to lower reaches of Anadyr R. and Koryak Highlands. During non-breeding period, occur in coastal Africa from delta of Nile R., S along coasts of Red Sea and Indian Ocean to South Africa, and then occasionally N to w. Namibia; occasionally to w. and central Africa, and may be recorded on passage inland in e. Africa. In Asia, occur round coastal Arabian Pen., and Persian Gulf, E to Indian subcontinent, Indomalaya, Indochina and SE Asia, and S to New Guinea, Aust. and NZ. In e. Asia, recorded as passage migrant through Mongolia, China, Korean Pen., Japan, Taiwan, Philippines and w. Micronesia (Dement'ev & Gladkov 1951; Ali & Ripley 1980; de Schauensee 1984; Urban *et al.* 1986; Pratt *et al.* 1987; Lane; BWP). Recorded casually or as vagrant to European and Mediterranean coasts, Aleutian and St Lawrence Is, w. and s.-coastal Alaska, Manitoba and Fiji (Smart 1973; AOU 1983; BWP).

Aust. More widespread and common along n. and e. coasts than in S. **Qld** Widespread in coastal regions, from se. Gulf of Carpentaria, N to Torres Str. and along e. coast to SE (Aust. Atlas). One inland record: single, Toomba L., 19 Oct. 1985 (Qld Bird Rep. 1985). **NSW** Scattered records round coasts from N. Rivers Region S to L. Wollumboola (Morris *et al.* 1981; NSW Bird Reps; Aust. Atlas). Single inland record: Mooki R., 1839 (Gould). **Vic.** Recorded from Corner Inlet, Anderson Inlet, Westernport Bay and w. Port Phillip Bay (Vic. Bird Reps; Vic. Atlas). **Tas.** First recorded at Port Sorell, 25 Nov. 1973 (Tas. Bird Rep. 3). Has occurred almost annually since late 1970s, mostly round George Town; in SE, recorded from Orielson Lagoon, Barilla Bay, Sorell and South Arm Neck; on w. coast, observed at Macquarie Heads, near mouth of Henty R., and on Kangaroo I.; recorded Flinders I. (Schulz 1993; Tas. Bird Reps; Aust. Atlas). **SA** First recorded 5 Feb. 1961 at St Kilda Saltfields (Lendon 1965). Subsequently recorded there and elsewhere in most years. Occasionally reported from SE and The Coorong; most records from Gulf St Vincent and Yorke Pen., especially Price Saltfields (Daley 1968; Eckert 1968; Taylor 1987; SA Bird Reps; Aust. Atlas). One inland record: single, Coward Springs, 1 Oct. 1978 (Badman & May 1983). **WA** Rarely recorded on s. coast: occasionally round Eyre (Nov.–Dec. 1978, Nov. 1980, Oct. 1981, Oct. 1984, Oct.–Nov. 1985) (Martindale 1980; Congreve & Congreve 1982; Dymond 1988); one, Pt. Malcolm, 10 Feb. 1982 (WA Bird Rep. 1982); one at Mullet L. NR, Jan. 1983 (Jaensch *et al.* 1988); and several records round Albany (Serventy & Whittell 1976; Anon. 1985; Jaensch & Vervest



1988; Vervest & Jaensch 1988; Aust. Atlas). On Swan R. plain, recorded between Bunbury and mouth of Moore R. Farther N, single records from Houtman Abrolhos and mouth of Greenough R., S of Geraldton (Aust. Atlas); occasional records round Shark Bay. Widespread in Pilbara region and Kimberley Division, from Dampier to Wyndham (Aust. Atlas). NT Recorded at estuary of Keep R.; widespread records from Darwin, N to Melville I., and E to w. Gulf of Carpentaria,

round Gove Pen., Groote Eylandt, Sir Edward Pellew Is and mouth of McArthur R. (Boekel 1976; Schodde 1976; Aust. Atlas; H.A.F. Thompson & D.K. Goodfellow).

NZ Compiled by J.L. Moore. Scarce visitor. First recorded 1951; recorded annually since 1967–68, numbers increasing during 1970s to a maximum of c. 14 in 1979–80. (Records singles unless stated.) NI First record: Miranda, 22 Nov. 1951–1 Mar. 1952 (McKenzie 1952). One or two,

Parengarenga Harbour, 1968–76 (Edgar *et al.* 1969; Edgar 1971a,b; CSN); Great Exhibition Bay, Jan. 1976 (CSN 23); Rangaunu Bay, Nov. 1969 (Edgar 1971b); up to three, Whangarei Harbour, 1969–76 (Munro 1971; CSN); Ruakaka, Jan. 1971 (CSN 19); Tamaki estuary 20 Nov. 1984, 1992, 1993 (CSN 31; A. Habraken); up to three, Kaipara Harbour, 1959–69 (Sibson 1968; CSN). Present most years since 1965, Firth of Thames (maximum of six, 1973) and Manukau Harbour (maximum of 7, 1980) (Sibson 1953, 1968; Imber 1966). Bay of Plenty: Kaituna Cut, Jan.–Apr. 1983 (CSN 31); Ohiwa Harbour, Oct. 1977 (CSN 25). Muriwai Lagoon, Mar. 1964, Mar. 1984 (Blackburn 1965; CSN 34); Opoutama (Mahia), Jan. 1970 (CSN 19 Suppl.); Ngamotu Lagoon (Wairoa), Dec. 1984 (CSN 34). One or two, Westshore (Napier), 1966–72, and at Manawatu R. estuary, 1966–83 (Imber 1966; Robertson & Dennison 1977; CSN). L. Horowhenua, Oct. 1965 (J.L. Moore). **SI** Fewer records than in NI. First record: Kaikoura, 5 Oct. 1966 (Cunningham 1966). Farewell Spit, 1977–83 (Dennison & Robertson 1979; CSN); Ashley R. estuary, Dec. 1982, Feb. 1989 (CSN); L. Ellesmere, 1976–83 (CSN). Southland: up to three, 1968–77, including Waituna Lagoon, Awarua Bay, Invercargill R. estuary and Oreti R. estuary (Muller 1969; CSN). Elsewhere, singles at Motueka, June 1976 (CSN 23); Kaikoura, Oct. 1966; mouth of Waimakariri R., Apr. 1981 (CSN 29); and Little Whanganui Inlet, Apr. 1980 (CSN 28).

Norfolk I. Rare visitor (Schodde *et al.* 1983). Single, said to be early 1970 (Hermes *et al.* 1986) but possibly any spring between 1968 and Nov. 1971 (J.L. Moore); single, 5–8 Nov. 1980 (Moore 1981); 1–2, 9–18 Dec. 1984 (Moore 1985).

Lord Howe I. Single, Nov.–Dec. 1959 (McKean & Hindwood 1965); single, specimen, 1977 (NSW Bird Rep. 1977); single, 17–18 Nov. 1986 (NSW Bird Rep. 1986).

Christmas I. Single, 6–12 Nov. 1978 (Stokes *et al.* 1987).

Prince Edward Is Single, 13 Oct. 1980 (Berruti & Schramm 1981).

Population Aust. Estimated at 18,000 (Watkins 1993). Sites of significance and maximum or average counts for summer and winter surveys round Aust., 1981–85, were: Eighty Mile Beach, WA, 3000; se. corner of Gulf of Carpentaria, Qld, 900; Roebuck Bay, WA, 820; n. coast of NSW, 150; Mackay area, Qld, 120 (Lane). Other areas of international importance and maximum counts (Watkins 1993), include: Great Sandy Str., Qld, 2494; and Hunter R. estuary, NSW, 600. Totals for summer and winter counts, 1986–91, summarized in Hewish (1986, 1987a,b, 1988, 1989a,b, 1990a,b), Anon. (1992) and Naismith (1992). **NZ** National counts in Nov. (before all have arrived), 1983–90, 5 (1–9); in June, 1–2 in 2 of 6 years (OSNZ). Between 1969–70 and 1991–92, fewer than 15 annually in summer (Jan.–Mar.); in winter (May–Aug.), 1–4 birds in 15 of 21 years (CSN; A. Habraken).

MOVEMENTS Migratory; breed Eurasia, moving S to non-breeding areas for boreal winter; small numbers cross w. Palearctic to non-breeding areas in Africa (BWP). Biometrics indicate that birds visiting nw. Aust. are from the same population as e. Indonesian birds, and probably breed farther N than slightly smaller birds that visit w. Indonesia and SE Asia (Lane; BWP); also that different populations occur in nw. and e. Aust. (Fry 1990). Band recoveries indicate that birds visiting e. and nw. Aust. migrate along e. coast of Asia on s. and n. migrations (see Banding). Move mainly overland in Eurasia but along coasts in s. hemisphere (Johnsgard 1981; BWP).

Departure Adults, first half July (females before males);

juveniles, mainly Aug.; exodus continues in Russia till early Sept. (BWP; P.S. Tomkovich). In Ussuriland, passage mid-July to mid-Sept. (P.S. Tomkovich). Migrate S through Korea, Japan, Mongolia and ne. China between mid-July and Oct. (Koslowa 1932; Gore & Won 1971; Lane). Fairly common on e. coast of China and Taiwan between mid-Aug. and Oct. (la Touche 1931–34; Chang 1980) and pass through Hong Kong, Sept. and Oct. (Chalmers 1986). Mainly occur on s. passage in sw. Brunei, Borneo, mid-Aug. to end Nov. (Harvey & Elkin 1991). Pass through Wallacea but rarely recorded in Bali (Ash 1984; White & Bruce 1986). In 1989, first appeared Olango I., Philippines, Aug., with numbers increasing till at least Nov. (Magsalay *et al.* 1990). Regularly migrate through w. Micronesia (Pratt *et al.* 1987). Usually arrive PNG, mid-Sept. (Coates 1985; Hicks 1990). **Aust.** Pass through Torres Str. (Draffan *et al.* 1983); arrive Cairns, Qld, and Darwin, NT, Aug.; in nw. Aust., arrive first week of Sept. (Lane). Arrival in S later than in N, e.g. arrive Swan Coastal Plain, sw. WA, mid-Sept., and Vic. in Nov. (Storr & Johnstone 1988; Vic. Atlas). Most visiting Aust. apparently remain on n. coast (Aust. Atlas). Rare visitor to Lord Howe I. and Norfolk I. where most records Nov. and Dec. **NZ** Arrive from mid-Aug. to early Sept. through to late Dec.; median date of arrival, mid-Dec. and rarely at s. sites before Dec. (J.L. Moore).

Non-breeding In Aust., inland records suggest some may move overland on s. migration (Aust. Atlas). Appear to be two waves of migration down e. coast: one in Aug. or Sept. and one in Nov. (Amiet 1957; Lane). Rarely occur se. WA (Storr 1987) but regular to Tas. Aust. retraps suggest strong fidelity to non-breeding site (see Banding). In NZ, irregular to SI; several records of birds apparently remaining at a locality for several months, even for duration of non-breeding period (CSN 36, 37, 39); move locally between harbours, e.g. between Manukau Harbour and Firth of Thames (A. Habraken).

Return NZ Leave end Mar. to mid-May; median date of departure, mid-Apr. **Aust.** Sometimes remain as late as early May in Westernport Bay, Vic. (Vic. Atlas). Temporary influxes in Mar. and Apr. at sites on e. coast, suggest n. migration along e. coast. Influx also recorded in nw. WA at this time, before birds leave in late Apr. Do not pass through Darwin, NT, on n. migration (Lane & Jessop 1985; Lane). Apparently leave se. Gulf of Carpentaria after mid-Apr. (Garnett 1986). Assuming likely pre-departure weights of 100–115 g, estimated flight range 3500–4800 km; heaviest birds in nw. Aust. in late Apr. could fly non-stop to Philippines or Taiwan (see Fry 1990).

Extraliminally, usually leave PNG, Mar.–May (Coates 1985; Hicks 1990). In 1989, apparently passed through Olango I., Philippines, in Mar. and Apr. (Magsalay *et al.* 1990). In Apr. and May, pass through Hong Kong, China, Taiwan and Japan (la Touche 1931–34; Chang 1980; Chalmers 1986; Lane) and move through Korea in large numbers; small numbers pass Mongolia in May (Koslowa 1932; Gore & Won 1971; AWB 1993) and through ne. China and Russia as late as early June (Dement'ev & Gladkov 1951; Hemmingsen & Guildal 1968; P.S. Tomkovich). On passage s. Ussuriland, May, with a few in early June; Sakhalin, second half of May to early June; L. Baikal, late May to early June (P.S. Tomkovich). Arrive Anadyr Territory, e. Siberia, late May (Dement'ev & Gladkov 1951).

Breeding Many said to remain in non-breeding grounds all year (Hayman *et al.* 1986). In Aust., small numbers, probably first-year birds, remain during breeding season (Fry 1990); regularly on n. coast (e.g. Torres Str.; Draffan *et al.* 1983) but only occasionally in s. Aust. (e.g. Westernport Bay, Vic.; Vic. Atlas). Reporting rate S of 26°S was 0.40% in summer, and

0.04% in winter (Aust. Atlas); recorded during winter as far S as nw. Tas. (Ashby 1991). In NZ, winter fairly regularly in small numbers, mostly on NI, at Manukau Harbour and Firth of Thames; also recorded Whangarei Harbour, Manawatu R. estuary, Farewell Spit and as far S as L. Ellesmere; several records of birds remaining in one area through winter (e.g. Sibson 1953; Sagar 1992; CSN 36, 37; J.L. Moore).

Banding Birds banded e. coastal Aust. and in NT recovered along e. coast of China and Taiwan. Birds banded nw. Aust. recovered e. China and e. Siberia. Birds banded Japan recovered on e. and nw. coasts of Aust. One banded Hong Kong recovered nw. Aust. (ABBBS 1992, 1993). Between-season retraps in nw. WA (n=50) were all at banding locality, suggesting strong fidelity to non-breeding site (Fry 1990). Extraliminally, some movement apparent from w. Malaysia and Singapore to e. China (AWB 1993).

18S122E	03	2+	U	38	9838	12	ABBBS
18S122E	04	2+	U	13	8737	1	ABBBS
32S151E	04	1+	U		7845	333	ABBBS
32S151E	04	1+	U		7845	333	ABBBS
35N139E	09	2+	U	26	7660	169	BMRC
32S151E	03	2+	U	12	7159	328	ABBBS
33N130E	08	U	U	44	7114	157	BMRC
19S121E	09	2+	U	23	6332	5	ABBBS
33N130E	05	2+	U	58	5807	190	BMRC
19S121E	03	2+	U	36	5572	1	ABBBS
18S122E	04	2+	U	16	5270	359	ABBBS
12S130E	09	1+	U		4967	349	ABBBS
22N114E	08	1	U	18	4591	168	BTO
22N114E	08	1	U	49	4591	168	BTO
12S130E	09	1+	U	31	4214	344	ABBBS
18S122E	04	2+	U	35	177	218	ABBBS
19S121E	04	2+	U	28	177	38	ABBBS

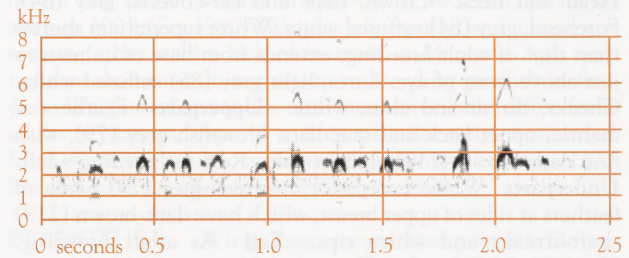
FOOD Crustaceans and insects; also, extraliminally, seeds, molluscs and arachnids. **Behaviour** Forage at high and low tide; feed in and on edge of flocks of other species, including Hooded Plovers *Charadrius rubricollis*, Red-capped Plovers *C. ruficapillus*, Ruddy Turnstones *Arenaria interpres*, Grey-tailed Tattlers, Bar-tailed Godwits *Limosa lapponica*, Red-necked Stints (Schulz 1989), Red Knot *Calidris canutus*, Wrybill, Double-banded Plover *Charadrius bicinctus*, and Black-winged Stilt *Himantopus himantopus* (McKenzie 1952; Sibson 1953; Sibson & Urquhart 1960; CSN 23, 34; J.L. Moore). On open beaches, feed at high tide on stranded seaweed, and at low tide along edge of water or in lower littoral zone on bare rock (Taylor 1981; Schulz 1989). Move much when foraging, moving forward then sharply changing, or reversing, direction. Peck at sand and surface of shallow pools; also peck floor of shallow pools or up to 2 cm below surface of water (Schulz 1989); probe deeply in exposed mud, often pulling with force to dislodge or extract prey (Austin 1954), or continuously walk forward, with head down and moving from side to side, to glean from surface of mud or in water. Chase prey along sand or water, making a short dash, then lunging with head low and bill horizontal; snap at and catch insects in air (Brown 1982; Schulz 1989). Not observed probing in sand (Schulz 1989). Occasionally use side-to-side scything action of bill like that of avocets *Recurvirostra* (Brown 1982). In Manukau Harbour, NZ, seen probing for, shaking and turning prey, possibly crabs, in bill before swallowing (Brown 1982); will wash prey before swallowing (P.J. Higgins); swallow with upward toss of head (Austin 1954). Suggested that shape of bill helps capture of active prey, whose escape path is horizontal, as curve allows

bill to be held horizontally, e.g. to take amphipods that swim away from predator, or bury themselves in sand (Schulz 1989).

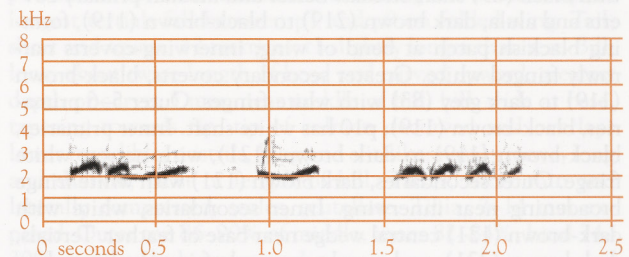
Adult At C. Howe, Vic. (10 faeces; Schulz 1989): Animals: Crustaceans: Amphipods 80%; Insects: Coleoptera 20; Diptera 100. **Other records** Insects: Diptera; Crustaceans: crabs (Brown 1982; P.J. Higgins).

VOICE No detailed studies; some sonagrams, but little detail (see Bergmann & Helb 1982; Maclean 1985; Miller 1992; BWP).

Adult Fluty twittering call given in flocks (sonagram A) has simple whistle structure; most energy at c. 3 kHz with overtones. Typical alarm calls more musical; described as *tu-li* (Hayman *et al.* 1986); here (sonagram B), showing strong whistle quality, roughly rendered *teeuu-duey*, *duey*, *wi-wi-wi-yu*.



A E. Slater & P.J. Fullagar; Broome, WA, Oct. 1992; P36



B R. Swaby; Cairns, Qld, Oct. 1981; P36

PLUMAGES Prepared by A.M. Dunn. Partial post-juvenile (first pre-basic) moult begins on breeding grounds or in non-breeding areas. Some moult outer primaries in first pre-supplemental in austral summer or autumn. Undergo partial first immature pre-breeding (pre-alternate) moult, attaining varying amount of breeding plumage. Thereafter moult twice annually: complete post-breeding (pre-basic), starting in breeding or non-breeding areas; and partial pre-breeding (pre-alternate) moult to adult breeding starting before n. migration. Adult non-breeding plumage first attained in complete second pre-basic moult. Age of first breeding not known.

Adult breeding (Second and subsequent alternate). **Head and neck** Feathers of crown, nape and ear-coverts, grey (84) with dark-brown (221) shaft-streaks; forehead similar but speckled by fine white tips to feathers. Indistinct supercilium, white streaked brown; extends from base of culmen to just above ear-coverts. Feathers of lores, cheeks, throat and chin, white, with dark-brown (221) shaft-streaks; streaking forms dark eye-stripe through lores to behind eye. Narrow eye-ring, white. **Upperparts** Feathers of mantle, inner scapulars and larger outer scapulars, brownish grey (79), with contrasting black (89) shaft-streaks, which are broad at base, tapering to point at

tip. Smaller outer scapulars, mostly black (89), narrowly edged brownish grey (79) near base of feather; forms prominent elongated shoulder-patch. Feathers of back and rump, brownish grey (79) with very fine dark-brown (219) shaft and white tips to feathers. Uppertail-coverts, as rump, but may have faint brown (28) spots or bars near margins of some feathers. **Underparts** White with pale-grey (86) areas at sides of breast and dark-brown (221) shaft-streaks to feathers of upper breast. **Tail** Inner feathers, brownish grey (c79), narrowly fringed white, with narrow dark-brown (121) subterminal fringe. Outer feathers, paler, with white fringes spotted or barred dark brown (121). **Upperwing** Mostly retained from non-breeding. Some median and lesser secondary coverts replaced, and similar to those of non-breeding. Tertials as larger scapulars. **Underwing** Retained from non-breeding plumage.

Adult non-breeding (Second and subsequent basic).

Head and neck Crown, nape and ear-coverts, grey (84). Forehead, grey (84) suffused white. White supercilium shorter than that of adult breeding; extends from base of culmen to just above front of eye. Lores, light grey (85) suffused white. Cheeks, throat and chin, white. **Upperparts** Feathers of mantle, upper back and scapulars, brownish grey (79), with fine dark-brown (219) shaft-streaks. Rest as breeding adult. **Underparts** White except for brownish-grey (79) patch of feathers at sides of upper breast, which have dark-brown (219) shaft-streaks and white tips. **Tail** As adult breeding. **Upperwing** Marginal and lesser secondary coverts, dark brown (121). Median secondary coverts, brownish grey (79) with thin black (89) shaft-streaks. Lesser and median primary coverts and alula, dark brown (219) to black-brown (119), forming blackish patch at bend of wing; innerwing-coverts narrowly fringed white. Greater secondary coverts, black-brown (119) to dark grey (83) with white fringes. Outer 5–6 primaries, black-brown (119); p10 has white shaft. Inner primaries, black-brown (119) to dark brown (121), with narrow white fringe. Outer secondaries, dark brown (121) with white fringe broadening near innerwing. Inner secondaries, white with dark-brown (121) central wedge near base of feather. Tertials, dark brown (221), and may be narrowly fringed white when fresh. **Underwing** Lesser primary and secondary coverts, brown (28) with broad white tips. Median secondary coverts, white, with small area of brown (28) at base. Greater primary coverts, white, with brownish-grey (79) basal half. Greater secondary coverts, white, with small concealed brownish-grey bases. Primaries, dark grey (83); inner 4–5 primaries, narrowly fringed white. Secondaries vary from light-grey (85) outer secondaries to mostly white inner secondaries.

Juvenile Differences from adult breeding: **Head and neck** Patterning less distinct than that of adult; ear-coverts, cheeks, sides of neck and throat, off-white, with brown (28) shaft-streaks to feathers. **Upperparts** Feathers of mantle, back, rump, scapulars and uppertail-coverts, have narrow buff (124) fringes that often wear quickly, plumage then appearing similar to worn adult breeding. Dark shaft-streaks on feathers of lower mantle, scapulars and tertials often wider near tip of feather than in adult breeding. Rump and uppertail-coverts often have indistinct dark-brown (219) subterminal bar below buff fringe. **Underparts** Feathers at sides of breast sometimes have narrow buff (124) fringes. **Tail** All feathers have narrow buff (124) tips with irregular dark-brown (121) subterminal fringe. **Upperwing** Secondary coverts, fringed buff (c123D). Tertials, brown (28) with black-brown (119) shaft-streak and narrow buff (123D) fringe when fresh.

First immature non-breeding (First basic). Similar to

adult non-breeding and sometimes indistinguishable. Often retain scattered juvenile wing-coverts and rectrices to Dec. and most can be distinguished from adults by wear of primaries.

First immature breeding (First alternate). Do not breed in this plumage. Varies between individuals. Some indistinguishable from adult breeding. Some attain only partial breeding plumage, intermediate between adult breeding and non-breeding plumages. Others remain in non-breeding areas during breeding season and do not develop breeding plumage, but moult directly from first immature to adult non-breeding plumage.

BARE PARTS Based on photos (Pringle 1987; Cudleigh & Chandler 1990; NZRD), labels (MV) and descriptions (Ferguson-Lees & Hosking 1959; Smaldon 1976; Simpson 1978; BWP). **Adult breeding** Iris, dark brown (121). Bill, mostly black (89), often with dull-red tinge near base. Legs, dark dirty orange (c116) to bright orange-yellow (17–18). **Adult non-breeding** Bill, black (89) with basal quarter to third of bill, salmon (106) to dull orange (c17). Legs, salmon (6) to orange (17). **Juvenile** Iris, dark brown (121). Bill, mostly black (89) with brown, olive or grey tinge and olive-green to orange-yellow base. Legs, light ochre, green-yellow, or bright yellow.

MOULTS Based on data from n. hemisphere (Dement'ev & Gladkov 1951; BWP), s. Africa (Waltner & Sinclair 1981), 33 Aust. skins (AM, HLW, MV, QM SAM, WAM), and data on primary-moult from 1500 live birds from Aust. (Fry 1990). **Adult post-breeding** (Third and subsequent pre-basic). Complete; primaries outward. Much variation in timing: some do not start moult of body till reaching non-breeding areas; others begin late July on breeding grounds, also moulting inner primaries, and arrive in non-breeding areas with much non-breeding plumage, 2–5 new inner primaries, and moult of primaries suspended (BWP). In nw. Aust., average PMS of birds in active primary-moult, Sept., 12; in Nov., 27; probably finish late Jan. In s. Africa, moult of primaries begins second half Sept. and finished about early Mar. Moult of secondaries begins about halfway through moult of primaries and finishes at same time. Moult some lesser coverts and tertials before start of moult of primaries; primary coverts moult with corresponding primaries; secondary coverts start at same time as primaries and finish when secondaries start. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial. Involves head, body, some median and lesser upperwing-coverts, and some tertials and central rectrices (sometimes, all tail and tertials) (BWP). Active Feb.–May. **Post-juvenile** (First pre-basic). Partial. Involves most feathers of body with some juvenile feathers retained on back and rump. Retain many upperwing-coverts and tertials, outer rectrices and all remiges. Timing varies (as adult post-breeding); some start in Aug. and have much immature non-breeding on arrival in non-breeding areas in Oct.; others fully juvenile in Oct. and first pre-basic moult not complete till Feb. (BWP). **Post-juvenile moult of primaries** (First pre-supplemental). Outer 5–6 juvenile primaries usually moulted Mar.–Apr. (Fry 1990). Some moult outer primaries as early as late Dec. and then return to breeding grounds; others occasionally delay moult of outer primaries till about Aug. (BWP). In s. Africa, moult Dec.–Mar., usually involving outer 2–5 primaries but as many as eight; a few also moult inner primaries at same time, either outwards from p1 or inwards from centre of wing.

Some secondaries, usually innermost, moulted at same time as primaries; numbers of secondaries moulted corresponds with numbers of primaries moulted. For information on other feather tracts, see Waltner & Sinclair (1981). **First immature pre-breeding** (First pre-alternate). Partial; extent varies greatly. Some may undergo moult similar in extent to adult pre-breeding and then migrate to breeding areas. Many remaining in non-breeding areas attain little or no breeding plumage; may moult almost directly into adult non-breeding plumage. **First immature post-breeding** (Second pre-basic). Timing of moult of those that return to breeding grounds not known. Of those that remain in non-breeding areas in s. Africa, often do not begin moult before Aug. In other areas, start to moult primaries, Mar.–July. Second pre-basic moult of inner primaries may begin before first pre-supplemental moult of outer primaries complete (observed in one Aust. skin).

MEASUREMENTS (1–2) Aust., skins: (1) Adults (AM, HLW, MV, QM, SAM, WAM); (2) Juveniles and immatures (AM, MV).

	MALES	FEMALES	
WING	(1) 131.7 (3.52; 125–138; 11) (2) 128.0 (2.34; 126–131; 5)	132.7 (4.99; 126–143; 10) 130, 135	ns
TAIL	(1) 52.5 (3.89; 47–58; 13) (2) 50.6 (3.65; 47–55; 5)	52.2 (3.07; 46–56; 12) 48, 48	ns
BILL	(1) 46.1 (1.76; 42.4–49.5; 13) (2) 44.5 (1.67; 42.5–45.9; 5)	47.7 (2.18; 44.5–51.2; 12) 48.7, 50.7	ns
TARSUS	(1) 28.7 (1.00; 27.2–30.1; 13) (2) 28.7 (0.88; 27.5–29.8; 5)	28.6 (0.96; 27.3–30.4; 12) 28.7, 29.7	ns
TOEC	(1) 24.3 (0.59; 23.5–25.2; 11) (2) 23.8, 24.5, 25.5	24.0 (0.59; 23.0–24.6; 7) 23.5	ns

In Aust. sample, differences between sexes not significant. Significant differences between sexes reported for population in nw. USSR (BWP).

(3–4) NW. Aust., live (Fry 1990): (3) Adults; (4) Juveniles and immatures with juvenile primaries in wing.

	UNSEXED	
WING	(3) Aug.–Nov. Mar.–Apr. (4) Aug.–Nov. Mar.–Apr.	135.9 (3.19; 125–148; 218) 137.4 (3.44; 123–149; 373) 134.2 (4.03; 125–144; 29) 132.3 (4.35; 123–140; 41)
BILL	(3) (4)	48.8 (2.69; 41.3–56.0; 609) 48.9 (2.62; 44.0–56.4; 96)
THL	(3) (4)	74.7 (3.01; 66.8–83.2; 561) 74.6 (2.71; 72.8–91.7; 67)

Primaries of adult wings worn on arrival in Aust. and were significantly shorter than in Mar.–Apr., when primaries new. Similarly, on arrival in Aust., juveniles have fresh primaries and wing is significantly longer than in Mar.–Apr., when primaries are worn.

WEIGHTS (1) Aust., adults, museum labels (AM, MV, WAM).

	MALES	FEMALES
(1) July–Aug.	69	45
(1) Oct.–Nov.	67, 67, 68	73
(1) Jan.–Mar.	70, 70, 72	77.2 (3.90; 72–81; 5)

(2) NW. Aust., live adults and juveniles–immatures (Fry 1990).

	ADULTS	JUVENILES–IMMATURES	
(2) Aug.	64.8 (4.18; 56–70; 11)	67.8 (3.25; 64–73; 6)	ns
(2) Sept.	71.8 (7.04; 50–85; 99)	70.2 (6.33; 62–82; 18)	ns
(2) Oct.	71.3 (4.79; 60–80; 45)	–	
(2) Nov.	70.4 (5.04; 54–80; 58)	69.7 (3.71; 62–73; 9)	ns
(2) Jan.	64, 69, 76	66.8 (4.57; 60–70; 4)	ns
(2) Mar.	78.8 (7.75; 59–104; 370)	66.2 (5.97; 58–95; 47)	**
(2) Apr.	93.0 (9.97; 63–126; 502)	71.2 (5.98; 56–87; 86)	**
(2) May	106, 110	–	

Weight of adults lowest on arrival in Aug.; increases to mean non-breeding weight of 71 g and remains stable till Mar., before migration. Weights at take-off in nw. Aust. probably average 100 g (Fry 1990). Weights of juveniles and immatures remain rather stable; lack of increase in Mar. and Apr. may indicate that most do not return to breeding grounds in first year. Weights of juveniles and immatures only differ from adults in Mar. and Apr. In s. Africa, similar weights recorded from wintering adults; estimated flight-range, between 2200 km and 4000 km (Summers & Waltner 1979).

STRUCTURE Wing, long, narrow and pointed. Eleven primaries; p10 longest; p9 1–3 mm shorter, p8 6–10, p7 9–19, p6 22–28, p5 33–39, p4 42–50, p3 51–58, p2 57–66, p1 62–72; p11 minute. Fifteen secondaries including five tertials; tips of longest tertials fall between p7 and p9 on folded wing. Tail, short and square; 12 rectrices; t1 slightly longer than rest. Bill, long, about twice length of head and curved upward; greatest depth of curve, 3 mm, near middle of bill; bill, wide at base, tapering towards tip; tip of culmen decurved and overlaps lower mandible; nostrils, long and slit-like; nasal groove, long and shallow, most of length of bill. Tarsus, short thin and laterally compressed; scales, scutellate. Tibia, 7–14 mm exposed. Outer toe 86–90% of middle, inner 82–84%, hind 34–39%; small webs between each toe.

AGEING Differences in moult and wear of primaries can be useful guide to age. On arrival in Aust., primaries of juveniles fresh, while those of adults worn or moulting. When adult moult complete and primaries fresh, juvenile primaries more worn than those of adults, or moulting. When partial moult of primaries finished, immatures separable from adults by worn inner primaries contrasting with fresh outer primaries; a few immatures complete first pre-basic moult of primaries but retain a few secondaries, which appear more worn than secondaries of adults. After second complete pre-basic moult, as adults.

GEOGRAPHICAL VARIATION Slight variation in size with longitude, particularly in breeding range. Measurements of wing, tarsus and bill vary significantly between regions, though variation not well understood. Appear to be two groups, one with shorter wing, longer tarsus and longer bill; groups appear to overlap in distribution in some non-breeding areas and not known whether these two forms are present in Aust. (see BWP).

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Common Greenshank *Tringa nebularia* (page 144)
 1 Adult breeding; 2 Adult non-breeding; 3 Juvenile; 4, 5 Adult

Terek Sandpiper *Xenus cinereus* (page 165)
 6 Adult breeding; 7 Adult non-breeding; 8 Juvenile; 9, 10 Adult

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